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Treatment outcomes among children treated for uncomplicated severe acute malnutrition: a retrospective study in Accra, Ghana

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Abstract

Objectives: The objectives of the study were to describe outcomes of children with uncomplicated severe acute malnutrition (SAM) attending community-based management of acute malnutrition (CMAM) treatment centres in Accra Metropolitan Area (AMA) and explore factors associated with non-adherence to clinic visits and defaulting from the treatment programme.

Design: A retrospective cohort study analysing routinely collected data on children with uncomplicated SAM enrolled into CMAM in 2017 was conducted.

Setting: Study was conducted at seven sites comprising Princess Marie Louise Children's Hospital, three sub-metropolitan health facilities and three community centres, located in five sub-metropolitan areas in AMA.

Participants: Children with uncomplicated SAM aged 6–59 months, enrolled from community-level facilities (pure uncomplicated SAM, PUSAM) or transferred after completing inpatient care (post-stabilisation uncomplicated SAM, PSSAM), participated in the study.

Results: Out of 174 cases studied (105 PUSAM, sixty-nine PSSAM), 56·3 % defaulted, 34·5 % recovered and 8·6 % were not cured by 16 weeks. No deaths were recorded. Mid-upper arm circumference (MUAC) increased by 2·2 (95 % CI 1·8, 2·5) mm/week with full compliance and 0·9 (95 % CI 0·6, 1·2) mm/week with more than two missed visits. In breast-feeding children, MUAC increased at a slower rate than in other children by 1·3 (95 % CI 1·0, 1·5) mm/week. Independent predictors of subsequent missed visits were diarrhoea and fever, while children with MUAC < 110 mm on enrolment were at increased risk of defaulting.

Conclusion: A high default rate and a long time to recovery are challenges for CMAM in AMA. Efforts must be made to improve adherence to treatment to improve outcomes.

Keywords
Uncomplicated
Severe acute malnutrition
Community-based Management of Acute Malnutrition treatment outcomes
Accra Metropolitan Area
Default

Malnutrition is a major risk factor for mortality. Among the different forms of malnutrition, children who are severely wasted are at the highest risk of death[1,2]. Globally, an estimated 20 million children under the age of 5 years have severe acute malnutrition (SAM) and about one million children die every year from its complications[3]. Malnutrition estimates from 2017 showed that in Ghana, out of more than four million children under the age of 5 years, almost 5 % are wasted and 0·7 % are severely wasted[4]. The 2008 Lancet Series on Maternal and Child Undernutrition identified effective treatment of children with SAM as one intervention that could prevent almost half a million child deaths worldwide[5]. Community-based management of acute malnutrition (CMAM) is an evidence-based approach adopted by WHO for treating children with SAM[6].

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CMAM has been shown in several countries to cure high numbers of malnourished children and reduce the frequency of poor outcomes[6,7]. CMAM places emphasis on ambulatory care involving ready-to-use therapeutic foods (RUTF) supplied regularly to malnourished children[8]. Challenges with CMAM implementation across different settings include limited access[9], treatment outcomes often not corresponding to those realised in trial conditions and not meeting international standards[10–13]. According to international standards, mortality among patients enrolled in CMAM is expected to be below 10 %, fewer than 15 % of children would default from the programme and cure should be achieved in more than 75 % of children[2]. Despite Ghana adopting CMAM over a decade ago[6,14], the programme has seen declining recovery rates nationwide[14].

A high proportion of defaulters, which reached as high as 24 % in 2012, is a recognised challenge with CMAM nationwide[15]. Although in 2016, according to Ghana Health Service annual report, the national default rate dropped to 14 %; in the Greater Accra Region (GAR), located in southern Ghana, about 34 % of SAM cases defaulted treatment. This rate was the highest among the ten regions in the country, twice the national average and far above the international target[14]. Reasons for such a high default rate are unclear and research is needed to investigate this further. Studies from northern Ghana report that more than 25 %[11,12] of children in the programme were defaulters. There are no published data from southern Ghana on CMAM treatment outcomes. Furthermore, there are insufficient data to enable children who are at higher risk of unfavourable outcomes to be identified at the time of enrolment in CMAM[11,12,16]. The aim of the present study was to describe treatment outcomes of children with uncomplicated SAM enrolled in treatment centres in Accra Metropolitan Area (AMA) and to explore factors associated with non-adherence to clinic visits and defaulting from the programme.

Methods

This is a retrospective cohort study using secondary data on outpatient SAM cases enrolled in CMAM in AMA from 1 January to 31 December 2017. Data were extracted between September and December 2018.

Study sites

Study sites were selected from AMA in the GAR, in the south-eastern part of Ghana. GAR is predominantly urban and the most densely populated region in the country. Total SAM cases estimated to access treatment in GAR annually are 2338, and this estimate assumes 50 % coverage of actual SAM cases[17].

The population of AMA makes up about 50 % of GAR, being the largest metropolitan area within the region. In 2017, AMA had five sub-metropolitan areas. One permanent, major health facility offering CMAM per sub-metropolitan area was initially selected to serve as study site. However, for Osu-Klottey sub-metropolitan area, no cases were managed at its sub-metropolitan health facility in 2017, so data were collected from the three lower level community centres in that area. The other sites selected were Mamprobi Polyclinic, Kaneshie Polyclinic, Maamobi General Hospital and Princess Marie Louise Children's Hospital. Princess Marie Louise Children's Hospital is a major children's hospital in Accra with an eighty-one-bed capacity and the largest institution for managing malnutrition in Ghana with the most SAM cases in AMA.

Study population

Admission criteria into the CMAM programme in Greater Accra followed the national guidelines for children aged 6–59 months which defined SAM based on mid-upper arm circumference (MUAC) < 115 mm and or nutritional oedema. Oedematous SAM (kwashiorkor) refers to children with bilateral pitting oedema[18]. SAM can be classified as complicated or uncomplicated. Complicated cases required inpatient management because of a failed appetite test, grade 3+ oedema or the presence of medical complications[19]. These medical complications include the following: Integrated Management of Childhood Illnesses general danger signs – inability to drink, repeated vomiting, convulsions, lethargy or unconscious – and hypoglycaemia, axillary temperature >39°C or <35°C, severe dehydration, severe palmar pallor or anaemia (< 40 g/l), eye signs of vitamin A deficiency, flaky paint dermatosis and severe pneumonia defined by increased respiratory rate with chest indrawing or a danger sign[6,8,20]. These complications were identifiable by less skilled health workers at primary health facilities with limited diagnostic tests. Uncomplicated SAM cases were managed on outpatient basis because they lacked medical complications, passed the appetite test and may have had only grade 1+ or 2+ nutritional oedema[19].

The data on children aged 6–59 months who had been diagnosed with uncomplicated SAM based on a MUAC < 115 mm or nutritional oedema and who had been enrolled in the CMAM programme in 2017 were eligible for inclusion in the study. Uncomplicated SAM cases were subdivided into two groups, which were both eligible for inclusion in the present study: (i) children enrolled directly from community-level facilities like child welfare clinics or those transferred from another outpatient health facility (named pure uncomplicated SAM, PUSAM) and (ii) children enrolled after inpatient care who had not achieved cure, that is, their MUAC was <125 mm and or nutritional oedema had not yet resolved for two consecutive weeks (named post-stabilisation uncomplicated SAM, PSSAM).

Cases with missing data on age, admission MUAC and referring facility were excluded. Cases were also excluded if admission MUAC was > 115 mm unless they had oedema or had been referred from another health facility to continue treatment.

Data collection: methods and instruments

Trained research assistants extracted baseline and follow-up data (for a list of variables please see online supplementary material, Supplemental Table 1) from treatment cards of eligible cases enrolled at study sites into paper-based extraction forms.

SAM cases enrolled in CMAM in 2017 were managed according to the national and WHO guidelines. On the day of enrolment in outpatient care, patient's demographic characteristics, medical history and physical examination findings were documented by the health worker who was a community health nurse, or a nutritionist trained in the outpatient management of children with SAM. The medical history included questions about whether child had had diarrhoea, vomiting, cough or oedema. Caregivers were also asked about the child's appetite at home. The health worker's physical examination included taking the child's temperature, counting respiratory rate, assessing presence of chest indrawing, changes in the eyes, skin or mouth and whether there was moderate or severe dehydration. MUAC was measured using a non-stretchable tape measure on the left arm to the nearest 1 mm. Bilateral oedema was demonstrated by depression of the skin and soft tissues which remained after the thumb was removed after 3 s. Oedema was classified as grade 1+ if it involved both feet and 2+ if the feet, lower legs, hands or lower arms were involved[21]. Each child's weight was measured in light clothing or no clothing to the nearest 0·1 kg. To be treated as outpatients, children had to pass the appetite test by eating at least a third of a sachet of RUTF during the clinic visit. Children who failed this test or had complications were admitted for inpatient care and later transitioned to outpatient care once they were stabilised[8].

According to national guidelines, children were to be followed up for a maximum duration of 4 months in CMAM during which they attended weekly visits at the outpatient treatment centre[8]. Each week, children took home a ration of RUTF, calculated based on the child's weight. During the clinic visits, caregivers were asked about a history of vomiting, diarrhoea, fever or cough in the child. The child's anthropometry, axillary temperature, respiratory rate, presence of dehydration, palmar pallor, evidence of skin infection or oedema were assessed by the health worker. The appetite test was also performed at each visit. Children who failed the test at any of the follow-up visits were to be referred to inpatient care. Each visit's outcome and the final treatment outcome were documented.

Final treatment outcomes using Ghana's CMAM guidelines[8] and as defined in the international sphere standards were 'cured', 'died', 'non-recovered', 'defaulted' or 'referred to inpatient care'[2]. The criteria used for cure follow the updated WHO guidelines[6]. According to these guidelines, for patients whose admission criteria were based on their MUAC or nutritional oedema, patients could be declared cured and discharged if their MUAC reached a minimum of 125 mm for two consecutive weeks. In addition, if the patient had oedema at enrolment, then this also needed to have resolved for at least 2 weeks prior to discharge[6]. Defaulting was defined as three consecutive missed visits. Non-recovery was when cure was not attained by 16 weeks of follow-up. All cases were assigned a treatment outcome.

Statistical analysis

We expected to analyse data on about 335 cases of uncomplicated SAM out of an estimated 460 cases, accounting for about 12 % missing data and another 15 % of children below age 6 months or older than 59 months who could have also been treated for SAM based on a similar study in Upper East region[12]. The 460 cases were derived from estimates of total SAM cases in Greater Accra[17], the population of AMA from the 2010 census and assuming 50 % of cases sought treatment at these study sites in 2017.

Data were single entered into Microsoft® Excel for Mac (version 16.30) spreadsheets, cleaned, checked for outliers and exported to STATA Statistical software (Release 15; StataCorp LLC) for analysis. Each patient was classified as either PUSAM or PSSAM. Data were summarised using median and range for continuous variables, frequency and percentages for categorical variables including treatment outcomes. Baseline covariates including age, gender, MUAC, diarrhoea and fever (axillary temperature ≥37·5°C) were compared using Mann–Whitney U test and χ^2 test (or Fisher's exact test if appropriate) between SAM groups.

Time to cure, defined as time from enrolment until the visit that the cure criteria were satisfied, was analysed using Kaplan–Meier method. Children who were lost to follow-up or completed sixteen weekly visits but never achieved cure were censored at their last visit when MUAC or presence of oedema was recorded. Children who defaulted (i.e., missed three consecutive visits) more than once (returned defaulters) were censored earlier, at the last visit before their first default. Any child who failed the appetite test while being followed up was censored at that visit.

Risk of missing the next week's visit was examined in the logistic regression model with random intercept for child to account for multiple visits. Effect of baseline covariates and covariates measured at each visit were examined. Risk of defaulting from the programme was modelled using Fine and Gray model[22] with cure treated as a competing event. Stepwise variable selection procedure was employed to identify independent predictors in all regression models. All baseline covariates were evaluated in the procedure and 5 % significance level was selected to retain variables in the final model.

Weekly change in MUAC was estimated for each child by a random slope for time from a random effect normal

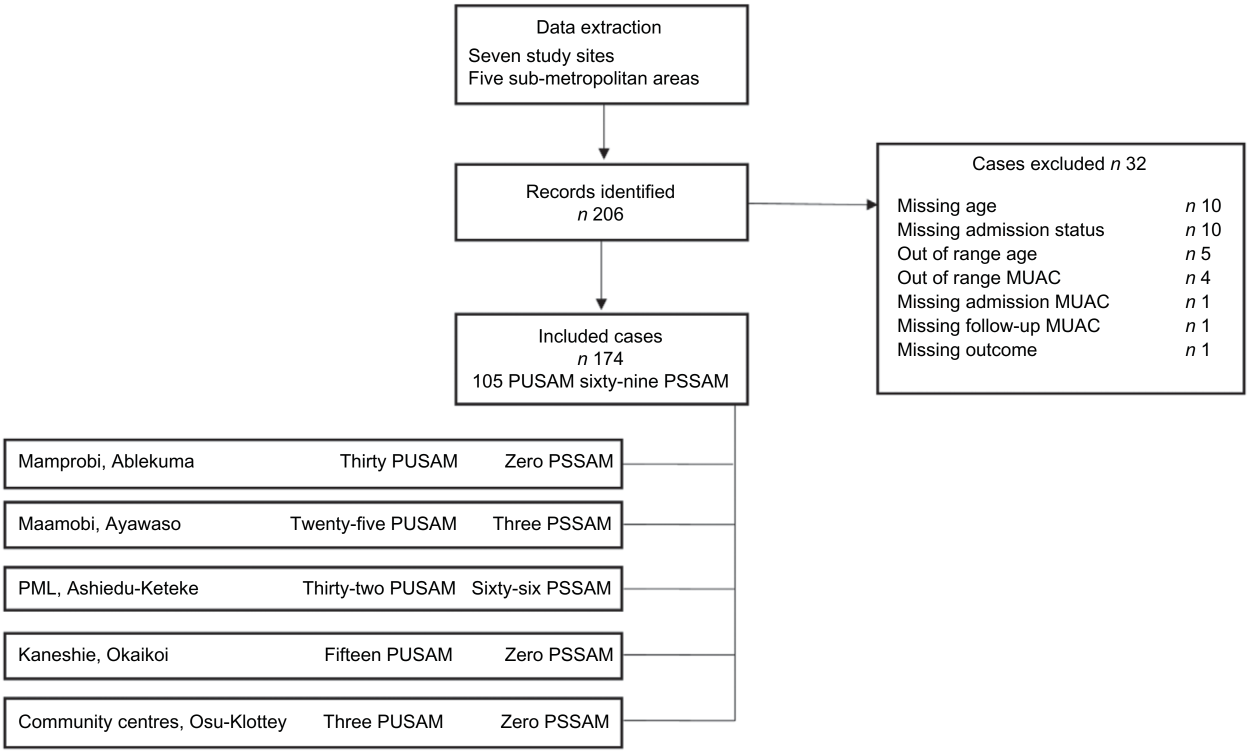

Fig. 1 Study profile. MUAC, mid-upper arm circumference; PUSAM, pure uncomplicated severe acute malnutrition; PSSAM, post-stabilisation uncomplicated severe acute malnutrition; PML, Princess Marie Louise

regression model. Results are presented as the population mean weekly change (fixed-effect estimate from the model), 95 % CI and SD. Association between baseline characteristics, covariates evaluated at each visit and baseline MUAC and slope (as appropriate) were explored as fixed effects.

Results

Descriptive characteristics

Data from 174 children aged 6–59 months were included in the study comprising 105 PUSAM cases, who were either enrolled directly from the community (*n* 35) or referred from another outpatient facility (*n* 70), and sixty-nine PSSAM cases referred from inpatient care. Majority of cases were from Princess Marie Louise (Fig. 1).

Median MUAC at presentation was 111 mm (range 85–135 mm) with mean of 110 mm (SD 0·67) and was not different between the two groups. Children presenting with oedema (grade 1+ or 2+) had a larger MUAC than children with no oedema, with difference in means of 11·6 mm (95 % CI 7·2, 15·9). Eight children (4·9 %) had oedema, seven had grade 1+ and one had grade 2+ oedema. Only a few children had symptoms of diarrhoea (3, 1·8 %), vomiting (1, 0·6 %), dehydration (9, 5·6 %) or cough (16, 9·5 %). An increased respiratory rate (defined by respiratory rate >40 cycles per minute (cpm) in children 12–59 months old; >50 cpm in children 6–12 months) was observed in 13 (8·1 %), chest indrawing in 3 (1·8 %) and fever in 21 (14·6 %) children. Most of them were reported as having a good appetite at home by the caregiver (149, 89·8 %). Majority of children under 2 years of age were breastfeeding (116, 76 %). Data were missing on amoxicillin administration in 124 (71·2 %) cases, so this variable could not be analysed.

Most baseline characteristics were similar between the two SAM groups (Table 1). However, in the PSSAM group, there were significantly more boys (56 % compared with 35 %), more children enrolled with oedema (10 *v.* 1 %) or fever (23 *v.* 10 %) but fewer with perceived poor appetite (3 *v.* 15 %), increased respiratory rate (3 *v.* 12 %) or moderation dehydration (0 *v.* 10 %) as compared with PUSAM.

Twelve eligible children (seven females, five males) who were excluded from the analysis due to missing admission status or follow-up data were aged 6–18 months, with MUAC 90–114 mm and majority (86 %, 6/7) were breastfeeding. The observed symptoms at baseline were fever (1/9), cough (1/12), poor appetite (2/12), increased respiratory rate (2/11), diarrhoea (1/12), vomiting (1/12) and pale conjunctiva (1/12).

Treatment outcomes among uncomplicated severe acute malnutrition cases

Out of 174 uncomplicated SAM cases, sixty (34·5 %) children were cured, including seven who returned after

Table 1 Baseline characteristics of post-stabilisation uncomplicated severe acute malnutrition (PSSAM) and pure uncomplicated severe acute malnutrition (PUSAM)

	PSSAM			PUSAM			
Parameters	*N*	*n*	%	*N*	*n*	%	*P*
Age (months)	69	11		105			0·105
Median		11			10		
Range		6–54			6–42		
Age (months)							0·242
6–11		39	57		64	61	
12–23		21	30		35	33	
24–59		9	13		6	6	
Poor appetite†	67	2	3	98	15	15	0·008**
Breast-feeding‡	60	43	72	93	73	78	0·220
Cough	67	4	6	101	12	12	0·156
Chest indrawing	65	0	0	99	3	3	0·217
Pale conjunctiva	64	0	0	97	5	5	0·076
Moderate dehydration	67	0	0	92	9	10	0·006*
Diarrhoea	67	1	1	98	2	2	0·640
Eye discharge	66	1	2	103	0	0	0·391
Fever (≥37·5°C)	56	12	21	87	9	10	0·058
Gender: male	69	38	55	105	37	35	0·010*
Any GI symptoms§	62	3	5	80	11	14	0·066
No. in household							0·794
<5 people		34	51		52	55	
5–6 people		23	34		32	34	
>6 people		10	15		11	12	
Mouth sores	67	1	1	95	0	0	0·413
MUAC (mm)	69			105			0·267
Median		111			110		
Range		85–135			90–118		
MUAC < 110 mm	69	23	33	105	36	34	0·515
Enlarged lymph nodes	66	0	0	100	2	2	0·361
Oedema	69	7	10	102	1	1	0·008**
Increased RR‖	67	2	3	93	11	12	0·038*
Skin changes	67	1	1	95	1	1	0·658
Frequent stool	65	1	2	95	0	0	0·406
Vomiting	67	1	1	102	0	0	0·396
Weight (kg)	69			103			0·571
Median		5·7			5·7		
Range		3·6–12·2			1·7–8·5		

N, number of evaluated patients; *n*, number of patients with the characteristic; GI, gastrointestinal; MUAC, mid-upper arm circumference; RR, respiratory rate.
**P* < 0·05, ***P* < 0·01, ****P* < 0·001.
†Poor appetite = caregiver's perception of the child's appetite.
‡Breast-feeding only applicable to children < 24 months of age.
§Any GI symptoms = any gastrointestinal symptoms including diarrhoea, vomiting, dehydration and frequent stool.
‖Increased RR ≥ 40 cpm for children 12–59 months, and >50 cpm for children < 12 months.

missing at least three consecutive visits and one who failed the appetite test at week 3 (and at some later visits) but was kept in outpatient treatment by the health worker. Fifteen children (8·6 %) did not recover by 16 weeks of follow-up, including two children who returned after missing at least three visits. Majority of children (98, 56·3 %) were lost to follow-up and were classified as defaulters, including two who failed their appetite tests at week 2 of follow-up but were retained in outpatient treatment by the health worker. One child (0·6 %) was referred to another treatment centre. There were no recorded deaths (0 %). Among those classified as defaulters, four attained one MUAC of a minimum of 125 mm on one visit during their follow-up. Overall, 107 (61·5 %) children missed at least three consecutive visits during their treatment.

Time to cure in malnourished children in Community-based Management of Acute Malnutrition

Eighteen patients missed three consecutive visits after their initial visit, so were excluded from further outcome analysis; 156 were included. PSSAM children recovered faster ($P = 0·034$, Wilcoxon test) with a median cure time of 10 weeks compared with 14 weeks among PUSAM (Fig. 2). In children who achieved cure during follow-up, mean time to cure was 9·4 (median 7·5, range 1–26) weeks in PSSAM and 12·5 (median 13, range 3–25) weeks in PUSAM ($P = 0·005$). Cure was achieved sooner in children presenting with oedema on enrolment, at mean time of 4·6 (median 4, range 2–10) weeks, compared with 11·6 (median 12·5, range 1–26) weeks in non-oedematous children ($P = 0·003$).

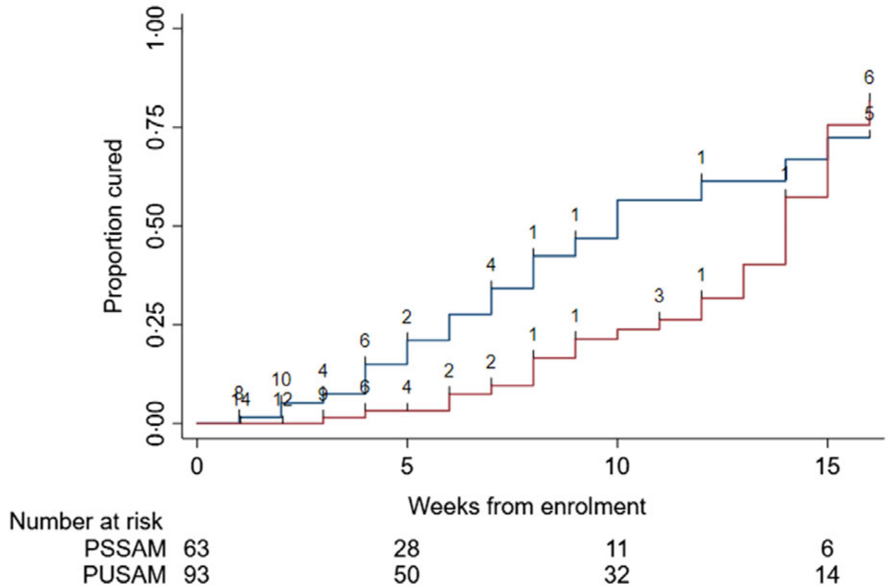

Fig. 2 (colour online) Kaplan–Meier estimates of time to cure for post-stabilisation uncomplicated severe acute malnutrition (PSSAM) and pure uncomplicated severe acute malnutrition (PUSAM) cases. –, PSSAM; –, PUSAM

The efficacy of CMAM, that is, the proportion of children who stayed in the programme who would attain cure within 16 weeks of follow-up, was estimated at 79 % (95 % CI 67, 88) using the Kaplan–Meier method (Fig. 2). This proportion estimates the potential of the programme to cure SAM among children who remain enrolled and is in clear contrast with the actual cure rate observed of only 34·5 %.

Factors affecting default (loss to follow-up) and non-adherence to clinic visits

The risk of defaulting treatment was much higher at study sites other than Kaneshie Polyclinic (subdistribution hazard ratio (SHR) 14·04, 95 % CI 2·09, 94·08, $P = 0·006$). After adjusting for study site, out of all baseline covariates, only a MUAC < 110 mm was associated with a higher risk of defaulting (75 %, 44 /59 compared with 58 %, 67/115 in children with larger MUAC; SHR = 1·47, 95 % CI 1·00, 2·16, $P = 0·052$).

Among children who were cured or completed 16 weeks follow-up, more PSSAM children were compliant with all scheduled clinic visits compared with PUSAM (42 %, 11/26 compared with 19 %, 7/37, $P = 0·02$). Probability of missing the next visit was different between study sites ($P = 0·001$), with 19 % of the subsequent visits missed at Kaneshie Polyclinic compared with the average of 34 % in the remaining sites (between 33 and 37 % in the other three large study sites). After adjusting for study site, independent predictors of missing a subsequent visit were diarrhoea and fever (Table 2). Children presenting with diarrhoea, compared with those without, were more likely to miss the next visit (adjusted OR (AOR) 4·29, 95 % CI 1·03, 17·84, $P = 0·045$) while febrile children compared with afebrile children were less likely to miss clinic the next time (AOR 0·36, 95 % CI 0·15, 0·88, $P = 0·025$). Diarrhoea resulted in 60 % (6/10) of subsequent visits being missed compared with 32 % (269/836) among those who presented without diarrhoea. Febrile children at a follow-up visit missed 20 % (8/40) of subsequent visits compared with 33 % (268/807) subsequent missed visits by children without a fever.

Changes in mid-upper arm circumference over time

Overall, within 16 weeks of follow-up, mean weekly increase in MUAC was 1·5 (95 % CI 1·3, 1·7) mm with variability between children with SD of 1·1 mm. The rate of change was lower in children living in larger households, who were breastfed or presented with pale conjunctiva at enrolment (Table 3).

However, in the multivariable model, after adjusting for all significant patient characteristics (oedema, number of people in the household, age group and respiratory rate) and study site, the rate of change in MUAC was independently associated only with breast-feeding or pale conjunctiva at enrolment. Breastfed children under the age of 24 months had an average weekly change in MUAC of 1·3 (95 % CI 1·0, 1·5) mm compared with 2·3 (95 % CI 1·8, 2·7) mm in children in the same age group but not breast-feeding and 2·0 (95 % CI 1·2, 2·9) mm in older children. Average weekly change in MUAC in children with pale conjunctiva at enrolment into CMAM programme was even lower at 0·9 (95 % CI 0·03, 1·8) mm compared with 2·3 (95 % CI 1·8, 2·7) mm in children with no signs of anaemia (Table 3).

After adjusting for age and presence of oedema at baseline, the weekly increase in MUAC also decreased in patients who missed visits ($P < 0·001$): it was 0·9 (95 % CI 0·6, 1·2) mm in patients who missed three

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Table 2 Logistic regression showing factors associated with missing a subsequent clinic visit

	Univariable analysis			Multivariable analysis		
Parameter	OR	95 % CI	*P*	AOR	95 % CI	*P*
Evaluated at baseline						
PUSAM	1·67	1·03, 2·70	0·038*			
Age (months)	0·99	0·96, 1·02	0·536			
Gender: male	0·98	0·69, 1·39	0·913			
Age group (months)						
6–11	Reference					
12–23	1·02	0·71, 1·46	0·926			
24–59	0·80	0·38, 1·69	0·556			
No. in household						
<5 people	Reference					
5–6 people	1·67	0·79, 3·53	0·178			
>6 people	1·28	0·60, 2·73	0·515			
MUAC < 110 mm	1·17	0·82, 1·68	0·386			
Oedema	0·39	0·13, 1·14	0·085			
Breast-feeding						
No (<24 months)	Reference					
Yes (<24 months)	1·55	1·00, 2·41	0·050			
No (≥24 months)	1·10	0·50, 2·43	0·808			
Pale conjunctiva	0·53	0·21, 1·33	0·174			
Enlarged lymph nodes	0·70	0·15, 3·35	0·653			
Chest indrawing	0·46	0·12, 1·82	0·270			
Any GI symptoms†	0·82	0·41, 1·61	0·561			
Poor appetite‡	0·67	0·33, 1·33	0·250			
Study site (Kaneshie)	0·43	0·26, 0·74	0·002*	0·40	0·23, 0·68	0·001**
Evaluated at baseline and each visit						
Diarrhoea	3·39	0·88, 13·08	0·076	4·29	1·03, 17·84	0·045*
Vomiting	1·04	0·17, 6·19	0·970			
Moderate dehydration	0·41	0·07, 2·37	0·317			
Cough§	0·91	0·41, 2·05	0·829			
Skin changes	0·26	0·03, 2·28	0·223			
Increased RR‖	0·73	0·41, 1·30	0·292			
Fever¶	0·44	0·19, 1·01	0·054	0·36	0·15, 0·88	0·025*
Temperature (°C)††	1·21	0·94, 1·57	0·137			
Any GI symptoms†	1·25	0·50, 3·14	0·631			
MUAC (cm)	0·88	0·71, 1·09	0·240			
Weight (kg)	1·00	0·87, 1·16	0·961			

AOR, adjusted OR; PUSAM, pure uncomplicated severe acute malnutrition; MUAC, mid-upper arm circumference; GI, gastrointestinal; RR, respiratory rate.
Univariable analysis shows results for all tested parameters; multivariable analysis only includes independent predictors
$*P<0·05$, $**P<0·01$, $***P<0·001$.
†Any GI symptoms = any gastrointestinal symptoms including diarrhoea, vomiting, dehydration, frequent stool at baseline, and diarrhoea, vomiting, dehydration for each visit, as reported by the caregiver.
‡Poor appetite = caregiver's perception of the child's appetite.
§Cough is a symptom noticed by the caregiver during the week prior to the visit.
‖Increased RR = increased respiratory rate defined as > 40 cpm for children 12–59 months, and >50 cpm for children <12 months.
¶Fever = for follow-up visits denotes fever during the week prior to the visit reported by the caregiver, for baseline denotes temperature ≥37·5°C at enrolment.
††Temperature = measured during follow-up only; OR refers to 1°C rise in temperature.

or more visits, 1·4 (95 % CI 1·1, 1·7) mm in those who missed between 1 and 2 visits and 2·1 (95 % CI 1·8, 2·5) mm in those who never missed a visit.

Discussion

Our study showed that majority of the 174 uncomplicated SAM cases at study sites in AMA defaulted treatment, while only a third were cured. Time to recovery was prolonged for both groups compared with international targets[8]. MUAC below 110 mm was the only baseline predictor of a child defaulting treatment altogether, while diarrhoea and fever were predictors of a child missing a subsequent clinic visit.

Significantly, more boys were enrolled in the PSSAM group. No clear gender predilection has previously been shown for SAM[11–13,23–25]. The median MUAC at enrolment in outpatient treatment was similar for both groups. Poor appetite was a more frequent complaint of caregivers of PUSAM than PSSAM cases, even though all children passed the formal appetite test enabling them to enrol as outpatients. A history of poor appetite could indicate undiagnosed infection[26]. However, there was no correlation between appetite test results and laboratory evidence of infection in a study by Zangenberg *et al.*[27] in Ethiopia and children who failed the test at enrolment had higher weight gain compared with those who passed[27]. Nevertheless, further evidence for possible infection among PUSAM is provided by significantly more PUSAM presenting

Table 3 Factors affecting weekly change in mid-upper arm circumference (MUAC), random effect models

	Weekly change in MUAC (mm)					
	Univariable analysis†			Multivariable analysis‡		
	Mean	95 % CI	*P*	Mean	95 % CI	*P*
Evaluated at baseline						
SAM group						
PSSAM	1·7	1·4, 2·0				
PUSAM	1·4	1·1, 1·6	0·140			
Age group (months)						
6–11	1·4	1·1, 1·7				
12–23	1·6	1·2, 2·0	0·317			
24–59	2·1	1·1, 3·0	0·171			
Gender						
Female	1·4	1·1, 1·7				
Male	1·7	1·3, 2·0	0·165			
No. in household						
<5 people	2·3	1·5, 3·1				
5–6 people	1·5	1·2, 1·8	0·065			
>6 people	1·4	1·0, 1·7	0·034*			
MUAC < 110 mm						
No	1·5	1·2, 1·7				
Yes	1·6	1·2, 2·0	0·688			
Oedema						
No	1·4	1·2, 1·7				
Yes	3·1	2·0, 4·1	0·003**			
Breast-feeding						
No (<24 months)	2·1	1·7, 2·6		2·3	1·8, 2·7	
Yes (<24 months)	1·2	1·0, 1·5	<0·001***	1·3	1·0, 1·5	<0·001**
No (≥24 months)	2·1	1·2, 3·0	0·915	2·0	1·2, 2·9	0·652
Pale conjunctiva						
No	1·6	1·3, 1·8		2·3	1·8, 2·7	
Yes	0·5	–0·5, 1·6	0·053	0·9	0·03, 1·8	0·003**
Enlarged lymph nodes						
No	1·4	1·2, 1·7				
Yes	2·6	0·8, 4·3	0·209			
Chest indrawing						
No	1·5	1·3, 1·8				
Yes	1·2	–0·4, 2·8	0·710			
Any GI symptoms§						
No	1·5	1·3, 1·8				
Yes	1·5	0·7, 2·4	0·963			
Poor appetite‖						
No	1·5	1·3, 1·7				
Yes	1·2	0·5, 1·8	0·352			
Evaluated at baseline and each visit						
Diarrhoea						
No	1·5	1·3, 1·7				
Yes	1·5	0·9, 2·0	0·862			
Vomiting						
No	1·5	1·3, 1·7				
Yes	1·3	0·7, 2·0	0·548			
Cough¶						
No	1·5	1·3, 1·7				
Yes	1·5	1·1, 1·9	0·857			
Skin changes						
No	1·5	1·3, 1·7				
Yes	1·1	0·5, 1·6	0·097			
Increased RR††						
No	1·5	1·3, 1·7				
Yes	1·5	1·3, 1·8	0·444			
Fever‡‡						
No	1·5	1·3, 1·7				
Yes	1·3	0·9, 1·7	0·320			
Any GI symptoms§						
No	1·4	1·2, 1·7				
Yes	1·3	0·9, 1·7	0·385			

SAM, severe acute malnutrition; PSSAM, post-stabilisation uncomplicated severe acute malnutrition; PUSAM, pure uncomplicated severe acute malnutrition; MUAC, mid-upper arm circumference; GI, gastrointestinal; RR, respiratory rate.
Univariable analysis show results for all tested parameter; multivariable analysis only includes independent predictors.
**P* < 0·05, ***P* < 0·01, ****P* < 0·001.
†Model also includes intercept adjustment (main effect) and site.
‡Model also includes intercept adjustment for site, breast-feeding, pale conjunctiva and significant covariates: oedema, number of people in the house, age group and respiratory rate.
§Any GI symptoms = any gastrointestinal symptoms including diarrhoea, vomiting, dehydration, frequent stool at baseline, and diarrhoea, vomiting, dehydration for each visit, as reported by the caregiver.
‖Poor appetite = caregiver's perception of the child's appetite.
¶Cough = symptom noticed by the caregiver during the week prior to the visit.
††Increased RR = increased respiratory rate defined as > 40 cpm for children 12–59 months, and >50 cpm for children <12 months. Breast-feeding only applicable to children < 24 months of age.
‡‡Fever = for follow-up visits denotes fever during the week prior to the visit reported by the caregiver, for baseline denotes temperature ≥37·5°C at enrolment.

with a high respiratory rate and moderate dehydration compared with PSSAM. WHO guidelines recommend that uncomplicated and complicated SAM cases should receive antibiotics[6,8] and studies have shown that antibiotics improve recovery rates and reduce mortality from SAM[28,29]. Failure to treat SAM cases with antibiotics could allow infections to persist. While PSSAM cases would have received antibiotics during inpatient care[6,8], antibiotic administration in PUSAM group depends on its affordability if the child is not covered by the National Health Insurance Scheme or if antibiotics are not provided for free in the care package for outpatients at the study site. Overall, few cases in the present study presented with signs of infection as is expected among children with uncomplicated SAM.

Comparing data from the present study in AMA, within the GAR, with Ghana's regional and national data on CMAM outcomes in 2016, our cure rate of 35 % was about half of the national average of 69·7 %. Defaulters were 56 % of cases which was almost four times the national figure of 14·1 %, and still higher than the 34 % in GAR[14]. Only 8·6 % were non-recovered compared with 14 % nationwide. Furthermore, cure and default rates found in the present study population failed to meet international standards. No recorded deaths among uncomplicated SAM are not unusual because most SAM deaths occur during inpatient care when they are complicated[30,31]. Nevertheless, some children classified as defaulters may have died without these deaths being reported at their treatment centres.

Treatment outcomes in the CMAM programme in other regions or countries in sub-Saharan Africa also do not always meet required targets, but the default rates are lower than in our study. Saaka *et al.*[11] examined all outpatient SAM cases attending Tamale Teaching Hospital in Northern region and cure, default, death rates and referrals to inpatient care were 33·6, 49·1, 0 and 0·3 %, respectively. In Upper East region, out of 488 uncomplicated SAM cases, excluding those referred from inpatient care, 71·8 % were cured, defaulters formed 28·5 % and deaths were 1·6 %[12]. In Nigeria, out of 12 073 uncomplicated SAM children, 58 % were cured, 40 % defaulted and 0·02 % died[10]. In Mali, outcomes for 934 outpatient SAM children met international standards: 82·2 % were cured, 5·5 % defaulted and 0·7 % died[32]. Only 61·7 % of cases recovered in Northern Ethiopia, but mortality and default rates met international standards[16].

Among children discharged cured, mean time to recovery for both PUSAM and PSSAM groups exceeded the average of 6–8 weeks expected for CMAM[8] and was longer than what pertained in several studies[11,12,25,33–36]. Frequent missed visits were a likely contributory factor. PUSAM children were more likely to miss clinic visits than PSSAM which also correlates with PUSAM's significantly smaller weekly increase in MUAC and consequently significantly longer time to recovery (average length of stay) compared with PSSAM. Better adherence to clinic visits among PSSAM cases could have been influenced by the fact that these children had previously been ill, requiring admission and caregivers saw the importance of nutritional rehabilitation to the children's survival. Parents of PUSAM cases referred directly from the community who appear 'well' may not appreciate the importance of adherence, especially if they were not adequately counselled on the condition and the expected duration of treatment.

Indeed, the risk of non-adherence was significantly lowest at Kaneshie Polyclinic. Of the four major facilities for CMAM, Kaneshie had the fewest cases which could have enabled health workers to spend more time counselling caregivers and carry out home visits for cases that missed visits. The negative effect of heavy caseload on performance indicators has been suggested previously[13]. The performance of each facility also depends on resources available to health workers, the level of training, monitoring and supervision that they receive. Quality of care provided has previously been suggested to affect adherence[37]. Wrong caregiver perceptions about treatment of malnutrition could also be a factor[12].

Children presenting with a history of diarrhoea had four times higher odds of missing their next visit than those without diarrhoea, while children who had had a fever had 60 % lower odds compared with children without fever. Parents may take fever as a sign of serious illness for which they must present again to clinic for review. Diarrhoea without severe dehydration may not be recognised as requiring urgent attention. Also, if the caregiver withheld RUTF because of diarrhoea, or the child could not consume the prescribed ration because of the gastrointestinal symptoms, caregivers may opt to postpone the visit until another week.

Our finding that enrolment MUAC below 110 mm was a predictor of a child defaulting CMAM programme agrees with findings from another study[36]. A lower enrolment MUAC implies a longer duration of treatment required to attain recovery. In turn, longer duration of treatment has been shown to be a predictor of default[33] as clinic visits can become burdensome, due to travel costs, distance and poor programme quality[37–39]. Other factors associated with default from previous studies include a rural dwelling, deceased parent[40] and age <2 years[33]. Marasmic children had significantly lower enrolment MUAC compared with oedematous cases, which could have made marasmus a risk factor for default. Because oedematous children started with a larger MUAC, recovery time was shorter as compared with marasmic children. This agrees with reports from several studies of a shorter time to recovery for oedematous children compared with those with marasmus[11,25,34,40] which could link marasmus to default. In Cameroon however, time to recovery was unaffected by presence of oedema[25].

Weekly change in MUAC determines time to cure as the discharge criteria for outpatient care are based on MUAC. However, there is no agreed target for weekly MUAC gain. Performance indicators for CMAM include average daily weight gain[2,8] not weekly MUAC gain. Therefore, most papers report daily weight gain even though it is unclear how helpful this is in determining recovery[41]. Mengesha *et al.*[34] showed that children whose MUAC increased by at least 0·24 mm/d had a greater probability of earlier recovery than those whose MUAC increased by < 0·24 mm/d. In Zambia, children who did not meet the targets for improvement in MUAC and weight were more likely to default and die[40].

The overall mean increase in MUAC of 1·5 mm/week (1·3–1·7) mm in the present study falls within the range previously reported of 1·4–2·8 mm/week[6]. Among children who never missed a visit, and among children under 2 years of age who were not breast-feeding, the mean MUAC increase went up to 2·4 and 2·1 mm/week, respectively. Other studies yielded similar mean increase in MUAC quoted in mm/d[25,34,36]. However, Burrell *et al.*[41] excluded children with kwashiorkor, readmissions and included complicated SAM and estimated a much higher mean (0·7 mm/d).

A small weekly increase in MUAC of 0·9 mm observed among children who had pale conjunctiva at enrolment agrees with other studies showing that anaemia has a negative effect on recovery[42,43]. Thus, Fe supplementation is an important part of CMAM[6,8]. RUTF contains Fe[6], so this finding suggests that either these children were not taking the prescribed amount of RUTF or they require additional Fe supplementation because their baseline Fe stores are lower than other children with SAM. However, since there were only five children with pale conjunctiva, more research is needed.

There is paucity of data on the association between breast-feeding and change in MUAC for children under 2 years of age which is the age group that usually breast-feeds. Few studies exploring the association between breast-feeding and time to recovery from SAM found none[12,35]; however, neither study did a sub-analysis for children under 2 years or explored an association between breast-feeding and gain in MUAC. The small weekly increase in MUAC in breast-feeding children under 2 years of age observed in the present study was unexpected and requires careful consideration. Exclusive breast-feeding is recommended in infants under age 6 months. After age 6 months, breast-feeding without adequate complementary feeding is insufficient to meet the infant's growing needs[44]. Therefore, this finding suggests that adequate complementary feeding was not being practiced, which is one of several suboptimal feeding practices accounting for children developing SAM. Providing RUTF serves as a short-term intervention that lifts the child out of their malnourished state, with the hope that adequate complementary feeding can be established subsequently. Consequently, adequate consumption of RUTF becomes a major determinant of weekly gain in MUAC and factors that interfere with RUTF availability or consumption would adversely affect this.

The non-breast-feeding child probably has limited options for food and will more likely consume the prescribed amount of RUTF, leading to the expected increase in MUAC. On the other hand, breast-feeding children with SAM may not consume enough RUTF due to continued overreliance on breast-feeding by the mother. This scenario can occur when the infant is unwilling to take the full ration because it is less palatable than breast milk. From 6 to 11 months, infants are adjusting to the textures and tastes of complementary foods and RUTF may be less acceptable to them. Infants may also reject RUTF after having to eat it repeatedly, resulting in the frustrated mother reverting to breast-feeding which alone may now be insufficient for the child's growth. Furthermore, sharing RUTF with siblings has previously been hypothesised to account for reduced cure rates[12] and reduced weight gain[25]. Arguably, RUTF will more likely be shared with older siblings of a breast-feeding infant than one who is not breast-feeding because the mother can provide some nutrition to the affected child with breast milk.

Limitations

There are several limitations with this retrospective study design using observational data from treatment cards. Firstly, data are restricted to routinely collected information. Factors such as economic status, parents' educational level, level of counselling on SAM and health system parameters which in principle could have affected adherence to treatment could not be assessed. Data accuracy, consistency and completeness could not be controlled at the data collection stage. It is possible that some patients' treatment cards were missing and therefore their data could not be extracted. Any deaths that may have occurred in the community or at other hospitals were not reported at the CMAM treatment centres which could account for no recorded deaths. Moreover, the research team had no control over how cases were managed which may lead to deviations in evaluation of patient parameters between health workers and sites. However, treatment centres are manned by health workers who are trained in CMAM and expected to follow the CMAM guidelines. Finally, we could not enrol the proposed number of children in the study. This was either because fewer cases than expected accessed treatment at the permanent centres or SAM treatment coverage in AMA was less than predicted. Inclusion of all lower-level community centres would have increased the number of cases and hence the power of the study; however, this was not possible due to limited funding.

Recommendations

A framework of the factors identified that reduced the weekly change in MUAC by reducing RUTF availability

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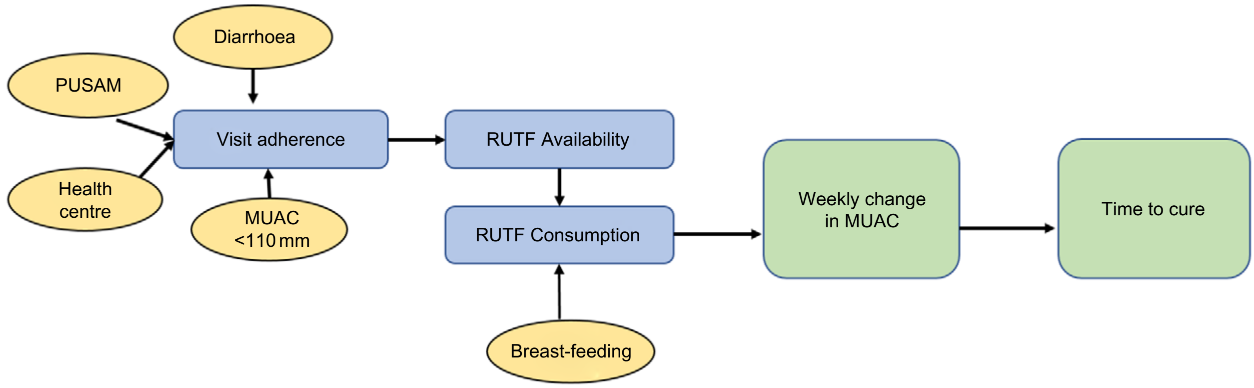

Fig. 3 (colour online) Schematic representation of factors influencing time to cure among children with uncomplicated severe acute malnutrition enrolled in Community-based Management of Acute Malnutrition (CMAM). Blue boxes represent processes during CMAM programme, green boxes represent treatment outcomes and yellow ovals represent patient and health centre factors affecting the CMAM programme participation. PUSAM, pure uncomplicated severe acute malnutrition; MUAC, mid-upper arm circumference; RUTF, ready-to-use therapeutic foods

and consumption, and which resulted in a prolonged time to cure, is constructed as shown in Fig. 3.

Recommendations are targeted at measures to tackle these factors. Active community screening and early referral of SAM cases for treatment would ensure a relatively higher admission MUAC, reducing the time to recovery and lessening the risk of missed visits. Reducing missed visits, especially for PUSAM, involves health workers counselling on the importance of adherence to treatment. Current guidelines recommend home visits if MUAC stagnates for three visits or when 1–3 consecutive visits are missed[8]. However, waiting for three visits may adversely affect time to recovery. Each treatment site requires resources to enable health workers contact caregivers who miss clinic and conduct timely home visits. RUTF could be supplied at home if visits to the centre are becoming burdensome for the caregiver. During home visits, poor acceptance of RUTF can be detected and addressed and counselling on home-based management of diarrhoea and complementary feeding can be reinforced[8]. These interventions require regular training and supervision of health workers. To improve adherence, after reaching a particular MUAC and establishing an acceptable feeding routine, the programme could consider increasing the interval between visits to 2 weeks which was used in some studies[45,46] with enough RUTF to cover the period.

Adherence to protocols for antibiotic administration is important. Further research is required to explore whether there is poor acceptance of RUTF among especially breast-feeding infants. To provide some variety, other locally made therapeutic foods may need to be tested for their efficacy. Further studies are needed to investigate predictors of default and non-recovery, including child neglect or economic factors, and how identifying high-risk children and providing support for their families could improve adherence and outcomes.

Conclusion

The present study shows that uncomplicated SAM cases enrolled in CMAM in Accra have a higher default and a lower cure rate than the international targets. Missed visits as well as probably inadequate consumption of RUTF among breast-feeding children under 24 months led to a reduction in the weekly increase in MUAC. This in turn affected time to recovery. More efforts are therefore needed to improved adherence to treatment.

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to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Ghana Health Service Ethics Review Committee (protocol no. GHS-ERC-011/07/18). Permission to access the secondary data was granted by the Greater Accra Regional Health Directorate of the Ghana Health Service, and the health facilities that served as study sites.

Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980020002463

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