

Research Article

## Acceptability of Homemade Food, Zinc and Counseling to Reduce Growth-Faltering and Increase Catch up Growth after Diarrhea in India

Saijuddin Shaikh<sup>\*1</sup>, Dilip Mahalanabis<sup>1</sup>, Dilip Paul<sup>2</sup>, Anumita Mallick<sup>3</sup>

<sup>1</sup>Society for Applied Studies, Kolkata, India

<sup>2</sup>Dr. B.C. Roy PGIPS Hospital, Kolkata, India

<sup>3</sup>Belda College, West Midnapore, West Bengal, India

\*Corresponding author: Dr. Saijuddin Shaikh, Society for Applied Studies, CF-198, Sector-I, Saltlake City, Kolkata- 700064, India,

Tel: +91-33-2358 8850; Email: saiju60@hotmail.com

Received: 12-18-2015

Accepted: 01-18-2016

Published: 02-11-2016

Copyright: © 2016 Saijuddin

### Abstract

Repeated attacks of diarrhea in the same children may lead to reduced weight gain or weight loss and hence, they need proper nutritional rehabilitation after diarrhea to enhance catch up growth. The purpose of the study was to test the acceptability of energy dense homemade food with counseling and zinc after diarrhea to reduce concurrent episodes of diarrhea and growth-faltering, and increase catch up growth. A total of 63 diarrheal patients, aged 6-12 months who stayed in hospital for 2-4 days were recruited in the study on their discharge day. Anthropometry, 7 days morbidities and food frequencies, breastfeeding for 24 hours by recall were collected at recruitment, and at 7 day, 1 month and 3 month home visits. Hemoglobin was determined at recruitment and at 3 month home visit. The supplement was given for 14 days. Zinc syrup was provided for first 7 days. Mothers were counseled for 25-30 minutes at each visit. In depth interview for mothers and focus group discussion of health workers were conducted to identify the barriers to adherence and acceptability of supplements. Physiological parameters did not improve significantly in the follow-up visits, but none of them had new diarrheal episode during the intervention period after discharge from hospital. Based on mothers' statement we understood that community acceptance of food and counseling was very positive. Mothers were willing to prepare the food daily as long as their child eats it. Mothers' opinion was, they need more food for a longer time for their children to recover.

**Keywords:** Diarrhea, Counseling, Food Supplement, Zinc, Children, Morbidity, India

### Abbreviations

ID&BG: Infectious Disease & Beliaghata General;

MUAC: Mid Upper Arm Circumference;

Hb: Hemoglobin;

FGD: Focus Group Discussion;

NFHS: National Family Health Survey

## Introduction

Diarrheal disease is a leading cause of childhood morbidity and mortality in developing countries and a major cause of malnutrition [1]. Despite substantial advances in the understanding and management of diarrheal diseases in childhood, diarrhea is still a leading cause of childhood mortality, estimated at 1.8 million deaths a year globally [2,3]. Repeated attacks of diarrhea in the same child may lead to a reduced weight gain or even weight loss and may cause malnutrition. In India, according to NFHS-3 [4] on average, children below 3 years of age experience about 3 episodes of diarrhea each year. A study carried out in 5 villages in Ahmadabad, India reported that the number of diarrheal episodes per child/ year was 4.76 for 0-11 months of age children [5]. Twenty percent of the children aged 2-59 months were affected by diarrhea. Children under 3 years had a significantly higher susceptibility to diarrhea than older children. Overall, 74% of caregivers reported to have sought care outside home for the diarrhea episode in their children. An additional 13% reported to have some sort of treatment at home. The remaining 13% did not receive any treatment. There are large differences in care-seeking behaviour across the country. More than two-thirds of the parents, who sought treatment outside home, prefer a private practitioner or a private health facility in most districts of India. Children over 3 years of age are more likely to receive treatment at home. A large proportion of children (22%) in the age group 2-5 months do not receive any treatment at all. Parents reported that a child having too many stools, very weak in feeding, and diarrhea continuing for too long are the main considerations which lead the parents to seek treatment outside their home. Most common treatments reported are: ORS (47%), tonics (32%), injections (23%), and anti-diarrheals (18%). Zinc prescription is reported by only 1%. About 13% parents reported giving some home treatment for their children with diarrhea. Of them, salt sugar solution (48%), ORS (23%), rice water (19%) and dal water (15%) are reported as the main types of home treatment parents gave to their children for diarrhea [4].

In developing countries, under-5 children once admitted with diarrhea are more prone to have repeated attacks of diarrhea leading to malnutrition. It has been reported that, 6-32 month old undernourished children who had percent of days ill with diarrhea of 11 % or more, change in weight was inversely and significantly correlated with diarrhea [6]. The risk of stunting associated with episodes of persist diarrhea is reported by Villamor et al [7]. In Ghanaian preschool children, height-for-age and weight-for-height decreased with increasing incidence of diarrheal diseases [8]. Roy et al [9] conducted a study in children aged 3 months to 3 years in rural Bangladesh and followed them up at home for 12 months after treatment of diarrhea. During follow-up the children were found to have a significantly higher mortality rate than generally observed. Nearly 70% of the deaths occurred in the first 3 months after

discharge from the hospital. Severely malnourished children had a risk of death 14 times higher than their well-nourished counterparts. The highest mortality occurred in children under 2 years of age. Another group of investigators in Bangladesh conducted a study on 74 children aged 2-5 years; 43% of them were severely and 28% moderately malnourished when seen in their home after they had received treatment for diarrhea in the hospital at ICDDR, B [10]. They reported that high post-discharge mortality (33%) in similarly undernourished children were higher in rural area than urban area. Based on their result they suggested that nutritional rehabilitation is necessary to avert much of the morbidity and mortality that ensues after an episode of diarrhea. Mamidi et al [11] conducted a study in severely malnourished (WHZ score < -3) Indian children aged 2-60 months of whom 20% were diarrheal patients and most had high fever. They intervened with diet based energy dense local foods along with multivitamin micronutrient supplements and showed that the diet based energy dense food is suitable for nutrition rehabilitation of severely malnourished children. Health providers suggested nutritious food to be provided to the children who recover from diarrhea. Further, culture, habits and lack of knowledge are also barriers to proper feeding of post diarrheal children. The purpose of the study was to test the acceptability of energy dense homemade food with counseling and zinc for mother and child after diarrhea to reduce subsequent episodes of diarrhea and growth-faltering, and to increase catch up growth.

## Methods and Subjects

Population density is high in the study area and based on religion, 56% are Hindu and 44% are Muslim. Most children are malnourished and come from low SES area where sanitation system is not good and parents are not aware about the dangers of infectious diseases. Parents try to treat children at home first if children get sick. It has also been noticed in the area that after discharge from hospital, parents do not follow the doctor's advice due to lack of knowledge and money and children become ill again at home.

The study subjects were recruited at I.D & B.G Hospital, a big infectious disease hospital in Kolkata, India. A large number of diarrheal patients from various age groups come from around the hospital and from districts referred by district hospitals. Diarrheal patients admitted in the hospital in the diarrhea ward were recruited on their discharge day. Our research team went to the diarrhea ward at discharge time (10-11 am) from Monday to Saturday, talked to the parents and informed them about the study objective, procedure and benefits of participation in detail. A written informed consent was obtained from the parents before recruitment if they agreed to allow their children to participate in the study. Inclusion criteria were, children who were identified as having severe diarrhea, aged 6 - 12 months, stayed in diarrhea ward for 2-4 days and their houses were within 10 km from hospital for follow-up visit.

This study was conducted from June 2013 to July 2014 and was approved by the ethical review board of the Society for Applied Studies.

### Counseling

Child feeding counseling developed by Alive & Thrive [12] was translated in local language (Bengali) and used in this study purpose. Counselors were trained extensively and their practice session was extended for a longer time with role playing. Counseling session was for 25 – 30 minutes for each visit. First, counseling was given to the mothers at the study center with 7 key messages on breastfeeding for 2 years or longer, starting other nutritious complementary food in addition to breast milk from 6 months of age, thick enough to stay in the spoon to give more energy to the child, and providing animal source foods to the child to help them grow strong, healthy and lively, and to feed ½ bowl of 250 ml size of a variety of mashed nutritious food (fish, egg, dal, spinach, yellow fruits and vegetables) two times a day, and continue to feed breast milk as much as possible, encourage the child to drink and to eat during illness and provide extra food after illness to help the child recover quickly, to wash mother's both hands before cooking food for child and wash mother's and child's both hands before feeding the child etc. At 7 day follow-up visit, mothers were counseled at her home, asked mother of her practice about her previous lesson, counselors helped mothers to remember what they learned from previous lesson and mothers tried to recall it. At this visit, mothers were counseled on proper feeding, and kind, quality and amount of food. Mother was also given 4 key messages on to encourage and help the child patiently and allow the child to learn to eat, assist child to eat, feed slowly and patiently, encourage but not force, talk to child during feeding, to become strong, healthy and lively; child needs to eat ½ bowl of 250 ml size of nutritious mashed foods 3 times a day plus two snacks in addition to frequent breast feeds. At 1 month and 3 month follow-up visits, counselors went to the children's houses, asked the mothers whether they faced any problem to implement these suggestions. If the mothers faced any problem, counselors solved it and repeated previous advices and suggested again to follow the instructions.

### Food Distribution and Cooking

All children were given rice (200g/day), lentil (100g/day) and edible soya oil (50g/day) with cooking instruction for 14 days. Mothers cooked foods 2 times a day, 50% in the morning and rest of the 50% in afternoon. Mothers were instructed to prepare porridge (locally called *khichuri*) of rice 100g, lentil 50g and soya oil 25g, dense enough to stay in spoon at each cooking time. Mothers were instructed to feed the daily portion of porridge in addition to the amount of food and breast milk the children normally consume. If the children were not able to finish the full portion within one sitting, the mothers were instructed on hygienic food storage and reheating practices and

to feed again, and to discard all unfinished food after 3 hours of cooking. Zinc syrup for first 7 days of post treatment was given to the children.

### Data Collection

At recruitment, child's weight, length, mid-upper arm circumference (MUAC) and hemoglobin (Hb) using finger prick were measured. At the same time, 7 days morbidities and food frequencies were collected from their parents using a structured questionnaire. Mothers' contact address with phone number was recorded for further communication. Children were visited 3 times at their home. At 7 day follow-up visit, child anthropometry, 7 days morbidities and food frequencies, breastfeeding during last 24 hours and complementary feeding were recorded using the same questionnaire. Same information was collected from mothers and children at 1 month and 3 month follow-up visits. At 7 day and 1 month follow-up visits, mothers were also asked whether her child liked the cooked food, how much the prepared food the child ate in her opinion, why the child did not finish the food, whether the food was shared with other family members and what was done with any left-over food. Qualitative data were also collected through observations and in depth interview at 7 day and 1 month home visits. Counselors have observed full episode of cooking and feeding and have asked mothers about cooking problem, challenges during feeding, taste of food and whether child liked this food or not.

Weight was measured to the accuracy  $\pm 10g$  using a digital weighing scale. Length was measured 3 times in centimeters on a local made infantometer to the nearest millimeter. Left mid arm circumference was measured 3 times within the accuracy of 0.1cm using a non-stretchable tape at the midpoint between the acromion and the olecranon and median value of length and MUAC were used in analysis. Hemoglobin assessment was done using a HemoCue photometer (HemoCue 301 Inc., Mission Viejo, CA, USA) and was recorded in g/dl. All anthropometries were taken at all visits but hemoglobin was assessed at recruitment and at last home visit.

### Statistical Analysis

The baseline socioeconomic data and morbidities at different measurement points are presented as number and percent. Weight-for-age, length-for-age and weight-for-length were calculated using World Health Organization Anthro software version 3.2.2. Stunted, underweight and wasting were identified using the cutoff point  $< -2$  Z-score of length-for-age, weight-for-age and weight-for-length respectively. We assessed adherence which in this study we defined as the fraction of one time cooked (100g rice, 50g lentil and 25g oil) consumed at each time in a day of feeding and categorized it as more than 50%, 25% to 50% or less than 25%. Percent of adherence was tabulated by child age, as 7, 8, 9, 10 and 11 months. Fisher's exact

test was conducted to test difference of morbidities between baseline and at each follow-up visit. Wilcoxon Mann-Whitney U-test, a non-parametric test was done to test the change in anthropometry between baseline and each follow-up visit. Overall compliance is shown graphically to visually observe the change for each day. Food frequency for last 7 days at each visit was recorded and plotted as bar diagram to compare consumption in each visit. Analysis was performed using STATA 11.0 intercooled version (STATA Corporation, Houston, TX, USA) statistical software. Significant level was set at  $P < 0.05$ .

## Results

A total of 63 mother-child pairs participated at enrolment in the study: 59 pairs completed 7 day follow-up visit and 55 pairs continued upto the end of the study. Mean age of the children was  $9.0 \pm 1.49$  months (minimum 7 months and maximum 11 months). Eighty seven percent children were admitted to the hospital after acute diarrhea and 9.5% were taken to private clinic or doctors first and then referred to hospital. Socioeconomic characteristics of the parents were collected at recruitment (table 1). More than 60% parents' education were 6 class and above. Admission to the hospital was higher for male children (71%) than female children (28%). Most households (86%) used slab latrine and source of water was supply water (86%). Forty seven percent families income was below US \$75 per month. Table 2 shows morbidities and nutritional status of the children at different measurement points. All morbidities decreased at each follow-up visit except dysentery. Cough significantly ( $P < 0.05$ ) decreased at 7 day and 3 month visits and fever at 7 day and 1 month visits from start. Breastfeeding increased at each visit from start (figure 1). Other indicators (stunted, underweight and wasting) decreased at all home visits, although, these changes were not statistically significant. Weight, MUAC and length increased at 1 month and 3 month visits compared to start and 7 day visit, but these changes were also not statistically significant. Hemoglobin did not change between baseline and 3 month visit (table 3). Adherence was reported positive for children who ate more than 25% of cooked food as stated by mothers each day (figure 2). Average adherence was 87.5%, but it varied from day to day. Majority of the children consumed the cooked food in 1 or 2 sittings in each cooking session. Mean adherence was similar in all four age groups by month (table 4). Among children with low adherence (<75% portion cooked food consumed) on a particular day, most were reported to be ill on that day. Also among those with low adherence on any day, two thirds of mothers reported that their children did not like this food. On the other hand, among those with good adherence on a particular day, only 20% of mothers reported that their children did not like this food. Leftover portion of cooked food was also recorded. More than one third mothers reported that there was not any leftover food, meaning their children finished eating all cooked food. Another one third mothers mentioned that they have given leftover food to the other children and 16.4%

**Table 1.** Socio Demographic Characteristics of the Parents at Recruitment.

Variable	Number (%) n= 63
Mother education	
No education	14 (22.2)
1-5 class	11 (17.5)
6 class and above	38 (60.3)
Father education	
No education	7 (11.1)
1-5 class	11 (17.5)
6 class and above	45 (71.4)
Mother employment	
No	57 (90.5)
Yes	6 (9.5)
Father employment	
No	1 (1.6)
Yes	61 (98.4)
Latrine status	
No toilet	4 (6.4)
Pit	4 (8.0)
Slab/pan	54 (85.6)
Drinking water	
Supply water	54 (85.7)
Tube well	8 (12.7)
Others	1 (1.6)
Family income (USD/month)	
<75	29 (46.8)
75 - 150	25 (40.3)
>150	8 (12.9)

<sup>1</sup>Data Missing for Father's Employment, Latrine Status and Family Income.

**Table 2.** Morbidity and Nutritional Status of Study Children at Different Measurement Points<sup>1</sup>.

Variable	At recruitment n= 63	7 day follow-up n= 59	1m follow-up n= 55	3m follow-up n= 55
Breast feeding	53 (84.1)	52 (88.1)	47 (85.5)	48 (87.3)
Cough	36 (57.1)	15 (25.4)***	24 (43.6)	20 (36.4)*
Fever	22 (34.9)	11 (18.6)*	0 (18.2)**	15 (27.3)
Dysentery	3 (4.8)	1 (1.7)	3 (5.5)	3 (5.5)
Stunted	12 (19.4)	7 (11.9)	8 (14.6)	8 (14.6)
Under-weight	21 (33.9)	25 (42.4)	18 (32.7)	18 (32.10)
Wasting	19 (30.2)	24 (40.7)	14 (25.5)	11 (20.0)

<sup>1</sup>Data presented as number and percent only for "yes". Fisher's exact test has been done to find significant difference.

Significant levels show between recruitment and each follow-up visit. \*P<0.05; \*\*P<0.01; \*\*\*P<0.001

**Table 3.** Physical Parameters of Study Children at Different Measurement Points<sup>1</sup>

Variable	At recruitment n= 63	7 day follow-up n= 59	1m follow-up n= 55	3m follow-up n= 55
Weight, kg	7.2±0.89	7.2±1.00	7.5±1.06	8.0±1.01
MUAC, cm	12.7±0.92	12.7±0.98	13.2±0.92	13.7±0.98
Length, cm	68.6±3.04	69.1±3.24	70.2±2.96	72.0±3.94
Hemoglobin, g/dl	9.5±1.51	NA	NA	9.6±1.75
Height-for-age	-1.1±1.03	-0.9±1.11	-1.0±1.00	-1.1±1.03
Weight-for-age	-1.6±0.92	-1.7±1.00	-1.6±1.18	-1.5±1.09
Weight-for-height	-1.3±0.92	-1.6±1.10	-1.4±1.38	-1.2±1.10

NA, not available

<sup>1</sup>Data presented as mean±SD

mothers reported that they ate leftover cooked food. All mothers reported that children consumed zinc syrup fully that was provided to them.

### Child Diet

Consumption of other foods was reported at least one time a day for the last 7 days from visit day. All food consumptions increased at each follow-up visit except powder milk consumption (figure 3). Khichuri consumption dramatically increased

**Table 4.** Mean Percent of Daily Cooked Food (khichuri) Fed by Age.

Percent	Overall	7 months	8 months	9 months	10 months	11 months
≤25	8 (12.90)	1 (7.14)	2 (15.38)	2 (15.38)	1 (8.33)	2 (20.00)
>25 – 50	19 (30.65)	5 (35.71)	3 (23.08)	2 (15.38)	4 (33.33)	5 (50.00)
>50	35 (56.45)	8 (57.15)	8 (61.53)	9 (69.23)	7 (58.33)	7 (30.00)
Total	62 (100.00)	14 (100.00)	13 (100.00)	13 (100.00)	12 (100.00)	10 (100.00)

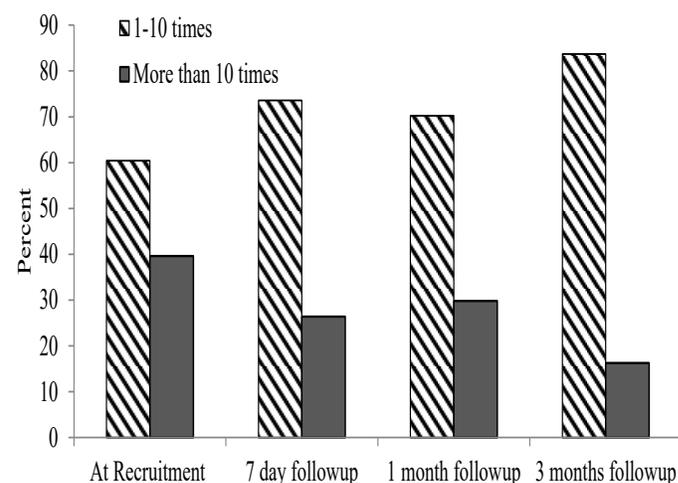
<sup>1</sup> data missing for adherence.

at 7 day and 1 month visits, but decreased at 3 month visit. However, suji (semolina) and payes (sweetend milk with rice), dal, rice and biscuits consumption increased at 1 month and 3 month visits.

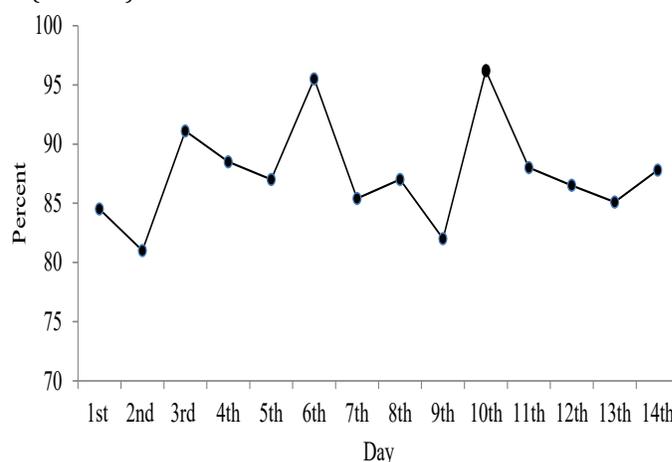
### Key Findings from Observation and in Depth Interview

Most mothers agreed that their children liked the cooked food but this was observed only after a few days of feeding. A few

**Figure 1.** Breastfeeding Frequencies on the Day Before Measurement.

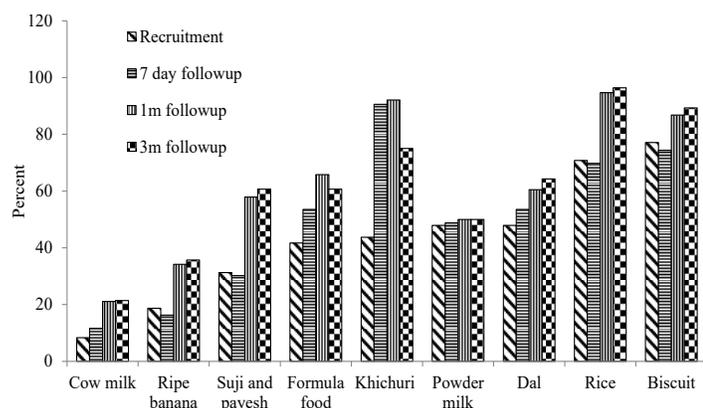


**Figure 2.** Adherence Rate of Energy Dense Homemade Food (khichuri).



mothers informed that their children had increased frequency of stools, 2-3 times a day after the cooked food was fed, but their symptom did not persist and mother did not perceive this to be a serious concern. Regarding the flavor of the cooked food, some mothers reported that flavor of the cooked food was good and child liked to eat when they added some vegetables, ghee and salt during cooking. Most mothers reported that child liked to eat thick porridge, this is why they cooked the food in pressure cooker. Child's illness was the main cause

**Figure 3.** Foods Consumed by Child within last 7 Days at Different Measurement Points.



of poor adherence. Majority of the mothers reported that child did not eat enough after coming back from hospital. Then 2-3 days later child increased consumption day by day. Almost all mothers agreed that they learnt a lot from counseling on maintaining hygiene, feeding sick child, breastfeeding etc. This is why they took care properly of their sick children that they did not do in past. Most mothers reported that it was easy to cook the food and they have no problem to cook khichuri 2 times a day if their child becomes well and healthy. Almost all mothers mentioned that it would be good if we can give this food for longer duration as their children are habituated to it.

### Mothers' Statement

1. At 1 month follow-up visit, a mother reported that her girl ate khichuri very well. Mother asked us "you were telling that you will do follow-up of my child for up to 3 months from recruitment but you gave food only for 14 days that is finished and not enough to make my child healthy". Mother also requested us to give more food to her child at least for 3 months.
2. A boy from a poor slum area was recruited. This child was not met at 7 day visit. At 1 month follow-up visit, health workers saw that mother sat and took the child on her lap in a small damp *jhupri*. Child's grand-mom said "child has cough-cold, fever, cannot sleep properly and does not want to eat after coming back from hospital and food that you gave was finished within 2 weeks". The mother was counseled on taking care of the child during illness, continue breastfeeding, give other nutritious foods to the child, keep the child in a worm place etc. At 3 month visit, it was noticed that the child was smiling, family members were happy and they requested us to give more food and medicines to the child. They even told us that if we do not give more food then at least we can come to their home frequently to give advice on nutrition. They expressed their gratefulness to our health workers for giving

them food and advice on taking care of the child.

3. A girl child came from a poor family of slum area and participated in the study. At 1 month visit, mother said. "Foods that you gave were finished within 2 weeks and we bought rice, lentil and soya oil from local market but the child did not like it". Mother asked us from where we bought these foods and requested us to give them more food at least for 3 months. We gave them Zinc syrup that was also finished within a week. Mother stated that if we give some foods and vitamins then her child would be fully cured and become healthy.

### Key Findings of Field Workers' Focus Group Discussion (FGD)

Focus group discussion was conducted among field workers who collected data, information and gave counseling. During observation of field workers at 7 day home visit, they noticed that cooked food was too much for a young child. Porridge of 100g rice, 50g lentil and 25g oil that mother cooked one time was big a volume, a child could not finish and mothers shared leftover food to child's siblings. We provided 200g rice, 100g lentil and 50g oil per child per day for 14 days. Mothers could easily use these foods for 3 weeks for index child. Due to lack of supervision and knowledge mothers wasted lot of cooked food.

### Discussion

Zinc supplementation in children is associated with reduced rate of diarrhea [13] and Baqui et al [14] reported that to control diarrheal disease, zinc supplementation has a beneficial role. A randomized controlled clinical trial conducted in Bangladesh mentioned that a short course of zinc supplementation during acute diarrhea can reduce growth faltering and incidence of diarrhea during subsequent 2 months [9]. Another Indian study conducted in children revealed that zinc supplementation was associated with a 21% reduction in the risk of continued diarrhea. This study also reported that there was a 39% reduction in the mean number of watery stools per day in the zinc supplemented group [15]. Hence, zinc syrup and food supplement with counseling were provided to the children to reduce incidence of diarrhea after treatment.

The results of the study suggest that zinc and homemade energy dense food from local ingredients with counseling on nutrition education and hygiene are an acceptable package after acute diarrhea in underweight low SES Indian children. The children have been followed-up for 3 months from discharge and visited in their home 3 times (at 7 day, 1 month and 3 month from recruitment) and not a single child had a recurrent diarrheal episode during subsequent period. It was observed that adequate adherence defined as a child consuming more than 50% of the daily portion was commonly observed.

Mothers preferred to prepare the food themselves than receiving pre-cooked foods. This supplementation did not alter the frequency of breastfeeding, even it increased from the time of recruitment as reported by mothers in a 24-hours recall, although the sample size was small and duration of the feeding was only for 14 days.

We observed some potential challenges for the cooked food effectiveness as a complementary supplement in the population. These are: (1) food sharing with other children in household, (2) low consumption of food during child's illness and (3) substitution for the child's usual diet. Typically the complementary child's foods in the locality are rice and potato from the family cooking pot, sweetened porridges made with water or on rare occasions milk (suji and payesh) (figure 3); others are low cost biscuits and formula feed which are not quantitatively and qualitatively enough for sick children. Introduction of nutritious animal source foods is generally delayed due to cultural beliefs, lack of knowledge and not being affordable like other setting [16].

Adherence of cooked food (khichuri) was higher in 7 day and 1 month home visits compared to enrollment. Adherence of khichuri at recruitment was due to mothers' knowledge and practice. But adherence was high at 2<sup>nd</sup> and 3<sup>rd</sup> visits because, ingredients of khichuri were provided and mothers were counseled on cooking energy dense homemade food. However, adherence was little decreased at 3 month visit as ingredients had been finished and some adherence only for mother's knowledge that she learnt from counseling. Better adherence was also observed for younger children. The age group was not balanced by sex and maximum younger children were boy but most of the girl children were in older age group. It is speculated that mothers took much care of younger and boy children than older and girl children. In South Asia, girls seem to be generally less well cared for by their families and parents [17-19]. In depth interview of mothers, and observation and FGD of health workers revealed that the ingredient amounts of cooked food (100g rice, 50g lentil and 25g oil) were too much for this age group. In perhaps, 50% portion of cooked food was enough for a child and more than 50% adherence indicated high consumption. The study workers were local women with a minimum of 12 years school education, who were trained to deliver study-related supplements and messages to the mothers. Employing this type of workers to assist with the introduction of a novel food supplement program and provide health messages may be an affordable and effective way to improving acceptance of and adherence to a supplemental feeding regimen after diarrhea.

Sharing of food may be a significant barrier to complementary food supplement effectiveness. In this study, nearly one-third of the participating mothers reported sharing the cooked food with siblings other than the index child on at least one day of the study period. Food sharing with siblings and other family members is common in food supplement program and trial

and has been associated with lower than expected effectiveness of supplement [20,21]. Some trials and programs have addressed this challenge by providing food packages for the family or other children in the same age group as the target child [22-24] but it is expensive, especially for scaling up the program. For research purposes, the most cost effective approach may be careful adherence and dose monitoring when sharing is a common problem.

Regular consumption of substitute foods with supplement may also diminish the observed effectiveness of the supplemental food. A randomized controlled trial has measured diet in supplemented and unsupplemented groups suggest that total caloric and micronutrient intakes in supplemented group is higher compared to unsupplemented group and total calories from the usual diet are reduced in the supplemented group [25]. We observed in our study through 7 day food frequency questionnaire that increasing the number and frequencies of usual diets (figure 3) at all follow-up visits, may have been the main and important cause of low adherence in older children. Although, the changes in usual foods did not display statistically significant trends, this finding may be due to the small sample size, variation in child age and adherence, and short duration of the trial. To address potential substitution of cooked food for usual dietary intake, feeding instructions in the planned supplemental trial will need to be emphasized and the purpose of the distributed food explained.

The different types of data collection, in the form of direct observation of cooking and feeding, mothers' reports of children on complementary food and other food consumption, and focus group discussion of health workers provided information about many aspects of supplement adherence and acceptability that are valuable for designing a planned supplemental food (foods, zinc and counseling) trial after diarrhea, and may be applicable to other complementary food supplement projects and programs. Although the findings may not be widely generalizable, they revealed important considerations that inform the delivery mechanism for supplied foods in the nutritional rehabilitation after diarrhea at home. This pilot study also confirmed some factors that may complicate the effectiveness of complementary food supplement for the prevention of malnutrition in this and other populations. These factors should be further considered and monitored when implementing programs and trials.

Limitations of the study include small sample size, wide age range, age groups was not balanced by sex, participants not selected randomly, and the duration of the intervention was only 14 days.

In conclusion, no child had new diarrheal episode during the intervention period after discharge from hospital. The supplemental package (foods, zinc and counseling) is a good intervention to reduce growth faltering and increase catch up growth after diarrhea. Mothers were willing to prepare the food daily

as long as their child eats it. Mothers' opinion is the child needs more food for longer time to recover. Substitution for other foods and sharing with siblings and other family members are concerns that will need to be addressed through weekly adherence monitoring and carefully crafted feeding instructions delivered to mothers frequently by health workers and finally need to monitor children's growth bi-monthly to understand their better health.

### Acknowledgements

The present work was supported by Department of Science and Technology, Government of West Bengal, India. We gratefully acknowledge good work of our health workers who have collected data from the field and hospital staff for their cooperation at recruitment. We convey our special thanks to the parents and children who had participated in the study.

### References

1. WHO/ UNICEF. The management of diarrhoea and use of oral rehydration therapy, Geneva: World Health Organization.1985.
2. Bryce J, Boschi-Pinto C, Shibuya K, Black RE, WHO Child Health Epidemiology Reference group. WHO estimates of the causes of death in children. *Lancet*. 2005, 365(9465): 1147-1152.
3. Black RE, Morris SS, Bryce J. Where and why are 10 million children dying every year? *Lancet*. 2003, 361(9376): 2226-2234.
4. National Family Health Survey 2005-2006. (NFHS-3) India Reports.
5. Sutariya S, Talsania N, Shah C. Study of prevalence of diarrhoeal diseases amongst under five population. *Natl J Commnt Med*. 2011, 2(1): 96-99.
6. Becker S, Black RE, Brown KH. Relative effects of diarrhea, fever, and dietary energy intake on weight gain in rural Bangladeshi children. *Am J Clin Nutr*. 1991, 53(6): 1499-1503.
7. Villamor E, Mbise R, Spiegelman D, Hertzmark E, Fataki M et al. Vitamin A supplements ameliorate the adverse effect of HIV-1, malaria, and diarrheal infections on child growth. *Pediatrics*. 2002, 109(1): 1-10.
8. Biritwum RB, Isomura S, Assoku A, Torigoe S. Growth and diarrhoeal disease surveillance in a rural Ghanaian preschool child population. *Trans R Soc Trop Med Hyg*. 1986, 80(2): 208-213.
9. Roy SK, Chowdhury AKMA, Rahaman MM. Excess mortality among children discharged from hospital after treatment for diarrhoea in rural Bangladesh. *BMJ*. 1983, 287(6399): 1097-1099.
10. Stanton B, Clemens J, Khair T, Shahid NS. Follow-up of children discharged from hospital after treatment for diarrhoea in urban Bangladesh. *Trop Geogr Med*. 1986, 38(2): 113-118.
11. Mamidi RS, Kulkarni B, Radhakrishna KV, Shatrugna V. Hospital based nutrition rehabilitation of severely undernourished children using energy dense local foods. *Indian Pediatr*. 2010, 47(8): 687-693.
12. Alive & Thrive. Implementation Manual for BRAC's Community-based Alive & Thrive Infant and Young Child Feeding Program in Bangladesh. Dhaka, Bangladesh: 2013.
13. Bhutta ZA, Black RE, Brown KH, Gardner JM, Gore S et al. Prevention of diarrhea and pneumonia by zinc supplementation in children in developing countries: pooled analysis of randomized controlled trials. Zinc Investigators' Collaborative Group. *J Pediatr*.1999, 135(6): 689-697.
14. Baqui AH, Black RE, El Arifeen S, Yunus M, Chakraborty J et al. Effect of zinc supplementation started during diarrhoea on morbidity and mortality in Bangladeshi children: community randomized trial. *BMJ*. 2002, 325(7372): 1059.
15. Sazawal S, Black RE, Bhan MK, Bhandari N, Sinha A et al. Zinc supplementation in young children with acute diarrhea in India. *N Engl J Med*. 1995, 333(13): 839-844.
16. NIPORT, Mitra and Associates, and ICF International. Bangladesh Demographic and Health Survey 2011. Dhaka, Bangladesh, and Calverton, Maryland: NIPORT, Mitra and Associates, and ICF International. 2013.
17. Birch LL, Fisher JO. Mothers' child-feeding practices influence daughters' eating and weight. *Am J Clin Nutr*. 2000, 71(5): 1054 -1061.
18. Fisher JO, Birch LL. Parents' restrictive feeding practices are associated with young girls' negative self-evaluation of eating. *J Am Diet Assoc*. 2000, 100(11): 1314-1316.
19. Shaikh S, Mahalanabis D, Chatterjee S, Kurpad AV, Khaled MA. Lean body mass in preschool aged urban children in India: gender difference. *Eur J Clin Nutr*. 2003, 57(3): 389-393.
20. Flax VL, Phuka J, Cheung YB, Ashorn U, Maleta K et al. Feeding patterns and behaviors during home supplementation of underweight Malawian children with lipid-based nutrient supplements or corn-soy blend. *Appetite*. 2010, 54(3): 504-511.
21. Ickes SB, Jilcott SB, Myhre JA, Adair LS, Thirumurthy H et al. Examination of facilitators and barriers to home-based supplemental feeding with ready-to-use food for under-

- weight children in western Uganda. *Maternl Child Nutr.* 2012, 8(1): 115-129.
22. LaGrone LN, Trehan I, Meuli GJ, Wang RJ, Thakwalakwa C et al. A novel fortified blended flour, corn-soy blend "plus-plus," is not inferior to lipid-based ready-to-use supplementary foods for the treatment of moderate acute malnutrition in Malawian children. *Am J Clin Nutr.* 2012, 95(1): 212-219.
23. Chaparro CM, Dewey KG. Use of lipid-based nutrient supplements (LNS) to improve the nutrient adequacy of general food distribution rations for vulnerable sub-groups in emergency settings. *Maternl Child Nutr.* 2010, 6(suppl 1): 1-69.
24. Patel MP, Sandige HL, Ndekha MJ, Briend A, Ashorn P et al. Supplemental feeding with ready-to-use therapeutic food in Malawian children at risk of malnutrition. *J Health Popul Nutr.* 2005, 23(4): 351-357.
25. Dewey KG, Adu-Afarwuah S. Systematic review of the efficacy and effectiveness of complementary feeding interventions in developing countries. *Maternl Child Nutr.* 2008, 4(suppl 1): 24-85.