

Feeding Pattern of Malnourished Infants <6 Months of Age and Their Response to Treatment Using Diluted F-100 Formula

Hajer Fadlalla Ali¹, Ali Arabi^{2,*}, Jalal Ali Bilal³

¹Federal Ministry of Health, Sudan

²Paediatrics Department, Faculty of Medicine, University of Khartoum, Sudan

³Pediatrics Department, College of Medicine, Qassim University, Kingdom of Saudi Arabia

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Abstract Severe acute malnutrition is associated with mortality in young infants. Associated risk factors and management were not well addressed. The aims of this study were to identify factors associated with severe acute malnutrition in children < 6 months of age and to evaluate the outcome of treatment after feeding them diluted therapeutic formula milk (F-100) along with breast-feeding. This interventional hospital-based study was conducted at 2 major children hospitals in Khartoum during the period between September 2011 and January 2014 among malnourished children less than 6 month of age. Infants' demographic, clinical and anthropometric measurements were recorded and then received routine medications and breastfeeding and/or 130ml/kg/day diluted F100 formula for 5 consecutive days and weight gain was recorded. All recruited infants (N=83) received diluted F-100 with breast milk. They had a mean±SD age of 3.8±5.8 months. The male to female a ratio was 1.3. The majority was from poor socioeconomic background and most mothers were below 40 years of age. Only 36 (43.3%) were exclusively breastfed and 37 (44.6%) of infants fed on food other than milk. Following feeding for 5 days, 76 out of 83 (91.6%) malnourished under the age of 6 months infants were discharged with adequate weight gain, 5 (6%) prematurely left the hospital and thus the study, 2 (2.4%) were defaulters and there was no deaths. Infants <6 months of age with severe acute malnutrition were mostly from poor backgrounds and developed malnutrition despite breast-feeding. Diluted F-100 formula was beneficial in treatment along with breastfeeding.

Keywords Feeding Pattern, Malnourished Infants, Breast-feeding, Nutritional Treatment

1. Introduction

Protein energy malnutrition accounts for 1.4 % burden of disease estimated at 2.45 billion disability adjusted life years (DALYs) (1). Acute malnutrition defined as wasting i.e. low weight-for-length; and/or low mid-upper arm circumference; and/or edema is of paramount importance as of its high case fatality rate (2). Twenty million children under 5 years of age have severe acute malnutrition (SAM) worldwide. Out of them, 3.8 million are infants (3). SAM is frequently associated with greater mortality in young infants than in older children (4). In Sudan the national rate of malnutrition is 14.8% just below the internationally recognized thresholds for nutrition emergency (15%), 31% of children below the age of 5 years are under weight, and 32.5% are stunted (5). Studies, which examined the risk factors for young infants with severe acute malnutrition, are scant; comparably, there are few reports defining approaches of management of severe acute malnutrition among this age group (6). Similarly the guidelines of treatment in the program of Integrated Management of Childhood Illness (IMCI), a widely adopted guideline in African health facilities, is deficient of details of management of SAM in infants below 6 months of age (7). The aims of this study were to identify factors associated with severe acute malnutrition in children under the age of 6 months and to evaluate the outcome of treatment of these children after feeding them diluted therapeutic formula milk (F100) along with breast-feeding.

2. Patients and Method

This interventional hospital-based study was conducted at Gaffer Ibn Auf Specialized Children Hospital (GSCH) and Omdurman Pediatric Hospital (OPH) in the period between September 2011 and January 2014 among malnourished children less than 6 month of age.

All malnourished children below 6 month of age who attended these two hospitals during the study period were admitted and included in the study unless otherwise refused

enrollment. A child was included in this study if he/she was less than 6 months with a weight-for-length <-3 z score of the median weight for length according to the WHO medians for age.

Exclusion criteria were any infant who had normal growth (normal weight, normal length), an infant's parents/caregiver who refused to participate in the study and those who discharged themselves from hospital before the end of the study and an infant with a chronic disease or disability that affected the infant's ability to suckle, assimilate or swallow food, and /or a developmental/psychomotor problem affecting infant feeding.

Upon admission, two examiners measured the length to the nearest millimeter, using a wooden infantometer for 1 day to 6 months, from the top of the head to the sole of the foot with the infant lying on the back with hips and knees extended. Weight was measured to the nearest decimal gram using a hanging spring scale. Measures were plotted the (WHO growth standards) Weight-for-Length Reference Card, to classify the nutritional status of the infants. Children were then put on routine medications (Vitamin A, folic acid, and antibiotics), as needed according to the hospital guidelines. The aim of the nutritional treatment was to support breastfeeding and to stimulate breast milk production. Breast milk production was stimulated wherever possible, in association with the supplemental milk. Mothers were encouraged to breastfeed as often as possible. Infants were initially fed 130ml/kg/day diluted F100 formula if not breastfeeding adequately. The milk supplement was decreased to half when the infant was gaining at least 20g/day for 3 consecutive days and was completely stopped when the infant maintained 10g/day weight gain. The infant was discharged when weight gain continued at 10g/day for at least 3 but up to 5 consecutive days. Five days were the preferred observation period to evaluate weight gain on breast milk alone, however many mothers found it difficult to continue in the hospital once the infant was no longer getting supplemental milk.

A pretested validated questionnaire was used to collect infants' information. These included personal data, gestational age, birth weight, pregnancy and delivery problems, parent education, breast-feeding practices, other food, relevant family history, anthropometric measurements on admission and discharge, signs on admission, date of admission to hospital, date of discharge and number of feed/day.

The rate of weight gain of every infant was calculated as follows:

1. The child's weight in the previous day (W1) was subtracted from the child's weight on the next day (W2). This was done even if the child had lost weight. The difference expressed as grams ($\text{kg} \times 1,000$) was the total amount of weight gained during the day.

$$W2 - W1 = \text{___ kg}$$

$$\text{___ kg} \times 1,000 = \text{___ grams gained}$$

2. Grams gained (from step 'a') were divided by the child's weight in the previous day. The result was the weight gain in g/kg/day.

$$\text{Weight gain in grams} \div W1 = \text{___ g/kg/day}$$

The 'weight gain' for a particular day would be negative if the child had lost weight during the previous day. If the weight gain was positive then the infant would be labelled as adequately gaining weight.

The results of this study including nutritional assessment, problems and intervention were summarized and handed to the treating doctors for further management.

Ethical Issues

All parents or caregivers signed a written informed consent to participate in the study. The Pediatric Board, Sudan Medical Specialization Board, approved this study and the hospitals administrators provided written approval.

Data Handling

Data were collected, double entered and checked by trained personnel and then analyzed using SPSS version 17. Frequencies and percentages were inferred; mean and standard deviation were calculated for quantitative variables.

3. Results

A total of 83 malnourished infants were recruited into the study; all received standard therapy (diluted F-100). The majority (76, 91.6%) of malnourished infants were 4-6 months of age with a mean \pm SD age of 3.8 \pm 5.8 months, a median and a mode of 5 months. Table 1 summarizes the different age categories of the studied infant cohort. Males {47 (56.6%)} outnumbered females {36 (43.4%)} with a ratio of 1.3. Eighty (96.4%) of them were delivered normally at term and most of them had normal birth weight (figure 1). The majority was from poor socioeconomic background living in crowded houses however most mothers were below 40 years of age and housewives of whom the majority had no diseases during pregnancy. Most of the infants were immunized (table 1).

Table 1. Age categories of malnourished infants

Age (months)	Frequency (%)
<2	7 (8.4%)
2-<4	36 (43.4%)
4-6	40 (48.2%)
Total	83 (100%)

36 (43.3%) were exclusively breastfed and 35 (42.2%) were bottle-fed and the majority of mothers had adequate knowledge of the correct breast-feeding practices. A considerable number (37, 44.6%) of infants fed on food other than milk mostly juice, pudding, tea and other local

fluids. However, mothers reported adequate number of feeding/day for infants. The rate of exclusive breastfeeding for 6 months, in this cohort, was low for only a little above third of infants were so (Table 2).

Table 2. Family and household characteristics and immunization status of malnourished infants below the age of 6 months

Variable	Category	Frequency	%
Socioeconomic condition	Poor	48	57.83
	Moderate	35	42.2
Crowded housing	Yes	46	55.4
	No	37	44.6
Mother status of work	Housewife	74	89.
	Other	9	10.8
Maternal disease during pregnancy	No	71	86.5
	Yes	12	14.5
Maternal age (years)	20-30	43	63.9
	30-40	29	34.9
	>40	1	1.2
Infants immunized up-to-date		60	72.3

Table 3. Malnourished infants type of feeding and feeding practices

Variable	Category	Frequency	%
Type of infant feeding	Exclusive breast feeding	36	43.4
	Both breast and bottle	35	42.2
	Only bottle	12	14.4
Mothers Knew the right technique of breastfeeding		76	91.6
Infants feeding on food other than milk		37	44.6
Number of feedings/day	5-7/day	16	19.3
	9-10/day	67	80.7
Infants fed on exclusive breast feeding	Yes	30	36
	No	53	64

Sixty-two (74.7%) infants received 6 supplemental milk (diluted F100) feeds/day in addition to breast-feeding and the remaining 21(25.3%) received 4 feeds/day.

Following encouragement of breast feeding and/or feeding on diluted F-100 formula for 5 days, 76 out of 83 (91.6%) malnourished under the age of 6 months infants were discharged with adequate weight gain, 5 (6%) prematurely left the hospital and thus the study, 2 (2.4%) were defaulters however, there was no deaths i.e. a zero case fatality (figure 2).

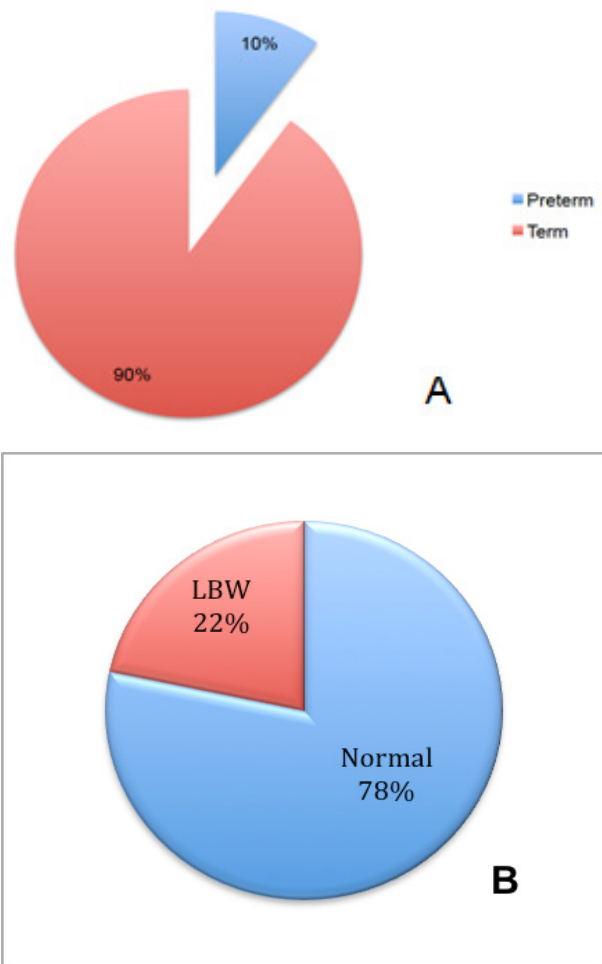


Figure 1. Distribution of the malnourished infants below 6 months of age (N=83) according to preterm delivery A and birth weight B

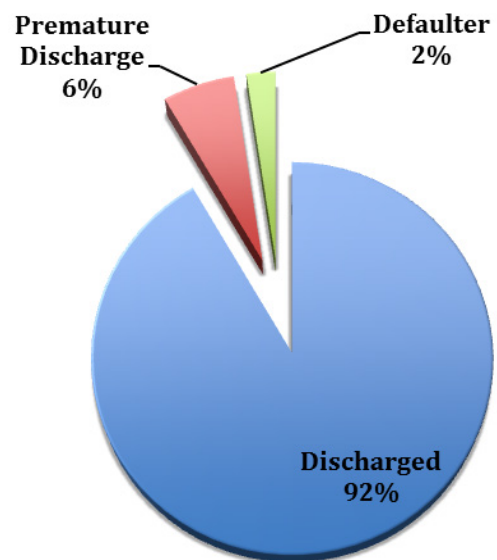


Figure 2. The outcome of malnourished infants below 6 months of age (N=83) after administering breastfeeding and/or diluted f-100 formula

4. Discussion

Despite numerous limitations, this study is one of the few of its type and an initial one in this country. The main findings were that most infants were born at full term and normal birth weight to relatively young apparently healthy mothers; they were from poor socioeconomic background living in crowded houses. The rate of exclusive breast-feeding for 6 months was low and most fed on foods other than milk. The increase of weight was significant in response to encouragement of breast feeding and/or diluted F-100 formula with no reported mortality.

The low socioeconomic status was reported, though among variable age groups, to be associated with inadequate nutrient intake and adversely leading to overweight later on as well as substandard housing (8-10). In this study most of malnourished were of low socioeconomic condition and substandard housing. The fact that the majority of them were delivered at term and of normal birth weight rendered intrauterine cause of under nutrition unlikely nevertheless intrauterine causes were not sought in this study; a clear limitation. Moreover, being selected from hospital population, generalization of the results of this cohort may not be valid hence a community survey will be more yielding.

Breastfeeding is a custom in Sudan. Nevertheless, the rate of exclusive breast-feeding in this cohort was low despite reasonable technique and frequency of feeding. Exclusive breastfeeding for 6 months was reported to be not absolutely protective against nutritional deficiencies where severe wasting was recorded in 12.7% of exclusively breastfed Indian infants (11).

The response of malnourished infants to feeding in this study is guarded since it lacked control and hence numerous confounders could not be excluded. However, it can be considered as a preliminary result inviting large scale well-constructed surveys and highlighting research priorities in this age group. That is because no published studies investigating feeding approaches of severe acute malnutrition in infants less than 6 months of age were found until 2013 (6). The feeding administered in this cohort was stabilization feeding for a maximum of 5 days; the rehabilitation phase was not part of this study. The responders' proportion in this cohort (92%) is higher than the 85% ratio reported by Vygen et al in a study among malnourished infants in Niger (12). However their mean±SD duration of therapy (13±6.9) was longer than in this study. The short duration of follow-up in this study might overestimate the percentage of responders. This might also explain the zero mortality as well compared to the 6% of the rate in Niger and also the low defaulters in this study. Moreover, Vygen et al administered 3 different modalities of treatment including a new protocol. The successful response to F-100 was documented in their study as well (12). Wilkinson et al. however, found no differences in treatment outcomes between the diluted F-100 formula and the standard formula for children 6-59 months; though,

their sample size was too small to fulfill poised conclusions (13).

The main limitations of this study in addition to the already mentioned ones are the small sample and many variables, which might enrich the findings, were not included. The causes and factors leading to acute malnutrition in the age need extensive investigation.

In conclusion infants <6 months of age with severe acute malnutrition were mostly from poor backgrounds and developed malnutrition despite breast feeding. Diluted F-100 formula was beneficial in treatment along with breastfeeding.

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Conflict of interest

None

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