

Risk factors of supplementary suckling technique in infants less than 6 months of age with severe acute malnutrition in Yemen and Sudan

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Abstract

Objectives: Supplementary suckling technique (SST) can support and sustain nutritional rehabilitation for catch-up growth. The main aim of this study was to identify the associated risk factors of supplementary suckling technique in infants less than 6 months of age with SAM in Yemen and Sudan.

Methods: This was a prospective hospital-based study among infants less than 6 months of age with SAM who were exposed to supplementary suckling technique, following breastfeeding failure. The study was conducted between January 2018 through December 2020 in both domains.

Results: A total of 145 infants with Severe Acute Malnutrition less than 6 months of age were included in this study. The risk factors that were studied included age, mother's education, income of the families per month, home displacement, war affection and feeding practices. In the current study the mean age of SAM infants was 3.8 months (SD±1.2), the minimum age of 1 month and the maximum of 5.5 month with a range 4.5 months. The mother's education of primary level represented 60(40.7%) while illiterate level constituted 59(41.4%) of them. The income per month of the families was less than 100 US Dollars representing 141(79.3%). Only 44(30.3) of SAM infants were displaced and 46(31.7%) were affected by war. A higher proportion of infants 108(74.5%) were not breastfed at all and 36(24.8%) were on partial breastfeeding and only one (0.7%) SAM infant was exclusively breastfed.

Conclusion: The major risk factors in this study were age between 2-4 months, partial breast-feeding, mother education, income per month of the family, home displacement, war affection and social class.

Keywords: Severe acute malnutrition (SAM); Supplementary suckling technique (SST); Risk factors.

Introduction

Yemen is among the most underdeveloped countries in the Middle East with poor socio-economic indicators and little prospect of achieving any of the Millennium Development Goals with nearly 2.3 million children less than five of age with acute malnutrition in 2021 [1,2]. The nutrition status in Yemen is greater than the emergency thresholds with 58.2% stunting, 41.3 % underweight and 14.3% wasting [3]. Exclusive breastfeeding rates among Yemeni infants less than six months of age was 43%, well below the worldwide rate probably because conflict intensity is negatively associated with breastfeeding incidence [4,5].

The prevalence of malnutrition in Sudan is increased by socioeconomic factor, poor nutrition, mothers' knowledge and feeding practices. Mid Upper Arm Circumference (MUAC) indicates 20.9% of children were badly nourished and 79.1% well nourished. The nutritional status in Sudan was 24.9% stunting, 15.4% underweight, and 21.1% wasting. The better child feeding practices and good maternal education can achieve maintenance of the children's nutritional status [6]. Early supplementation of nutrients especially during the first six month of life by breastfeeding improves neurodevelopment outcome over extended periods of life is advocated for all nutrition programs guidelines [7-9].

Infants less than 6 months of age with severe acute malnutrition need inpatient treatment and follow-up with appropriate supplemental feeds through management protocols with appropriate quantities, routine medical treatment, focus on relactation and exclusive breast feeding [3].

Severe acute malnutrition (SAM) in infants less than 6 months of age are given an important role globally, although inpatient care is considered as the main choice. WHO guidance considers the community-based approach as another option [10]. The management of SAM in different countries as Senegal depend mainly on outpatient and community-based management for children between 6 months and 5 years [11,12]. The introduction of the screening tool (MUAC) to detect acute malnutrition in the community play an important factor in this issue [13,14].

Clinically malnutrition is considered in infants less than 6 months of age [15], while their treatment is not appropriate for outpatient due to the screening method and nutrition supplement [16]. World Health Organization (WHO) treatment guideline for infants less than 6 months with SAM advises (diluted) F-100 milk as a supplement using the supplementary suckling technique for those with no oedema and F-75 for oedematous infants [12]. Exclusive breastfeeding for six months is best everywhere and considered as main important goal for growth and development of infants.

Standard inpatient management of SAM includes initial stabilization to treat life-threatening complications, and nutritional rehabilitation for catch-up growth. Special therapeutic milk based formula F-75 and F-100 contain all the essential Type 1 and Type 2 nutrients required to treat and correct the pathophysiological changes in a child with SAM. In 1994, action against hunger/Action Contre la Faim (ACF) established the use of milk formula F-100 for the treatment of SAM [17].

Supplementary suckling technique (SST) is used in infants less than 6 months of age suffering from

SAM, emphasizing the support and sustain of breastfeeding through counseling and re-establishment of lactation in mothers with lactation failure. The SST is a simple technique theoretically but practically is a challenge to implement it correctly within therapeutic feeding units. It should be worked closely with the mothers to establish their confidence in their ability to improve their breast milk output. Mothers need to understand the technique and time is consumed with listening to and supporting them through this period. The main aim of this study was to identify the associated risk factors of supplementary suckling technique in infants less than 6 months of age with severe acute malnutrition in Aden and Khartoum.

Patients and Methods

This was a prospective hospital-based study among infants less than 6 months of age with SAM, who were exposed to supplementary suckling technique following breastfeeding failure. The study was conducted between January 2018 through December 2020 in both domains. It was conducted in Al-Sadaqa Teaching Hospital, therapeutic feeding center (TFC) in Aden, Yemen and the Pediatric Department at Mohammed Al-Amin Emergency Hospital, Ibrahim Malek Hospital and Ahmed Qasem Hospital, Khartoum, Sudan.

The following formula was used to calculate the sample size $n = z^2 P(1-P)/d^2$

The prevalence of SAM under 6 months of age was calculated based on a hospital study in Aden by Abbas LM, which resulted in 50% (55/110 infants). The CI of 95%, power 80%, and a precision of +10%, was calculated to estimate the required sample size of 139 infants with a maximum sampling error of $\pm 1.3\%$.

A total of 145 SAM infants were included based on the definition of updated WHO criteria for management of SAM in infants and young children [18]. The number of included children from Aden was 108 while those from Khartoum was 37. The inclusion criteria were SAM infants less than 6 month of age due to failure of breastfeeding admitted for feeding in TFCs. They included weight-for-length less than -3 Z-score, or presence of bilateral pitting oedema and all mothers unable to maintain successful breast feeding at admission due to failure of lactation owing to stress of political-conflict.

Infants with known underlying organic diseases as a cause of malnutrition, serious clinical or medical complication, recent weight loss, ineffective feeding (attachment, positioning and suckling) directly observed for 15-20 min, or any social issue requiring intensive support were excluded [18].

Infants were chosen using a computer-generated set of random numbers. A validated questionnaire containing personal and clinical data was filled and labeled with a code number.

All infants were exposed to a full history, physical examination, assessed and evaluated clinically. Data of the main socio-demographic characteristics and clinical attributers were recorded using a data collection sheet.

The infants were weighed to the nearest decimal point on daily basis using a beam balance scale. Length was initially measured and then every five days using locally-made measuring board. Bilateral pit-

ting edema was confirmed by pressing on the dorsum of lower limbs.

Supplementary suckling technique was used in the management of SAM infants with supplementary feeding formulas Diluted F feeding (DF100), a milk formula with higher protein and energy content with a cup for those with no oedema, while those with oedema were fed on feeding formula F-75, a low-protein milk-based formula diet. All mothers were counseled about breastfeeding attachment and positioning based on WHO guidelines [19]. Mothers were trained on the use of SST in TFC. Nasogastric tube size 8 was used for feeding. The tip of the tube was cut about 1 cm and the end of the tube was put in a cup with supplementary diluted F-100 or F-75. The tip of the tube adhered to the nipple was put inside the angle of the infant's mouth during breastfeeding. The cup was initially put 5-10 cm below the breast, while the child was breastfeeding, the milk from the cup was sucked up through the tube and was taken by the infant initially. The cup was then gradually lowered to approximately 30 cm below the level of the breast so that the milk did not flow too quickly. The volume of F100D in the cup was gradually reduced when the infant gained weight for 2-3 days (at least 20 g per day), was free from illness and breast milk flow was evident. Then supplementary cup milk (F100D) was reduced by one third and mother continued breastfeeding for 2 or 3 days. When the weight continued to rise, the amount of supplementary milk (F100D) was reduced until no longer needed and the infant gained weight from exclusive breastfeeding without any milk. If weight gain was not satisfactory during volume reduction then the policy was to increase to previous volume level for next 2 days, with successive repeat trial.

Four infants developed signs of pneumonia, three had gastroenteritis and sepsis, who were all consequently transferred to inpatient care at TFC but succumbed thereafter. An infant was discharged if he/she was gaining adequate weight on isolated breastfeeding to be followed in the nutritional units at health centers.

The outcome variables denoted that that infant was cured, died, defaulter or in non-recovery state. Cured denoted an infant gaining adequate weight on breastfeeding at the time of discharge. The standard indices of nutritional status of children were weight, length, weight-for-length Z score (WLZ) and weight-for-age Z score. Indicators were expressed as Z scores in standard deviation (SD) from the median reference population as stated by WHO multicenter growth reference [20].

Ethical approval obtained from Ministry of Public Health, Yemen and Federal Health Ministry in Sudan. Mothers agreed to participate after signing an informed consent form.

Data analysis performed using Statistical Package for Social Science SPSS Version 24. Test of normality (Shapiro-Wilk), with parametric and nonparametric tests, mean (SD) or median interquartile range (IQR), paired student t test or Wilcoxon test, Chi-square test were used when appropriate. A binary logistic regression model and Odd ratio (OR) with 95% CI was also used. A p value <0.05 was considered statistically significant.

Results

A total of 145 infants with SAM less than 6 months of age were included in this study. The mean age was 3.8 months (SD±1.2), minimum 1 and maximum 5.5 month with range 4.5 months. The higher proportion of SAM infants 97(66.9%) were in age group 2-4 months. Male infants represented 58.6% (85) forming male to female ratio of 1.42:1. A higher proportion 55.2% of malnourished infants were from other governorates while 19.3% from Aden. Infants residing in and out of Khartoum city comprised 20.7% and 4.8% respectively (Table 1).

About 97(66.9%) of SAM infants of both sexes were in age group 2-4 months and 72.4% aged less or equal to 4 months (Table 2). Regarding breastfeeding, a higher proportion 108(74.5%) were not breastfed at all, followed by 36(24.8%) was partial breastfeeding and only one (0.7%) SAM infant was exclusively breastfed (Table 3).

The primary school level of father's and mother's education represented 72(49.7%) and 60(40.7%) respectively. The fathers' private work comprised 108(74.5%) while housewife mothers 115(96.7%). Around 143(98.6%) of mothers were married. The family income per month was less than 100 US Dollars in 141(79.3%). Only 44(30.3%) of SAM infants were displaced and 46(31.7%) affected by war. Around 89 (61.4%) of SAM infants showed a satisfactory social level (Table 4).

History of twin births was documented in 12.4% of SAM infants. The mean weight of infants before intervention was 3±0.8 kg, which showed an increase to 3.4±0.9 kg after SST feeding, with a significant difference (0.001). The mean weight differences within their age groups before and after SST intervention was significant (0.001) (Table 5). Feeding by SST with D F-100 and F-75 documented a total cure rate of SAM infants in (81.4%), and fatality rate of (6.9%). A higher proportion of SAM infants (63.4%) had a hospital stay for 1-2 weeks and cure rate (68.9%) at 2-4 months age and (81.2%) with a hospital stay of <1 week of SST feeding. Only 4 SAM infants of age 2-4 months died with a hospital stay of <1 week and 4 died between 1-2 weeks among >4 and <6 months' age. A statistical relationship was observed between duration stay and outcome of SST among 6 months SAM infants (P=0.005) (Table 6).

Table 1: Demographic characteristics of the study group using SAM.

Demographic characteristics	Number (n = 145)	Percentage (100%)
Sex		
Male	85	58.6
Female	60	41.4
Residence		
Aden	28	19.3
Out of Aden	80	55.2
Khartoum	30	20.7
Out of Khartoum	7	4.8

Table 2: Demographic characteristics of the study group using SAM.

Age categories (Months)	Male	Female	No.	%
<2	7	1	8	5.5
2-4	59	38	97	66.9
>4-<6	19	21	40	27.6
Total	85	60	145	100.0

Table 3: Distribution of study group using SST by feeding type.

Type of feeding	Number	Percent
Breastfeeding		
Partial	36	24.8
Not Breastfed	108	74.5
Exclusive	1	0.7

Table 4: Distribution of study group using SST feeding by social variables.

Item	Number (n=145)	Percent (%)
Father Education		
Illiterate	30	20.7
Primary school	72	49.7
Secondary school	34	23.4
University	9	6.2
Mother Education		
Illiterate	60	41.4
Primary school	59	40.7
Secondary school	21	14.5
University	5	3.4
Father Occupation		
Governmental	13	9.0
Private	108	74.5
Military	24	16.6
Mother Occupation		
Governmental	3	2.1
Private	2	1.4
Military	0	0.0
Housewife	140	96.6
Marital status		
Married	143	98.6
Divorced	1	0.7
Others	1	0.7
Income per month		
<100\$	115	79.3
100-200\$	18	12.4
>200\$	12	8.3
Catastrophe		
Yes	9	6.2
No	136	93.8
Home Displacement		
Yes	44	30.3
No	101	69.7
War affection		
Yes	46	31.7
No	49	68.3
Social class		
Very poor	27	18.6
Poor	26	17.9
Satisfactory	89	61.4
Very good	3	2.1

Table 5: Comparison of study group by age group and weight before and after using SST.

Age group (months)			Weight (kg)				P value
			Before		After		
	No.	%	Mean	SD	Mean	SD	
<2	8	5.5	2.6	0.5	2.9	0.6	0.001*
2-4	97	66.9	2.8	0.7	3.3	0.9	
>4-<6	40	27.6	3.7	0.8	4.0	0.8	
Total	145	100.0	3.0	0.8	3.4	0.9	-

Student T test done and showed (P=0.001).

Table 6: Distribution of infants using F100D by SST by age, duration of stay, and outcome.

Outcome of SST	Age group (months)	Hospital duration (weeks)						Total	
		<1week		1-2 week		>2 week			
		No.	%	No.	%	No.	%	No.	%
Cure	<2	0	0	6	7.5	0	0	6	5
	4-Feb	13	81.2	54	67.5	15	65.2	82	68.9
	>4-<6	3	18.8	20	25	8	34.8	31	26.1
	Subtotal	16	100	80	100	23	100	119	100
Defaulted	<2	0	0.0	0	0.0	1	100	1	6.7
	4-Feb	5	62.5	4	66.7	0.0	0.0	9	60
	>4-<6	3	37.5	2	33.3	0.0	0.0	5	33.3
	Subtotal	8	100	6	100	1	100	15	100
Non-response	<2	0	0	1	100	0	0.0	1	50
	4-Feb	1	100	0	0	0	0.0	1	50
	>4-<6	0	0	0	0	0	0.0	0	0.0
	Subtotal	1	100	1	100	0	0.0	2	100
Died	<2	0	0	0	0	0	0.0	0	0.0
	4-Feb	4	100	1	20	0	0.0	5	55.6
	>4-<6	0	0	4	80	0	0.0	4	44.4
	Subtotal	4	100	5	100	0	0.0	9	100
Total	-	29	20.0	92	63.4	24	16.6	145	100

Total Percentage calculated by row. Chi-Square test, P=0.005

Discussion

Severe acute malnutrition is considered a critical nutritional problem in Yemen and Sudan especially with the current situations affecting economy, health and security. Severely malnourished infants less than 6 months are a common problem and often associated with fatal outcome. It is worth mentioning that to the best of our knowledge, there were no similar studies conducted on supplementary suckling technique in infants less than 6 months of age with SAM in Yemen and Arab Countries.

In this study the mean age of SAM infants of both sexes was 3.4 months ($SD\pm 1.2$) which was comparable to report of Oberlin O et al. of 4 months [21], but higher than Singh DK et al. of 2.5 months ($SD\pm 1.3$) [22]. This clearly indicates that the early detection of SAM in different literature reviews require prompt intervention with SST.

The male infants (58.6%) predominated females with twin births comprising 12.4% coinciding with Oberlin O et al, males (63%) and twin birth of 17% infants [21]. In most Arab countries, due to the local traditions, male sex is overprotected and their parents usually seek immediate medical advice [23].

Exclusively breastfed infants," means feeding baby with only breast milk, not any other foods or liquids (including infant formula or water), except for medications or vitamin and mineral supplements. In this study only 0.7% of infants were exclusively breastfed comparably lower to Vygen SB et al. reporting 3% [24]. Around 74.5% of Yemeni infants were not breastfed showing a higher percentage than Singh DK et al. (45%) [25]. The majority of Yemeni mothers who did not breastfeed their babies verbally explained having insufficient milk expression with a feeling of not satisfying their babies feeds. This could also be because some mothers satisfy their feeding patterns with artificial milk formulas for ease of performance and their continuous busy interaction with the social medias.

Concerning the education level, the illiterate mothers comprised 41.4%, which was lower than that in Senegal of 64%, [26] and the housewives was 96.6% comparably higher than 80.7% by Gobre et al. [27]. Although a higher proportion of Yemeni mothers were educated, but opportunity of getting jobs was far less than their partners explaining high percentage of housewives. Around 98.6% were married mothers with monthly family income less than 100 US Dollars 141(79.3%) comparable to other studies [27]. The low income of Yemeni families is due to the instability of current poor economic circumstances in the country.

There was a high cure rate of 81.4% SAM infants feeding on SST with a low case fatality rate of 6.9% with no difference from literature reports [27]. In Niger, the failure rate was much higher but mortality lower (6%) [24]. Mothers usually try to seek early medical information on the practice of infant's nutrition when they did not satisfy need for breast feeding due to improper practice.

It was quite difficult to find a comparable result of SST feeding due to the lack of literature [25,29, 30]. The noticeable response in SAM infants was probably due to the relatively safe hospital environment, hence early production of breast milk. Re-lactation was found to be associated with the infants' age; where the younger the infant's age at time of intervention the better was the re-lactation achievement [31]. Long duration of treatment might possibly establish better and independent breastfeeding. Human breast milk is the best source of nutrients enhancing immunity, protecting the baby from many illnesses, hence healthy growth and development [32].

In this study, the higher proportion of SAM infants (66.9%) were between 2-4 months. The mean weight of infants before intervention was 3 kg that gradually increased to 3.4 kg after SST feeding showing a significant difference (0.001). Moreover, the mean weight difference of SAM infants within age groups be-

fore and after intervention showed a significant difference (0.001). This weight gain of these infants fed on SST may be explained by the fact that these mothers received good encouragement with sufficient health education. The health professionals gave continuous support providing the advantages of breast-feeding in a friendly atmosphere with mothers happy to restart on breastfeeding after a short cessation.

The current findings revealed a higher proportion of SAM infants (63.4%) with a hospital stay for 1-2 weeks, while in age groups <1 week, and >2 weeks were 20% and 16.6% respectively. There is a great likelihood that mothers' response to SST was good requiring a hospital stay of less than a fortnight for accepting this simple technique.

The cure rate in SAM infants was (68.9%) among 2-4 months age where (81.2%) showed a hospital stay less than 1 week of SST feeding. In contrast, the death rate was (55.6%) with (44.4%) of SAM infants among 2-4 months and >4 and <6 months respectively. All SAM infants died with a hospital duration <1 week among 2-4 months age, and (80.0%) died between 1-2 weeks among >4 and <6 months age. This result indicated a significant relationship between hospital stay duration and outcome of SST among SAM infants <6 months of age ($P=0.005$). It is most probable that their condition on admission was relatively unstable due to their SAM exposing them to a poor prognosis with fatal outcome.

The major risk factors in this study were age between 2-4 months, partial breastfed, mother's education, family income per month, home displacement, war affection and social class. Improving breast-feeding practices are needed because most mothers although aware of the importance of breastfeeding were unable to practice it well. Severe acute malnutrition in infants less than 6 months can be managed successfully as inpatients with an adopted protocol. In this study infants less than 6 months of age showed a high risk to develop SAM due to the fact of not being breastfed; therefore, it is important to emphasize on exclusive breast-feeding which is a good source of nutrition and protection against SAM. Furthermore, it is essential to reinitiate breast feeding in mothers who stopped it by supporting and educating them on this new supplementary suckling technique considered an intervention to manage SAM by trained health workers.

Limitation of the study was principally in follow up of infants after discharge from therapeutic feeding center as they will continue follow up in outpatient therapeutic center in the district with all expected difficulties because of safety issues and displacement.

Conclusion

The major risk factors in this study were age between 2-4 months, partial breast-feeding, mother education, income per month of the family, home displacement, war affection and social class. Supplementary suckling technique provides the SAM infant less than 6 months with therapeutic milk in order to initiate rehabilitation and re-establish exclusive breastfeeding through stimulating re-lactation. SAM infants less than 6 months ago with DF100 and F-75 feeding using SST have shown marked improvement in their weight gain. Improving and focusing on continuous breastfeeding practices effectively are highly recommended.

Advances in knowledge

- 1) Infants less than 6 months of age grow and develop rapidly and are at risk to develop severe acute malnutrition (SAM) having direct results in terms of morbidity and mortality.
- 2) Due to many problems, which may occur in this age, it is important to emphasize on exclusive breastfeeding as it provides good nutrition with protection against SAM.
- 3) Mothers who stopped breast-feeding due to any cause are capable to reinstate breast-feeding if provided with good support and education. One of the new techniques to reinstate breast-feeding is supplementary suckling technique considered an intervention to manage SAM.
- 4) This reintroduction of breast-feeding is probable when the mother gets enough support with good motivation from trained health workers.

Application to patient care

- 1) Supplementary suckling technique (SST) is a new standard of care in inpatient setting that is easy to apply and manage failure of breast-feeding and increase the milk secretion in mothers who have discontinued lactation.
- 2) Supplementary suckling technique provides SAM infant with beneficial milk that helps increase satisfactory weight and considered a treatment for them. This SST feeding is of great benefit especially in war-conflict settings.
- 3) It needs good knowledge and clinical skills by staff to restore possible breast-feeding in these mothers. It is considered a challenge that requires motivation of mothers and trained staff to be involved in this counseling.

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