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Outcome and Mortality of Hospitalized children with Severe Acute Malnutrition at Aden, Yemen

Mazin A. Jawass[1*], Randa N. Alwaal[2]

[1]Department of Pediatrics, College of Medicine and Health Sciences, Hadhramout University, Mukalla, Yemen.
[2]Department of Pediatrics, College of Medicine and Health Sciences, University of Aden, Aden, Yemen.

*Corresponding author: dr.mazin.jawass@gmail.com

Abstract: Severe acute malnutrition (SAM) is considered a common cause of morbidity and mortality among children in low- and middle-income countries, being responsible for 45% of deaths among under-five children. The aim of the study was to determine the outcome and mortality of severe acute malnutrition among hospitalized children in Aden, Yemen. This is a descriptive, retrospective study. The studied population includes hospitalized children of both sexes with SAM admitted to the nutritional unit of Al-Sadaka General Teaching Hospital/Aden during the period from January 1st to December 31st 2021. A total of 537 under 5 years, males constitute 53.4% over females 46.6%. In this study, 509 children had a favorable clinical evolution, while 28 deaths were recorded. This corresponds to a mortality rate of 5.2%. The most common cause of death is due to Acute diarrhea in 60.7% of cases .Mortality is higher among males 67.8 % than females and high 85.7% among children < 24 months. Of these 28 deaths, most mortality cases occurred in the non-edematous type of SAM in 89.3% of cases. The most common nutritional feeding formula was F75 in 66.3% of cases. Only 28% of cases achieved target weight; edema had been resolved in 75.8% of cases of edematous SAM at discharge. Severe acute malnutrition remains a severe public health problem, and it mainly affects children under 24 months. A national policy of nutritional intervention should be implemented.

Key words: Aden, Mortality, Outcome, Severe acute malnutrition, Yemen.

1. Introduction

Severe acute malnutrition (SAM) is considered a common cause of morbidity and mortality among children in low- and middle-income countries, responsible for about 45% of deaths among under-five children [1, 2]

Severe acute malnutrition (SAM) is defined as severe wasting and/or bilateral edema [4, 5].

In Africa, severe malnutrition is responsible for 5–15% of deaths in children from zero to 59 months, causing about 1 to 2 million deaths yearly [6].Infants and children under 5 years old with SAM more likely to die than healthier children under 5 years of age. SAM is among the deadliest forms of malnutrition in Low- and middle-income countries [7, 8]. Although of efforts to improve care of children with SAM, hospital mortality remains at 10%– 40% [9]

Yemen is one of worst countries in child malnutrition; it is the first in severe underweight and the second in stunting rate, with increasing death rates amomg malnourished children [10].In a study conducted on SAM children at Aden during the period 2012-2013 a mortality rate of 6.6% was identified [11],while other study at Aden during the period 2015-2016 a mortality rate of 5.4% was identified [12],, other study at Al-Mukalla identified the most common risk factors for SAM poverty, illiterate mothers , lack of exclusive breastfeeding less than 6 months and non-vaccination [13]

Aim of the study is to determine outcome and mortality of SAM among hospitalized children at Aden, Yemen.

2. Patients and methods

This is a descriptive retrospective study. The studied population included all children aged 1–59 months of both sexes admitted to the nutritional rehabilitation Centre at Al-Sadaka General Teaching Hospital/Aden during the study period from January 1st to December 31th 2021. This center is the main referral center for cases of malnutrition in Aden and the neighboring governorates. Source of our data was the admission medical files. Nutritional assessment, presence of any medical illness Cause of death is determined by the pediatric specialists or pediatric residents in duty in the nutritional rehabilitation Centre.

Inclusion Criteria

All under-five children with SAM according to the following diagnostic criteria: [3]

1.Weight-for-height Z-score (WHZ) <−3SD.

2. Bilateral nutritional pitting edema.

3. Middle-upper arm circumstance (MUAC) <115 mm (in children ≥ 6 months).

Exclusion criteria

1. Children outside age limits.
2. Those with non-nutritional cause of edema.
3. Those with non-nutritional causes of wasting and failure to thrive.
4. Unrecorded treatment outcome.
5. Those with incomplete data.

The Z-score was used to differentiate between normal condition and malnutrition. SAM classification was in accordance with the last recommendations of WHO Expert Committee in Malnutrition, and the last WHO growth reference standards were used [14]

Age range of patients was 1-56 months and were divided into two age groups < 24 months and ≥ 24-59 months , with body weight groups < 6.5 kg and ≥ 6.5 kg

Definitions [15, 16]

Discharged cured: weight for height 6-59 months WFH > -2 Z-score, 5-18 years BMI for age > -2 Z-score, or for all ages 2 consecutive weights > -2 Z-score as long as MUAC is > 12.5 cm or 10% weight gain.

Transfer to Outpatient therapeutic program (OTP) or named in some centers as Outpatient therapeutic care (OTC): if condition of the patient has stabilized, child's appetite has returned, the medical complication has resolved and the child referred to outpatient care to continue treatment.

Non-responder: remain for 3 months and not reach target weight gain.

Defaulter: clients missed 2consecutive visits.

DAMA: discharged against medical advice.

Referred (Moved) to other therapeutic feeding center (TFC): refered to other nutritional rehabilitation centers.

Referred to other inpatient care or hospital: if condition of the patient has deteriorated

Discharged died: death of the patient while on the nutritional rehabilitation program.

Ethical consent

This study is reviewed and approved by the Ethical Research Committee at Hadhramout University /College of Medicine.

Statistical methods.

Statistical Package for Social Sciences version 24 (SPSS Inc., Chicago, IL, USA) is used for processing data. Data was expressed in frequency and percentages. Chi square and Fisher Exact test were used. A p-value <0.05 was considered significant.

3. Results

A total of 537 under 5 years (1-56 months) patients were admitted with SAM during the period of study 1st Jan 2021-31th Dec 2021. The mean ± SD age is 11.01 ± 8.44 months. The most common age group affected are < 24months (92%) males constitute 53.4% over females 46.6%, most cases are new admission 91.8%.The non-edematous form of SAM is the major form 94.6% of cases, rest of results are shown in Table 1.

Table 1. Characteristics of patients with SAM admitted to nutritional rehabilitation Centre Aden, Yemen (n= 537)

Variable	Category	Number	Percent
Child age groups (in months)	< 24	494	92
	≥ 24-59	43	8
Sex	Male	287	53.4
	Female	250	46.6
Admission pattern	New	493	91.8
	Re-admission	44	8.2
Body weight range (kg)	< 6.5	455	84.7
	≥ 6.5	82	15.3
Type of SAM	Non-edematous	508	94.6
	Edematous	29	5.4
Children with SAM according to the inclusion criteria †	weight-for-height z-score (WHZ) <−3SD (age 1-59 months)	252	46.9
	MUAC < 11.5 cm (≥ 6–59 months)	256	47.6
	Bilateral nutritional pitting edema	29	5.5
Mean age (month) ±SD	11.01 ± 8.44		
Mean body weight (kg) ±SD	4.97 ± 1.62		
Mean length\ height(cm) ±SD	65.48 ±10.54		
† more than one category may be present at same patient			

Regarding outcome of admitted SAM patients, 40.6% were improved partially (gaining weight but not reach the normal weight) and shifted to outpatient therapeutic program (OTP) , and 27.95 were cured and discharged ,0.4% has no response to treatment,0.4% were shifted to other therapeutic feeding Centre (TFC),7.4% were referred to other hospital,18.1% were discharged against medical advice(DAMA),5.2% were died corresponds to mortality rate of 5.2 % among admitted patients Table 2.

Table 2. Outcome of patients with SAM admitted to nutritional rehabilitation Centre Aden, Yemen (n= 537)

Outcome of patients with SAM admitted to nutritional rehabilitation Centre	Frequency	Percentage
Improved partially and shifted to OTP	218	40.1
Cured and discharged	150	27.6
No response to treatment	2	0.4
Referred to other TFC center	2	0.4
Referred to other hospital	40	7.4
DAMA	97	17.8
Death	28	5.1
OTP: Outpatient Therapeutic Program. TFC: Therapeutic Feeding Centre. DAMA : Discharge Against Medical Advice.		

Most cases of cure are in the group of age < 24 months 26.2% , (141 out of 537 cases), Also most cases of death occurs in this age group 85.7%(24 out of 28) > most of dead cases are males 67.8% (19 male versus 9 females rest of results are shown in Table 3.

The most common cause of death is due to Acute diarrhea and consequently severe dehydrations in 60.7% of cases followed by Acute pneumonia in 21.4% then septicemia\septic shock in 7.1%, unknown in 10.7% of cases Fig. 1.

Table 3. Outcome and characteristics of patients with SAM admitted to nutritional rehabilitation Centre Aden, Yemen (n= 537)

Variable	Category	Outcome							P value *
		shifted to (OTP)	cured	No response	shifted to other TFC	Referred	DAMA	Died	
Age groups months	< 24	195 (36.3%)	141 (26.3 %)	2 (0.37%)	2 (0.37%)	38 (7%)	92 (17.1 %)	24 (4.5 %)	0.407
	≥ 24-59	23 (4.3 %)	9 (1.7%)	-	-	2 (0.37%)	5 (0.93%)	4 (0.74)	
	Total	218 (40.6%)	150 (28%)	2 (0.37%)	2 (0.37%)	40 (7.4%)	97 (18%)	28 (5.2%)	
Sex	Male	123 (23%)	73 (13.6 %)	-	1 (0.18%)	15 (2.8%)	56 (10.4 %)	19 (3.6%)	0.72
	Female	95 (17.7 %)	77 (14.3%)	2 (0.37%)	1 (0.18%)	25 (4.7%)	41 (7.6%)	9 (1.7%)	
	Total	218 (40.6%)	150 (28%)	2 (0.37%)	2 (0.37%)	40 (7.4%)	97 (18%)	28 (5.2%)	
Type of SAM	Non-edematous	205 (38.2%)	143 (26.6 %)	2 (0.37%)	2 (0.37%)	38 (7%)	93 (17.3 %)	25 (4.7 %)	0.882
	Edematous	13 (2.4%)	7 (1,2 %)	-	-	2 (0.37%)	4 (0.74%)	3 (0.53%)	
	Total	218 (40.6%)	150 (28%)	2 (0.37%)	2 (0.37%)	40 (7.4%)	97 (18%)	28 (5.2%)	
Body weight range (kg)	< 6.5	161 (3%)	125 (22 %)	2 (0.37%)	2 (0.37%)	37 (6.9%)	82 (15.3 %)	23 (4.3%)	0.827
	≥ 6.5	57 (%)	25 (4.7 %)	-	-	3 (0.5 %)	15 (2.8%)	5 (0.93%)	
	Total	218 (40.6%)	150 (28%)	2 (0.37%)	2 (0.37%)	40 (7.4%)	97 (18%)	28 (5.2%)	

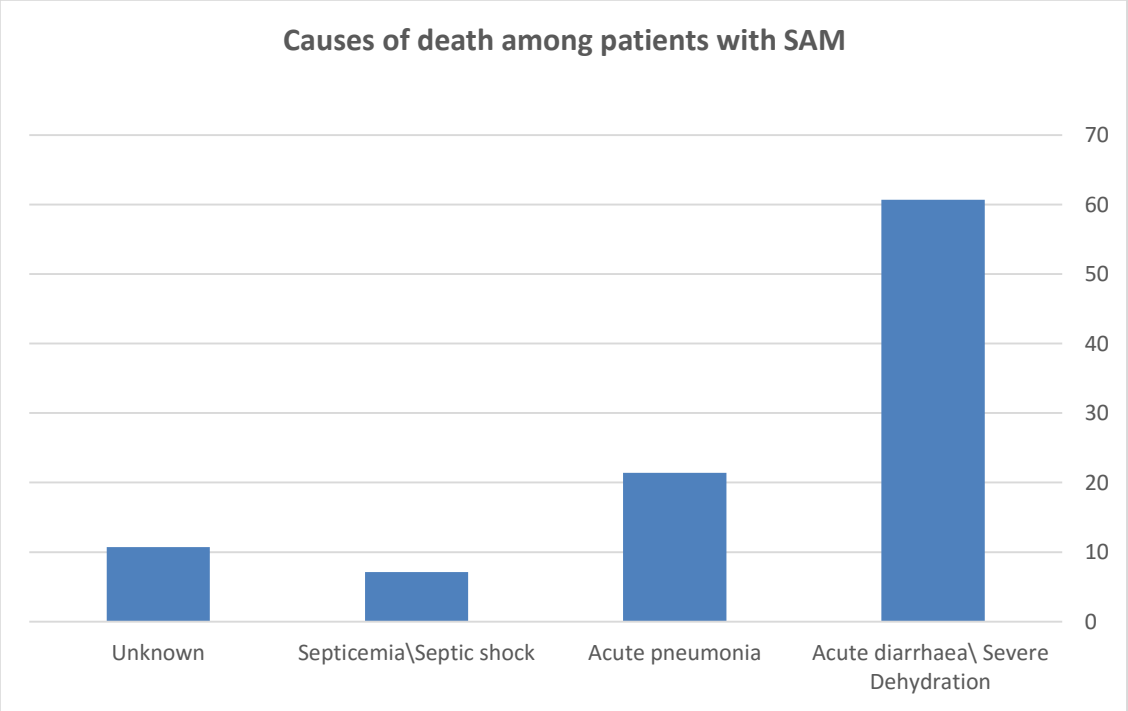

Figure 1. Causes of death among patients with SAM admitted to nutritional rehabilitation Centre Aden, Yemen (n= 28).

Mortality is higher among males than females 67.8%, mortality is high in children < 24 months 85.7%, and mortality is high 82.1in body weight < 6.5 kg, of these 28 deaths, most mortality cases occurs in non-edematous type of SAM in 89.3% of cases than edematous type, presence of associated medical illness acute diarrhea and associated dehydrations along with acute pneumonia carry a significant mortality risk ,this result has high significance (p-value 0.000) , most cases 60.7% of death occurs in patients takes F75 Nutritional formula feeding Table 4.

Table 4. Survival outcome and characteristics of patients with SAM admitted to nutritional rehabilitation Centre Aden, Yemen (n= 537)

Variable	Category	Survival outcome		P-value
		Survival	Death	
Sex	Male	268	19	0.113*
	Female	241	9	
Age group (months)	< 24	470	24	0.162*
	≥ 24-59	39	4	
Body weight range (kg)	< 6.5	432	23	0.391*
	≥ 6.5	77	5	
Type of SAM	Non-edematous	483	25	0.174*
	Edematous	26	3	
Presence of medical illness	Acute diarrhea	412	17	0.000 †
	Acute pneumonia	47	6	
	Malaria	7	-	
	Skin disease	1	-	
	Others	39	4	
	Absence of medical illness	3	1	
Nutritional formula feeding	F-75	339	17	0.122 †
	F-100(diluted)	118	4	
	LF	48	4	
	RUTF	7	-	

F75: Special Therapeutic feeding formula used as starter formula during initial therapy for SAM children contains 75Kcal per 100ml(kilo calori).
F100: Special Therapeutic feeding formula used as catch-up formula to rebuild wasted tissue which used after stabilization on F-75during initial therapy for SAM children contains 100Kcal per 100ml(kilo calori).
LF: Lactose-Free Milk used in patients with transient or permanent lactose intolerance.
RUTF: Ready-To use –Therapeutic-Food used as outpatient food.

Note: †chi-square test *Fisher's exact test.

Majority of death cases occurs in males in 67.9%, most death cases occurs in age group < 24 months in 85.7%, most death cases occurs in body weight < 6.5kg in 82.1%, most mortality occurs in non-edematous type of SAM in 89.3% of cases. Acute diarrhea and Acute pneumonia were associated with most death in 60.7%, 21.4% respectively, most deaths 60.7% were associated with use of nutritional formula feeding F-75, Table 5.

Table 5. Feeding outcome and type of nutritional formula feeding among patients with SAM admitted to nutritional rehabilitation Centre Aden, Yemen (n= 537)

Variable	Category	Number	Percent
Type of Nutritional formula feeding	F-75	356	66.3
	F-100(diluted)	122	22.4
	LF	52	9.6
	RUTF	7	1.3
Weight outcome	Achieved target weight	150	28
	Partial weight gain	218	40.6
	No weight gain	169	31.4
Edema at discharge (no 29)	No	22	75.8
	Yes	7	24.2

4. Discussion

SAM is a particularly important cause of mortality and is responsible for over 500, 000 deaths per year [17].in this study the most common age group affected are < 24 months (92%), similar results are in agree in a previous studies at Aden during the period of study 2012-2013 [11] where 58.0% of the children were under 1 year and 40.8% were between 1-5 years while 1.1% were over than 5 years, another study at Aden during the period of study 2015-2016 [12] where 66.6% of included children with SAM were at age between 6-23 months,also a study conducted at Al-Mukalla concluded that the majority of children with SAM 71% were at age between 6-24 months [13] also in other study at Nigeria where 55.7% of children at age of 6-12 months and 34.9% at age of 13-24 months [18]. The explanation may be partially due to inadequate breast feeding, improper poor feeding and weaning that occurs in this age group as these factors are considered as risk factors of SAM [13].

In this study males constitute 53.4% more than females 46.6% similar finding occurs in other studies where there is male predominance in Aden,Yemen where males constitute 54% versus females 46% [11],also a study Nigeria where 59% were males and 40.1% females 18], while in other study at Al-Mukalla there is slight female predominance 52% females versus 48% males[13]. In this study, the non-edematous form of SAM (marasmus) is the major form corresponds to 94.6% of cases, while the edematous form of SAM which includes Kwashiorkor and Marasmic Kwashiorkor corresponds to 5.4% of cases. This was in an agree with other studies at Aden where non-edematous form of SAM was the most common constitute 94.2% ,75.3% respectively [11,12], and at study at Al-Mukalla 88% [13] and 88.8% at Cameroon [19] while in other study at Zambia was concluded that edematous form of SAM is the most common form in 78.4% [20]. In this study 509 children had survived, while 28 deaths were recorded this corresponds to mortality rate of (5.2%)among admitted patients of SAM under 5 years, this mortality rate in our study was much lower than the acceptable cutoffs for death rate according to the SPHERE Minimum Standards for inpatient care outcome indicators of performance [21].

Two previous studies in Aden, during 2012-2013 and 2015- 2016 found a mortality rate of (6.6%) and (3%) respectively [11,12]; whereas a study in Al-Mukalla the mortality rate was (10%) [13]. Higher rates of death were recorded in Cameroon (15%) [19] and India (16.6%) [19,22].However, the death rate in this study was higher than that in Pradesh, India (2.5%),[23]and New Delhi, India (0.42%) [24].

The explanation for this relatively low mortality rate 5.2% in our study due to improving health facilities and periodical training courses of the working staff at the nutritional rehabilitation center at Aden. Most common cause of death in this study was acute diarrhea and it's complications as severe dehydrations in 60.7% of cases followed by acute pneumonia with respiratory distress in 21.4% then septicemia\septic shock in 7.1%, these results has high significance p-value 0.000 ,Similar findings was found in a previous study in Aden where the most common cause of mortality in SAM children was diarrhea followed by acute bronchopneumonia [12].

In one study it was documented that the most common causes of death were septic shock and respiratory distress [19], while in other study the most common cause of death among SAM patients were respiratory tract conditions such tuberculosis , pneumonia and acute bronchiolitis. Clinical signs of dehydration are confused with those of SAM, and diagnosis of dehydration was made if there was recent fluid loss form diarrhea or vomiting, a change in the eyeballs and thirst [19].

Malnutrition negatively affects the immune status of children and a co-infection which forms with malnutrition a vicious circle of immune-suppression makes patient more vulnerable to opportunistic infections that may be fulminant [20]. About significant percentage of patients, (18.1%) who were discharged against medical advice is due to poverty.

The non -edematous form of SAM was associated with a higher proportion of deaths in 89.3%, similarly recorded in other countries [15, 17], in contrast to other studies where edematous SAM was associated with majority of dead cases [18, 19]

In this study we adapt the most recent classification of discharging patients into several groups [14,15] where among the 368(68.6%) with favorable evolution with 150 cases (28%) of SAM achieve of target weight. while 218 (40.6%) has partial achievement and shifted to the OTP for further nutritional rehabilitation a similar finding was observed in in a

study at Aden [11] where it divides patients to 3 groups a cure group which has body weight gain, DAMA, and dead patient groups ,in the cure group was 79.1%.

5. Conclusions and recommendations

Severe acute malnutrition mainly affects children under 24 months. Mortality rate of 5.2 % among admitted patients. Mortality is higher among males than females 67.8%. Majority of death cases were due to acute diarrhea in 60.7% of cases followed by acute pneumonia in 21.4%. National policy of nutritional intervention should be implemented.

Limitations of our study

Limited diagnostic capabilities and registration systems.

Disclosure. The current study was funded by our charges and there is no conflict of interest.

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نهاية المرض والوفيات في الأطفال المرقدين المصابين بسوء التغذية الحاد الوخيم في عدن -اليمن

مازن أحمد جواس[1] ، رندة ناصر الوعل[2]

الملخص: يعد سوء التغذية الحاد الوخيم من الأسباب الشائعة لحدوث الأمراض والوفيات في البلدان ذات الدخل الضعيف والمتوسط ويعد مسئولاً عن حوالي 45% من حالات الوفيات في الأطفال تحت عمر 5 سنوات. هذه الدراسة هدفها تحديد نهاية المرض والوفيات في الأطفال المرقدين المصابين بسوء التغذية الحاد الوخيم في عدن –اليمن . هي دراسة مبنية على بحث وصفي استرجاعي، وقد شملت الدراسة كل الأطفال المصابين بسوء التغذية الحاد الوخيم من الجنسين المرقدين في وحدة التغذية في مستشفى الصداقة العام التعليمي في عدن خلال المدة من أول شهر يناير إلى 31 ديسمبر عام 2021م. الدراسة شملت 537 من الاطفال أقل من 5 سنوات الأطفال المصابين بسوء التغذية الحاد الوخيم ، شكل الذكور نسبة 53.4% مقابل 46.6% للأناث. في هذه الدراسة كان عدد الوفيات 28 حالة شكلت نسبة وفيات 5.2 % في مقابل 509 حالة تحسنوا إما تحسناً كاملاً أو جزئياً. من ضمن حالات الوفيات كان أكثر سبب للوفاة هو حالات الاسهالات الحادة ومضاعفاتها في 60.7% وكانت الوفيات في ضمن الذكور أكثر بنسبه 67.8% أكثر من الأناث وكانت فئة الأطفال تحت عمر أقل من 24 شهراً هي أكثر فئة تحصل فيها الوفيات، من ضمن حالات الوفيات ال 28 كان أكثر سبب هو نوع غير المتودم من سوء التغذية الحاد الوخيم بنسبة 89.3%. كان أكثر نوع مستخدم من الألبان الخاصة المستخدمة في العلاج الغذائي حالات سوء التغذية الحاد الوخيم في 66.3% من الحالات هو (F75) وبنهاية الترقيد تحسنت 28% من الحالات تحسناً كاملاً ووصلوا إلى الوزن المثالي، واختفى التودم في 75.8% من حالات نوع سوء التغذية الحاد الوخيم المتودم. سوء التغذية الحاد الوخيم يعد مشكلة صحية عامة شديدة وهي تصيب عادة الأطفال تحت عمر أقل من 24 شهراً. يجب تفعيل خطه وسياسة وطنية غذائية لحل مشكلات سوء التغذية في الأطفال.

الكلمات المفتاحية: نهاية المرض – الوفيات –سوء التغذية الحاد الوخيم –عدن –اليمن