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Title: Severe acute malnutrition in children aged under five years can be successfully managed in a non-emergency routine community healthcare setting in Ghana.

Running Title: Management of severe acute malnutrition in non-emergency contexts

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Conflict of interest

No competing conflict of interest.

Contribution of authors

These authors contributed equally to this work. RA conceived the study, led in designing the study and wrote the first draft of the manuscript. JH, LB and MH contributed to designing the study, supervised data collection and writing of the manuscript. MC provided advice on the data analysis, as well as editing of the manuscript. All authors read and approved the final manuscript.

Abstract

This study investigated the performance of Community-based Management of Severe Acute Malnutrition (CMAM) within routine healthcare services in Ghana.

A retrospective cohort study of n=488 children (6-59 months) who had received CMAM. Data for recovery, default and mortality rates were obtained from enrolment cards in 56 outpatient centres in Upper East region, Ghana.

Satisfactory rates of recovery of 71.8% were reported. Children who were enrolled with higher Mid-Upper Arm Circumference (MUAC) ≥11.5cm had 7 times greater chance of recovery compared with children who were enrolled with lower MUAC <11.5cm (OR=7.35 (95% CI: 2.56, 21.15, $p<0.001$). Children who were diagnosed without malaria at baseline were 30 times (OR=30.39 (95% CI: 10.02, 92.13, $p<0.001$)) more likely to recover compared to those with malaria ($p<0.001$). The average weight gain was 4.7g/kg/day, which was influenced by MUAC status at baseline (β= 0.78 (95% CI: 0.46, 1.00, $p<0.001$)), presence of malaria (β= -1.25 (95% CI: -1.58, 0.92, $p<0.001$)) and length of stay (β = 0.13 (95% CI: 0.08,

0.18, $p<0.001$)). The default rate (28.5%) was higher than international standards recommendations by SPHERE. Mortality rate (1.6%) was lower than international standards.

Our findings suggest that community-based management of SAM can achieve similar success when delivered in routine non-emergency settings. However, this success can be diluted by a high default rate and the factors contributing to this need to be explored to improve programme effectiveness within communities.

Introduction

Recent estimates suggest that around 19 million children globally are suffering from Severe-Acute malnutrition (SAM), and the majority of these cases are concentrated in 36 countries (UNICEF 2009; WHO 2009). More than 90% of the cases are in South Asia and Sub-Saharan Africa (WHO 2009). For instance, in India alone, the number of children under 5 years who suffer from acute wasting has doubled in the last decade (WHO 2009). If untreated, SAM can have detrimental consequences on children's health and development, i.e. SAM limits children's ability to respond to stress, and makes them more vulnerable to infectious diseases (Golden 2000). The condition also exposes children to high risk of morbidity and mortality (Golden 2000). According to Black and colleagues (Black et al. 2008) children who suffer from SAM are up to 20 times more likely to die compared with children who are well nourished. They estimated that severe malnutrition directly causes around 2 million deaths of children under 5 years annually, and is responsible for nearly 22% of overall global disability adjusted life years in children under 5 years. Those children who survive death from SAM are more likely to be below average height when they reach adulthood, and to give birth to smaller or low birth weight children (Black et al. 2013; Schubl 2010).

Despite the devastating consequences of this condition, SAM has not been well managed in many low and middle-income countries (LMICs) until relatively recently (Collins 2004). Previous interventions to address SAM have achieved very little success because biomedical treatment models were mainly adopted, which limited treatment to hospital settings (Briend 2001; Collins 2006). A public health approach, known as Community-based Management of Severe Acute Malnutrition (CMAM), which allows children to be identified early and treated outside of the hospital setting was introduced in 2001 to expand therapeutic care to children in local community contexts (Collins 2001; Collins 2004). Initially called the Community-based Therapeutic Care model (CTC), CMAM has been widely implemented in emergency contexts and there are enough available data to demonstrate that the model has achieved successful outcomes in these contexts (Valid 2006). For instance, in many Sub-Saharan African countries, e.g. Ethiopia, Malawi, Niger and South Sudan, the implementation of CTC programmes in emergency situations has lowered mortality caused by SAM to <5% (Collins 2001). As a result, in 2007 the WHO called on national governments of LMICs to adopt and integrate CMAM into routine health services (WHO, UNICEF, WFP and UNSCN, 2007). Available data show that between 2007 and 2011, around 10 countries, including Ghana, had started CMAM programmes as part of routine healthcare delivery services (ENN 2011). However, very little research evidence has been generated from these programmes for us to understand the potential impact of the approach to address SAM in local communities. Therefore, the aim of this study was to assess the performance of the CMAM approach to treat SAM within routine community healthcare services in a non-emergency context.

Materials and methods

Context and setting

The Ghana Health Service (GHS), in collaboration with health development partners (UNICEF, USAID and WHO), introduced the community-based management approach in 2010 in Ghana, as a strategy to address the high prevalence of SAM among under-fives. The introduction of this approach was largely supported by an earlier study conducted in 2009, in some selected sites in the Greater Accra region, which explored the feasibility and applicability of integrating CMAM into the national healthcare system in order to prioritise and treat children with SAM more pragmatically (GHS 2010a). Following recommendations made by the earlier study, the GHS adopted the approach for implementation in high SAM prevalence regions. Initially, three regions (Upper East, Upper West and Northern) were selected to start CMAM programmes, however due to lack of resources and staff capacity only the Upper East region commenced implementation in July 2010. This region is located in the North-Eastern corridors of Ghana, and shares borders with Burkina Faso to the North, Togo to the East, and the Upper West and Northern regions of Ghana. Administratively the region is divided into eight districts (GHS 2011), three of which were prioritised to implement the programme (Bolgatanga, Bawku West and Kassena-Nankana). According to the GHS-Multi-Indicator Cluster Survey (GHS 2010b), the Upper East region has poor child health and nutrition indicators. SAM, malaria and diarrheal diseases remain the main reason for paediatric hospitals overcrowding (GHS 2010c). Culturally, the people in the three regions share common beliefs about food and feeding practices of under-fives, some of which impact negatively on women and children's nutritional status (LINKAGES 2000).

To facilitate the CMAM programme implementation process in Ghana, UNICEF and USAID provided financial support, helped with procurement of peanut-based ready-to-use therapeutic foods (RUTF), MUAC taps, drugs or medicines, as well as they supported and supervised the training of regional and district health workers and community volunteers. RUTF is designed to meet the nutritional needs of severely malnourished children (Briend et al. 1999).

The intervention and delivery procedure

The intervention was delivered in an uncontrolled community environment, to children aged 6-59 months old who had MUAC ≤11.5cm. They were identified at the community level through searches conducted house-to-house by community based health volunteers who are an integral part of the health care delivery system. The volunteers received special training on the CMAM approach, in order to understand the concept of malnutrition in children and the management of the condition using a community-based approach. After the training, the volunteers when house-to-house to sensitised community members, and identify malnourished children. The volunteers screened the children using a colour-branded MUAC Tape, alongside looking for clinical signs of oedema. They referred all the children who met the criteria for enrolment into the CMAM programme (<11.5cm) to a health centre for examination by a qualified health worker to confirm SAM. At the health centre level, the health worker (nurse) also received additional training on nutritional status assessment of children <5 years, measured the weight and MUAC of the referred children, and conducted an assessment to identify any medical conditions, including bilateral pitting oedema. The health worker measured the weight of the children unclothed or very light cloths and with no necklaces using the Salter scale (Collins and Sadler 2012; Grellety et al 2012; Shewade et al 2012). The scale was calibrated before and after each measurement, using a standard weight, and was adjusted to zero before each measurement. The health worker also measured the MUAC of each child to the nearest 0.1cm.

An appetite test was also performed on all the children who met the recruitment criteria before any treatment commenced. The test involved giving children a small sample of RUTF to taste. Children, who refused to eat the RUTF after 3 attempts were considered to have poor appetite. They, together with the children who were diagnosed with severe medical conditions such as hypoglycaemia, hypothermia, severe anaemia, anorexia dehydration as having complicated SAM and referred to hospital to be managed clinically, according to the national CMAM protocol (GHS, 2010d). Per the protocol, children who did not have a severe medical condition, and passed an appetite test were admitted to receive treatment under the CMAM programme. Children with MUAC <11.5cm, who were diagnosed with a co-morbidity considered less severe (mild form of malaria, fever, diarrhoea and vomiting), were also enrolled. The less severe co-morbidities were managed alongside nutritional therapy at home as recommended in the national CMAM protocol. The children who had MUAC ≥ 11.5cm but <12.5cm were classified as having moderate acute malnutrition (MAM), and referred to an alternative supplementary feeding programmes supported by the World Food Programmes.

RUTF was used in the therapeutic intervention for SAM. The efficacy of RUTFs in treating children with SAM has been trialled in emergency programmes (Collins 2004; Briend 2004) and RUTFs are now endorsed by the WHO as a therapeutic diet that can be used at community level to treat children (WHO, UNICEF, WFP, UNSCN, 2007). RUTFs have a good shelf life once opened, and are also resistant to bacterial contamination (Briend et al. 1999). Health workers distributed the RUTFs to caregivers weekly, the amount depending on the child’s body weight. Each week, the carer of the child was expected to attend a health and nutrition reassessment session, where the nurse measured the child’s weight, MUAC and identified clinical signs of co-morbidity and oedema. The nurse used a rationing chart to distribute RUTF to the carer to last for 7 days. The carer was advised to return to the care centre on the 7^{th} day for reassessment of the child's health and nutritional status, whether the course of RUTF was completed or not. The mother also received counselling on malnutrition and how to prevent and/or manage it, as well as education on the importance of RUTF to cure the child's condition, at the point of receiving it. Children were treated at home by their carers after receiving the RUTF, accompanied by advice on how to administer it to their children. During treatment, children who developed medical complications (or were not responding to treatment) were referred to hospital to receive hospital care, and returned to the programme when they were declared clinically well, with a good enough appetite to consume RUTF.

The children who were diagnosed with non-complicated co-morbidities prior to admission received medical therapy in line with the recommendations outlined in the Integrated Management of Childhood Illness (IMCI) guidelines and national CMAM protocol (GHS 2010d, WHO 1999). The health workers followed guidelines in these protocols and gave a 7 day course of antibiotics "Amoxicillin" (60mg/kg/day, 3 times daily) for children diagnosed with a mild form of diarrhoea and other infections. A single dose of Artesunate-amodiaquine combined therapy was given to treat children diagnosed with malaria, whereas paracetamol syrup was given to control fever (temp >37.5^{o}C). Vitamin A was given according to current Vitamin A supplementation guidelines, i.e. a single dose of 100,000 IU for children <12 months and 200,000 IU for children aged ≥ 12 months. The dose was given 4 weeks after commencing nutritional therapy. An anthelmintic (Mebendazole) was given orally as a single (250mg) dosage for children 12 - 24 months, and 500mg for children older than 24 months after 2 weeks of commencing nutritional therapy. Children who showed signs of dehydration were given Oral Rehydration Salt (ORS) solution, made from ReSoMal. Children were followed until they achieved 15% weight gain of the initial weight and discharged, died or defaulted. Children who completed the programme cycle of 16 weeks without meeting the recovery criteria were transferred to hospital to continue treatment.

Data collection

The data used in this study were obtained by reviewing children's attendance cards, which were originally collected by health workers following the treatment of children between July 2012 and January 2013. The cards were obtained from 56 outpatients' treatment centres across the three districts where the programme was implemented. Three health workers were recruited to help in the gathering of the children cards from the three districts, as well as in the retrieval of relevant data from the cards. To ensure data quality, we trained the health workers on how and what type of information needed to be collected. The cards contained information recorded at baseline, during treatment and at discharge. A data collection form was developed and used to extract relevant information based on the study objectives and the outcome of interest. Key variables of interest were: baseline and end line anthropometric measurements (weight and MUAC), medical history including information on oedema, personal details of the child and socio-demographic information of parents, such as whether mother and/or father were alive, and breastfeeding status. The main outcomes of interest for this study were recovery, mortality, default and rate of weight gain. Data on children who were first admitted to hospital before transfer to the community-based programme were excluded because we could not find details of their baseline (hospital treatment) information.

Statistical analysis

Extracted data were entered directly into an excel spreadsheet, cleaned and analysed using STATA version 11. An exploratory analysis was first carried out to check for consistency, missing data, presence of 'outliers', multicollinearity and normality. Possible outliers for anthropometric data were checked using standard references for weights and MUAC measurements for children <5 years. The aim was to ensure accuracy and reliability of the data and the findings of the study. For example, units of weight and MUAC were all checked to ensure that grams (g) or millimetres (mm) were not used for some children whereas kilogram (kg) and 'centimetres (cm) for others. After these checks, variables were then coded to conform to the STATA statistical software used. Missing data values were coded as missing. The children who did not attend three consecutive treatment sessions, and their cards labelled 'dropout' were coded as 'default'. Children who died whilst receiving the therapy were coded as 'died'. The children whose cards were labelled as 'nonresponse to treatment' and 'referred to hospital for medical care' were coded as 'nonresponse' and 'referred' respectively, whilst the children who completed 16 weeks of the treatment but did not meet the discharge criteria were coded as 'transfers'. Descriptive analysis was performed for the entire study population of children to estimate the proportion of children who recovered, died and defaulted during the intervention phase. Differences between continuous variables were compared using the student t-test, whereas the Chi-Square test was used to compare differences between categorical variables. The differences in outcome across more than two groups were compared using the Extended Mantel Haenszel Chi-Square test for linear trends. Relationships between outcomes and explanatory variables were identified using multivariate regression modelling.

The rate of weight gain for the children who were discharged as recovered, as well as the children who defaulted from the programme were computed separately using the formula: ((discharge weight (kg) - enrolment weight (kg))/(enrolment weight (kg))/number of days in programme (Bahwere et al. 2006). Multiple linear regression was carried out to identify predictors of rate of weight gain, whereas binomial regression was performed to identify the predictors of recovery and default. It did not make statistical sense to conduct multivariate analysis for predictors of mortality because of the relatively small sample size. Because there were multiple independent variables, a step-wise backwards regression approach was suitable (Barry 2012; Nathans 2012).

Ethics and consent

The study was based on data collected as part of routine non-emergency community healthcare services delivery in the Upper East region, and our study did not offer any supplementary intervention to children. Prior to the recruitment of children into the programme, the GHS had sought consent from parents/caregivers to use the data that will be generated following the intervention for research/evaluation. As children were already discharged from treatment before this study, it was difficult for us to obtain additional consent directly from parents/caregivers to review and use the clinical information of their children. Instead, we obtained consent or permission from the GHS - Upper East Region health directorate, and in all the three implementing districts, as well as all the 56 health centres where the children records/information was held. This was undertaken after the GHS Ethics Review Board granted ethical clearance for the study to be conducted (REF NO: GHS-ERC: 10/1/11). All information retrieved from the children clinical records were anonymized and de-identified prior to analysis. We also ensured that the information was held securely under password protection in an encrypted computer.

Results

Baseline sample characteristics

Records of 725 children who left the programme between July 2012 and January 2013 were retrieved from the programme database in 56 outpatients'/community health centres. Of these, 237 children were excluded from analyses because their record either had incomplete/missing baseline and discharge information (n = 87) or they were aged above 59 months (n = 46) or below 6 months (n = 67) (**Figure 1**). Therefore the overall sample included in the analysis was 488 children with accurate and complete information relevant to measuring the outcomes of the intervention. Most children (n = 483) were admitted based on their MUAC; the remaining 5 were enrolled with bilateral pitting oedema. Children were characterised on the basis of their sex, age, birth category (singleton, twin, triplet), parental status (mother is alive, father is alive), breastfeeding status, co-morbidity and nutritional characteristics recorded at baseline for bivariate comparison of differences in proportions and/or means where applicable **(Table 1).**

Place Table 1

More than half of children were females (57.2%). About 37% were enrolled with MUAC <11cm, 59% were enrolled with MUAC of 11-11.5cm, and only 4% had their baseline MUAC >11.5cm. The majority of children were breastfeeding at the time of enrolment. The mean age was 17.3 months **(Table 1).** The most frequent co-morbidity diagnosed at baseline was fever (18.0%), malaria (17.6%), and vomiting (14.0%). Diarrhoea (8.2%) and cough (6.0%) were less common. Anaemia was the least common illness diagnosed.

The programme results

Overall, 338 children (69.3%) completed the programme, with 150 (30.7%) failing to complete. Completers were those who did not default from the programme, i.e. they were either discharged from the programme because they attained nutritional recovery with a 15% weight gain of initial weight or discharged after completing the 16 weeks programme cycle (and either recovered or not recovered). Non-completers referred to children who defaulted or died, as well as children who were lost to follow-up after they were referred to hospital.

The results of the study showed that overall 346 of the 488 children (71.0%) who received therapeutic care recovered from SAM. They include n=332 who completed the programme, n=8 for those who re-joined the programme (when traced) after defaulting (returned defaulters) and n=6 for the children who achieved the recovery target but left the programme undischarged (defaulted before discharged time) (see Figure 1). Of the 338 children who completed the treatment, 6 (1.2%) failed to recover and were transferred to hospital for inpatient care. The mean recovery time was 6.2 weeks (95% CI: 5.8, 8.2).

More than a quarter (28.5%; n=138) of children did not complete the programme and were classified as defaulters or dropouts. Our analysis show that a small proportion (6%, n=20) of the defaulting children had met the recovery criteria prior to default, i.e. they attained a ≥15% weight gain from baseline weight during their stay in the programme. However, we did not include these children in our calculation of the proportion of children that recovered from the programme since they were not discharged as such. When the children who defaulted were traced to their homes 66 children returned to the programme within an average time of 3.2 weeks after defaulting, and the rest were lost to follow up. Of the returnees, 48 children recovered completely from SAM within 2 to 3 weeks after re-joining the programme. Four children who were referred to hospital for medical treatment during the nutritional therapeutic care failed to return to the programme, whilst 8 (1.6%) children enrolled died whilst receiving treatment **(Table 2).** For the children who defaulted, the median length of stay was 2.3 weeks (IQ: 2.0, 2.5), and for children who died, the median length of stay in the programme was 4.8 weeks (IQ: 3.7, 5.8). It took on average 5.4 weeks for children admitted without co-morbidity to recover from SAM, whilst children enrolled with a medical condition or co-morbidity took much longer. The average daily weight gain for all children was 4.7g/kg/day (95% CI: 4.5, 5.4).

Place Table 2

Predictors of recovery, weight gain and default

Children who were enrolled without malaria had a higher chance of recovery (OR=30 (95% CI: 10.02, 92.13, p<0.001)) compared with those who had malaria **(Table 3).** The results also show that children who were enrolled with higher MUAC (≥11.5cm) had 7.35 times (OR=7.35 (95% CI: 2.56, 21.15)) more chance of recovery compared with children who were enrolled with lower MUAC (**Table 3**). The children who stayed in the programme up to 6 weeks, compared with children who defaulted <6 weeks had a greater chance of recovery (OR=11.30 (95% CI: 3.46, 36.93, p<0.001)). Socio-demographic variables such as age sex and age of child, parental status (father or mother alive) and breastfeeding and nutritional status (weight, MUAC) recorded at baseline did not predict default rate.

Place Table 3

Staying longer in the programme (β=0.13 (95% CI: 0.08, 0.18, p<0.001)) and baseline MUAC (β=0.78 (95% CI: 0.46, 1.00, p<0.001)) were strong predictors of weight gain (**Table 4).** It suggests that for every unit increase in MUAC (cm), weight gain increased by 0.78g/kg/day, and for every extra one week stay in the programme, weight gain increased by 0.13g/kg/day. The rate of weight gain was lower among children diagnosed with malaria at baseline compared with children without malaria (β= -1.25 (95% CI: -1.58, 0.92, p<0.001))**.**

Results from bivariate analysis show that children >24 months achieved higher rates of weight gain [5.0 (95% CI: 4.7, 5.4) g/kg/day] than children aged less than 24 months [4.6 (95% CI: 4.3, 4.8) g/kg/day, t-test p<0.03)].

Place Table 4

Discussion and conclusions

This study evaluated the potential effect of a community-based therapeutic care programme delivered within routine community health services in a non-emergency context in Ghana. Currently there is no agreed standard protocol for evaluating the therapeutic effectiveness of community-based programmes delivered in this context. Many national protocols on the CMAM approach, including the national CMAM guidelines for Ghana (GHS 2010d) are currently based on the Sphere guidelines for nutrition therapeutic care in emergency contexts. Therefore, we compared the programme observed outcomes with the current acceptable Sphere indicators **(Table 2)**.

Our findings suggest that a community-based therapeutic care approach, which has achieved successful outcomes in a humanitarian context, can also achieve similar success when delivered in developmental non-emergency healthcare contexts. The mortality rate (1.6%) reported in the programme was within the Sphere acceptable standard of <10% (Sphere 2011). We found that, although the upper limit of the CIs of our results (95% CI: 68% to 76%) is well within the acceptable recovery rate of >75% (Sphere 2011), the overall average recovery rate was lower (71.0%) compared with the SPHERE rate (>75%). Our analysis of the data also shows a higher default and a lower rate of weight gain compared with the rates stipulated in the Sphere guidelines. These rates were also lower compared with the CMAM programmes delivered in emergency contexts (e.g. Defourny et al. 2009; Sadler et al. 2007; Amthor et al. 2009).

The current findings corroborate well with existing literature that are based on CMAM programmes delivered in routine health service contexts (Gebremedhin et al. 2013; UNICEF 2012). For example in Ethiopia, Gebremedhin and others (2013) reported a low mortality (3.0%) and recovery rate (61.8%) following analysis they performed on routine data collected prospectively on children treated for SAM in Northern Ethiopia. Even though the recovery rate they reported is slightly lower than the Sphere standard, it met the requirement for effectiveness in CMAM programmes delivered in routine health services contexts according to the Ethiopian national CMAM protocol (Gebremedhin et al. 2013; Ethiopia Federal Ministry of Health 2007). Our results should be interpreted with caution since the Ghanaian National CMAM protocol is based on what is stipulated in the Sphere emergency management guidelines. We argue that conditions for delivering CMAM programmes are not the same in non-emergency and emergency contexts, and for this reason using the Sphere guidelines to measure programme performance may not be appropriate. In developmental non-emergency contexts where interventions are mainly coordinated by government health agencies, resources are usually limited, including insufficient skills and motivated staff to achieve results (Schubl 2010; Collins 2007; Collins 2001; Defourny et al. 2009; ENN 2011). Where these resources are adequately in place, success rates have been reportedly high (e.g. Collins 2007, Manary et al. 2006; UNICEF 2012; Collins and Sadler 2002). For instance, the literature has consistently indicated that the successes achieved by programmes implemented in emergency situations were largely influenced by availability of adequate resources including human resource capacity and expertise to carry out regular supervision and monitoring (Collins 2007; Collins 2001; Defourny et al. 2009).

Although our findings suggest that having a lower MUAC and co-morbidity before joining the programme were factors contributing to poor recovery and weight gain (**Table 3**), we believe that sharing of the therapeutic food with other siblings at home is a potential explanation. Available qualitative information collected by the health workers delivering the programme provides evidence for this (Akparibo 2013). Sharing of food is a common cultural practice in Ghana, especially among rural traditional communities in the north where this study was conducted. We could argue that because each sachet of the therapeutic diet provided 500kcals of energy even if sharing did take place, this was less likely to impact on the nutritional recovery and weight gain of the children. However this conclusion can only be made if the exact amount of RUTF the children consumed per day was known. Unfortunately daily consumption of RUTF data were not analysed because of lack of data.

Data were also limited for us to be able to ascertain the main reasons for the high default rate reported. Socio-demographic, clinical and nutritional status variables did not predict default. However, in previous studies long duration of treatment has been identified as a strong predictor for dropouts when children are admitted to hospital for treatment of SAM (Briend 2001; Collins et al. 2006; Collins and Sadler 2002). It is also reported in the literature (Collins and Sadler 2002; Guerrero 2013; Puett et al. 2013) that caregivers (mothers) are usually overburdened with multiple tasks at home because of lack of support from their spouses, thus impacting on their ability to access CMAM services regularly, especially if the duration of treatment is longer than they anticipated.

Besides the duration, the high default rate might also be related to distance from health centres, travel cost and/or opportunity cost (Guerrero et al. 2013). It could also be attributable to unacceptability of the treatment by children and/or their parents (Sadler et al. 2007) and/or quality of care (Puett et al. 2013). Theoretically when children drop out from a freely provided community-based intervention, it is either a signal of unacceptability of the programme due to perceived quality of the services or issues with accessibility or both (Sadler et al. 2008). We could not determine whether these were associated with default in this intervention because of lack of data. However, a recent study in Kenya (Hauenstein 2013) shows that mothers withdrew their children, or were not accessing CMAM services because of geographical accessibility problem (distance). The study also highlighted quality of the service as a major contributory factor for non-uptake. Other possible reasons are: beliefs held by parents about malnutrition and its treatment and lack of supervision and monitoring due to weakness in the health system.

There were several limitations in this study. The first is that the variables analysed did not include socio-cultural, economic and geographical factors for us to determine whether these were also associated with the high default rate. Although the programme designers made provision for information such as distance covered to access treatment to be collected, the health workers failed to complete this portion of children's attendance form. The second limitation of this study is that there might have been inaccuracy in the anthropometry measurements of children, which could have led to misclassification of children for inclusion or exclusion in the programme. As this study is a retrospective analysis of routinely collected data, the researchers were unable to supervise the anthropometric measurements. Furthermore, the researchers are unsure of the full compliance with therapeutic care at home, especially consumption of plumpy'nut by children. Although health workers recorded the number of sachets they gave to each child per week, we do not know the actual amount of plumpy'nut each child consumed per day for their body weight. If sharing did occur, this was likely to impact on the daily recommended nutrient intake needed for a child to recover and gain adequate weight. The lower weight gain reported could also be explained using this assumption. Lastly we are unsure what might have happened to the children who defaulted and never returned to the programme - whether they survived or died. For that reason our estimation of mortality rate might be an underestimation of reality. The generalisation of the findings therefore should be undertaken with caution.

Notwithstanding the limitations, we enhanced the reliability of our data through the quality checks applied to the data before analysis, as well as the approach to the data analysis, i.e. outliers for anthropometric data were checked using standard references for weight and MUAC measurements. The units of weight and MUAC were all checked to ensure that the correct unit of measurements were used.

In summary, the outcomes measured following the implementation of the CMAM programme in Ghana have partially met the Sphere acceptable minimum standards (Sphere 2011), even if default rates were high and weight gain was low. Mortality rate was within what the Sphere guidelines stipulates, as well as the limits of the CIs of recovery rate fall within the acceptable minimum. We can therefore, conclude that the implementation of a CMAM approach in non-emergency contexts can achieve success but this can be diluted by a higher default rate. The factors associated with higher default rates need to be explored from the parents' perspective. This could help programme stakeholders to understand what needs to be addressed in order to improve effectiveness and to sustain the programme within community contexts. Furthermore, although there was no data to ascertain whether or not sharing of the RUTF occurred at home, previous analysis of routine monitoring data (Akparibo 2013) did suggest that this was likely to occur. Therefore, we recommend that the awareness of parents and carers be created about the potential impact of sharing the RUFT on the nutritional recovery of their children suffering from SAM.

Key messages

- Community-based management of children with SAM programmes can be delivered in routine non-emergency healthcare settings with high success rates.
- The success of Community-based management programme can be diluted by a high default rate.
- Further research on what needs to be done to address the high default rate to achieve maximum impact of community based SAM management programmes is needed.

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Table 1: Baseline demographic and nutritional characteristic of children aged 6-59 months enrolled into the community-based SAM management programme

Variables	n	(%)	Mean (±SD)
Sex			
Female	279	57.2	
Male	209	42.8	
Age (months)			17.4 ± 2.5
6 to 23	381	78.1	
24-36	107	21.9	
Multiple birth			
single	462	94.7	
twin	20	4.2	
triplet	6	1.1	
Breastfeeding			
Yes	409	83.8	
No	79	16.2	
Mother alive			
Yes	473	96.9	
No	15	3.1	
Father alive			
Yes	475	97.3	
No	13	2.1	
Appetite			
Yes	476	97.5	
No	12	2.5	
Baseline MUAC (cm)			11.1 ± 0.1
<11.0	182	37.3	
11.0 to <11.5	289	59.2	
>=11.5	17	3.5	
bilateral pitting Oedema			
Yes	5	1.4	
No	483	98.6	
Baseline weight (kg)	488		7.0 ± 0.1
Co-morbidity/symptoms			
Fever			
Yes	88	18.0	
Malaria			
Yes	86	17.6	
vomiting			
Yes	67	13.7	
cough			
Yes	28	5.7	
diarrhoea			
yes	40	8.2	
Anaemia			
Yes	3	0.6	
Multiple co-morbidity (2 or more)			
Yes	86	13.6	

Data are in Mean (M) ± Standard Deviation), numbers (N) and Percentages (%).

Table 2: The community-based programme outcomes compared with international acceptable standards (Sphere Project, 2011).

Primary outcomes measures	n	Mean (95% CI)	Standards (Sphere indicators)
Recovery rate (%)	346	71.0 (68.0 - 76.0)	>75
Death rate (%)	8	2.0 (1.0 – 3.0)	<10
Default rate (%)	138	28.0 (24.0 - 32.0)	<15
Total	488		
Secondary outcomes			
Average rate of weight gain for recovered (g/kg/day)	346	4.73 (4.50 -4.80)	≥8
Average length of stay (weeks)	488	6.02 (5.86 -6.21)	4-6

Data in Confidence Intervals (CI), Mean (M), Numbers (n) and Percentages (%). Total recoveries n=346 include n=332 of 338 children who complemented the programme, n= 8 for those who re-joined the programme (when traced) after defaulting (returned defaulters) and n=6 for the children who achieved the recovery target but left the programme undischarged (defaulted before discharged time).

Table 3: Predictors of recovery from severe acute malnutrition following treatment

Variables	**Recovery**		**Univariate analysis**		**Multivariate analysis**	
	Yes (n=349)	No (n=139)	OR (95% CI)	p	aOR (95% CI)	p
Sex						
Male	150(42.98)	59 (42.45)	1.02(0.69-1.52)	0.91	………	……
Age (months)						
6 to 23	272 (80.0)	109 (80.1)	Reference		……..	……
24-36	68 (20.0)	27(19.9)	1.01(0.61-1.66)	0.97		
Breastfeeding Yes	294(84.2)	115(82.7)	1.12(0.66-1.89)	0.68	……..	……
Mother alive Yes	338(96.8)	135(97.1)	0.91 (0.28-2.91)	0.87	………	……
Father alive Yes	341(97.7)	134(96.4)	1.59(0.51-4.95	0.42	……..	……
Default	20 (5.7)	118(84.9	0.01(0.01-0.02)	<0.001	** 11.30 (3.4636.93)	<0.001
Co-morbidity						
Fever						
Yes	51(14.6)	37(26.6)	0.47(0.29-0.76	0.002	……..	……
Malaria						
Yes	50(14.3)	36(25.9)	0.48(0.30-0.78)	0.003	**30.39 (10.02-92.13)	<0.001
Vomiting						
Yes	44(12.6)	23(16.5)	0.73(0.42-1.26	0.26	……..	
Cough						

Yes	20(5.7)	8(5.8)	1.00(0.43-2.32)	0.99	………	……
Diarrhoea						
Yes	25(7.2)	15(10.8)	0.64(0.33-1.25)	0.19	………	…….
Anaemia						
Yes	2(0.6)	1(0.7)	0.80(0.07-8.84)	0.85	………	…….
Length of stay (weeks)	6.0(5.0-6.0)	2.0(1.0-3.0)	4.14(3.22-5.32)	<0.001	3.28 (2.22-4.86)	<0.001
Admission weight (kg)	6.8(6.0-7.7)	7.0(6.0-7.6)	1.0(0.87-1.16)	0.98	……..	…….
Baseline MUAC (cm)	11.2(10.9-11.4)	11.1(10.8-11.3)	1.72(1.05-2.81)	0.03	7.35 (2.56-21.15)	<0.001

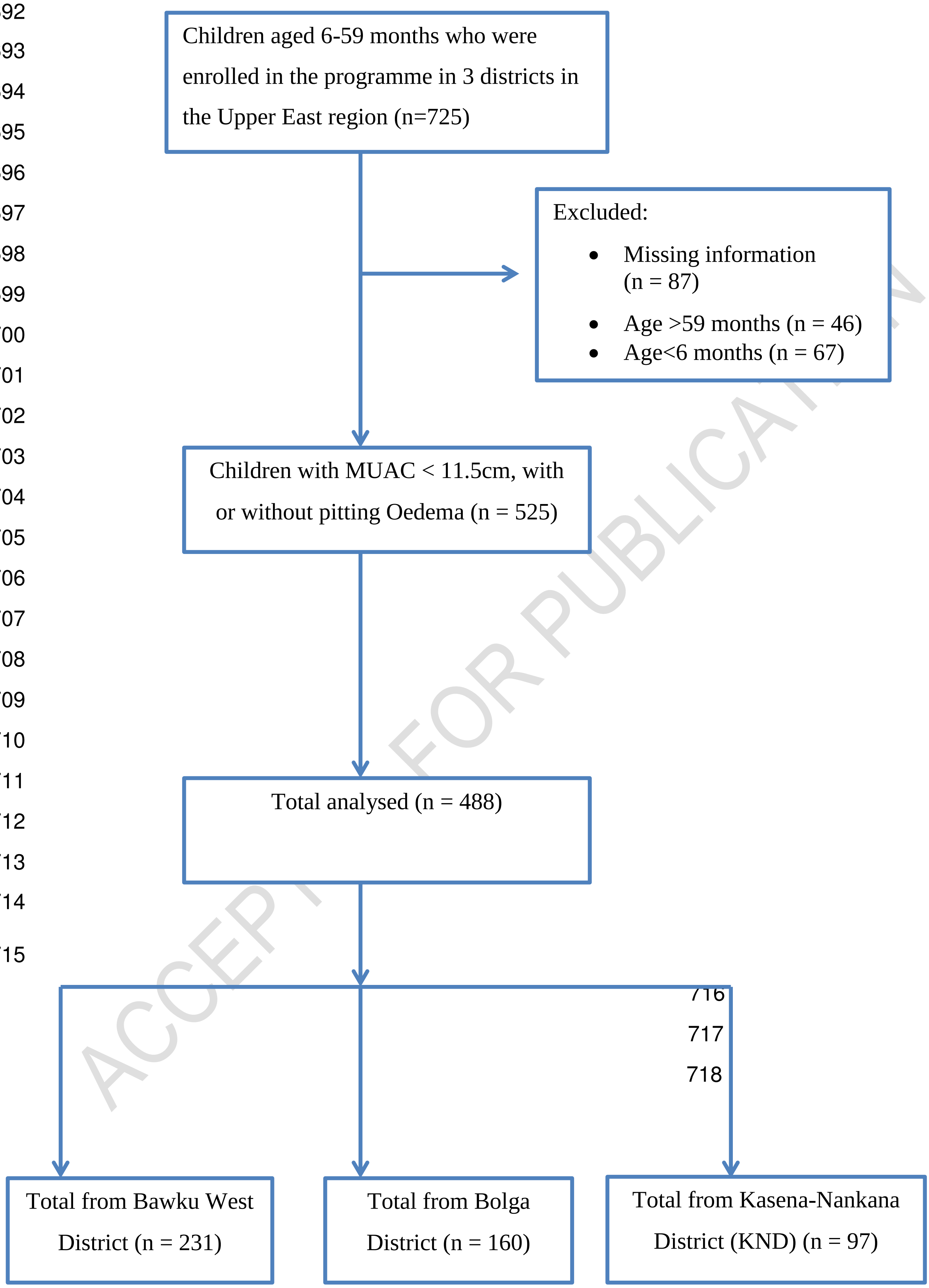
Notes: Data are in CI=Confidence Intervals, OR=Odd Ratios, aOR=adjusted Odd Ratios and p=Probability values. Length of stay, Admission weight and MUAC are in interquartile range (IQ). aOR with corresponding CI were calculated using step-wise multiple logistic regression model. Only variables showing significant associations *are reported. aOR and CIs (**) reported denote 'No malaria at enrolment' and 'Not defaulted'.*

Table 4: Predictors of weight gain for children discharged as recovered

	Average change in weight gain (g/kg/day)	
Predictors variable	**β (95% CI)**	**p-value[a]**
Malaria	-1.25(-1.58 - 0.92)	<0.001
Admission MUAC	0.78(0.46 - 1.00)	<0.001
Length of stay	0.13(0.08 - 0.18)	<0.001

Data in Beta *(β) co*-efficient, Confidence Intervals (CI) and Probability (p). [a]p-values, CIs and ORs were calculated using step-wise multiple logistic regression model. Only variables showing significant associations are reported.

FIGURE 1


Children aged 6-59 months who were enrolled in the programme in 3 districts in the Upper East region (n=725)
Excluded:
Missing information (n = 87)
Age >59 months (n = 46)
Age<6 months (n = 67)
Children with MUAC < 11.5cm, with or without pitting Oedema (n = 525)
Total analysed (n = 488)
Total from Bawku West District (n = 231)
Total from Bolga District (n = 160)
Total from Kasena-Nankana District (KND) (n = 97)