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

Hajer Fadlalla Ali1, Ali Arabi2,*, 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

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%) 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

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 130 ml/kg/day diluted F100 formula if not breastfeeding adequately. The milk supplement was decreased to half when the infant was gaining at least 20 g/day for 3 consecutive days and was completely stopped when the infant maintained 10 g/day for at least 3 but up to 5 consecutive months of age with a mean±SD age of 3.8±5.8 months, a majority (76, 91.6%) of malnourished infants were 4-6 months of age (table 1) 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).

### 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±SD age of 3.8±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).
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 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.

Acknowledgements

The authors would like to thank all children and mothers who participated in this study. Sincere appreciation goes to the staff of doctors, nurses and nutrition departments of the two hospitals.

Conflict of interest

None

REFERENCES

[1] Murray CJL, Lozano VT, Naghvi M, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990—2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet. 2011; 380(9859): 2197–2223.

[2] Heikens GT, Bunn J, Amadi B, Manary M, Chhagan M, Berkley JA, Rollins N, Kelly P, Adamczick C, Maitland K, Tomkins A. Case management of HIV-infected severely malnourished children: challenges in the area of highest prevalence. Lancet. 2008 Apr 12; 371(9620):1305-7.

[3] Centre for International Health & Development, University College London, United Kingdom, Washington University in the St Louis School of Medicine, United States, University of Malawi College of Medicine, Malawi, KEMRI/Wellcome Trust Research Programme, Kenya. Inpatient treatment of severe acute malnutrition in infants aged < 6 months. WHO publications. Geneva, Switzerland: World Health Organization; 2012. Available at: http://www.who.int/nutrition/publications/guidelines/updates_management_SAM_infantandchildren_review9.pdf.

[4] Briend A, Maire B, Fontaine O, Garenne M. Mid-upper arm circumference and weight-for-height to identify high-risk malnourished under-five children. Matern. Child Nutr. 2012; 8: 130–3.

[5] Sudan household health survey, 2006, review of Millennium Developmental Goals for health: nutrition and population, Republic of Sudan 2003; Sudan health strategy 2007-2011; FAO/WFP crops and food assessment mission to Sudan, February 2007.
[6] WHO. Guideline: Updates on the management of severe acute malnutrition in infants and children. Geneva: World Health Organization; 2013.

[7] WHO. Integrated Management of Childhood Illness Chart Booklet. Geneva: World Health Organization; 2014.

[8] Kim K, Shin SC, Shim JE. Nutritional status of toddlers and preschoolers according to household income level: overweight tendency and micronutrient deficiencies. Nutr Res Pract. 2015 Oct; 9(5):547-53.

[9] Diaz A, Arana A, Vargas-Machuca R, Antiporta D. Health and nutrition of indigenous and nonindigenous children in the Peruvian Amazon. Rev Panam Salud Publica. 2015 Jul; 38(1):49-56.

[10] Owoaje E, Onifade O, Desmennu A. Family and socioeconomic risk factors for undernutrition among children aged 6 to 23 Months in Ibadan, Nigeria. Pan Afr Med J. 2014; 17: 161.

[11] Patawri AK, Kumar S, Beard J. Undernutrition among infants less than 6 months of age: an underestimated public health problem in India. Matern Child Nutr. 2015;11: 119–126

[12] Vygen SB, Roberfroid D, Captier V, Kolsteren P. Treatment of Severe Acute Malnutrition in Infants Aged <6 Months in Niger. J Pediatr. 2013; 162(3): 515–521.e3.

[13] Wilkinson C, Isanaka S. Diluted F100 v infant formula in treatment of severely malnourished infants <6 months. Field exchange. Emergency Nutrition Network. November 2009, Issue 37. Available from: http://fex.ennonline.net/37/diluted. Accessed December 9, 2015.