Effect of food texture and responsive feeding on food intake of infants aged 9–11 months, West Gojjam, Ethiopia

Mulubrhan Kahsay Atsbha

Abstract: Globally, an estimated 162 million children less than five years of age are chronically undernourished. With 44% of children under the age of 5 years being stunted, 10% wasted, and 29% underweight, Ethiopia has one of the highest malnutrition rates in sub-Saharan Africa. Inadequate dietary intake due to compromised appetite along with poor quality complementary foods that are high in fiber and low in nutrient-density may be part of the problem. The objective of the study was to investigate the effect of fiber content and responsive feeding style on the food intake of infants. A within subject cross over design was used to evaluate the effect of fiber and responsive feeding on food intake of infants. Complementary foods that are high and low in fiber were formulated. A trial among 36 mother–infant pairs (9–11 months) was investigated the food intake when high and low fiber complementary foods with and without responsive feeding were provided. Intake of LF of the infants (87.66 g) was significantly higher than HF (86.18 g). After receiving responsive feeding training, infants’ intake was increased by 12.15 and 27.83% for HF and LF, respectively. Food intake decreases with increased fiber content. Responsive feeding significantly increases food intake, but the magnitude of the increase is dependent on fiber content. Applying responsive feeding and decorticating grains to decrease the fiber content is recommended to improve infants’ food intake and prevent under nutrition.

Subjects: Nutrition; Food Analysis; Nutrition

Keywords: child nutrition; malnutrition; fiber content; responsive feeding style and food intake

ABOUT THE AUTHOR

Mr. Mulubrhan Kahsay Atsbha is a young researcher and lecturer in Mekelle University. His current work focus on effect of food texture and responsive feeding style on food intake of infants aged 911 months.

PUBLIC INTEREST STATEMENT

Malnutrition is the devastating problem in the third world countries. Though, there are a lot of attempts that imposed to eliminate, the prevalence of malnutrition is still higher in sub-Saharan countries. Ethiopia is one among the countries with highest prevalence of malnutrition. The most vulnerable segment of the population is children and pregnant women. Reports shown that 38% of Ethiopian children are chronically malnourished. This could be due to the consumption of inadequate complementary foods, high fiber content coined with inappropriate feeding style. Thus, it is imperative to look at the effect of food texture and responsive feeding style on longitudinal studies.
1. Introduction
Malnutrition is a complex phenomenon that stems from various underlying determinants, including a lack of optimal feeding practices for infants and young children (UNICEF, 2005). It is the largest risk factor in the world for disability and premature mortality among young children, especially in developing countries. Of the nearly 1.9 billion children in the developing world, 31% are stunted (UNICEF, 2005 &. 2006). Despite the continued progress in all the developing countries, it is still predicted that there will be 128–155 million underweight children by the year 2020 with 35% of these children to be from sub-Saharan Africa (Underwood, 2002). In children, under-nutrition and micronutrient deficiencies are associated with poor growth, impaired cognitive development and poor health status (Black et al., 2008). The overwhelming impact of growth faltering is usually irreversible after the age of two, thereby leaving a small window of opportunity for intervention (Martorell et al., 1994). In this regard, the role of adequate complementary feeding, both in quantity and quality, is of great importance. Besides, not only what and when, but also how the child fed is crucial (Stewart et al., 2013).

In Ethiopia child malnutrition is of public health concern. With 44% of children under the age of five years being stunted, 10% wasted, and 29% underweight, the country has one of the highest malnutrition rates in sub-Saharan Africa (DHS, 2013). The few existing quantitative dietary intake surveys on children have indicated that energy and nutrient intakes were suboptimal (Gibson et al., 2009) and that mothers are concerned over the low appetite of their children. Whether this is associated to the high fiber contents of the complementary foods that are prepared from high extraction rate flours and, or to inappropriate feeding style remains unknown. Although inadequate food intake may partly be related to food insecurity, the high stunting rates in food surplus regions of Ethiopia (i.e., Gojjam) suggest that inadequate feeding styles and complementary foods of low nutrient density may also play an important role (Teshome et al., 2009). Thus, the aim of the present study was to investigate the effect of feeding style and fiber content of complementary foods on food intake of infants (aged 9–11 months) in West Gojjam, Ethiopia.

2. Materials and methods

2.1. Study area
The study was conducted in Mecha district, West Gojjam, Amhara regional state, Ethiopia (Figure 1). It is located at 524 km north-west of Addis Ababa, 34 km South East of BahirDar, the capital city of Amhara regional state (DOA, 2000).

2.2. Participants
A sampling frame was constituted based on the database records of the health centers of the study site. Convenient sampling was performed to select two rural kebeles of the study area from where study participants, aged 9–11 months, were recruited. The 9–11 month age range was selected because: 1) stunting rate starts to peak in this period (Good et al., 2009); 2) by this age, most if not all of the infants are introduced to CFs; 3) the child’s inability to talk makes responsive feeding behaviors of caregivers even more important than for older children (12–23 months); 4) energy intakes are often below the recommendations (Good et al., 2009). Infants who participated in this study were in the age range of 9–11 months, not anemic and have started cereal-based porridges. Besides, the caregivers should accept that intake of their child is weighed. While Infants affected by severe malnutrition with length-for-age (LAZ), weight-for-age (WAZ) or weight-for-height (WHZ) z-scores < -3 based on WHO growth standards (Onis, 2006), didn’t start complementary food and unable to fed breast milk were excluded.

2.3. Sample size estimation
The sample size was calculated by G-power software. Assuming a within subject variation of 46%, a sample size of 29 would allow us to detect 20% difference in mean intakes (α = 0.05 and β = 20%). To allow dropouts of up to 20% the sample size was increased to 36 infants.
2.4. Anthropometric measurements and hemoglobin screening

Anthropometric measurements were taken using standardized techniques with the children wearing no shoes and light clothes. All anthropometric measurements were made by the same person. Z-scores for length-for-age (LAZ), weight-for-age (WAZ) and weight-for-height (WHZ) were calculated using ENA software (2007), based on WHO multicenter growth reference data (Onis, 2006).

2.4.1. Hemoglobin screening

Hemoglobin was assessed using Haemocue HB 301 system. After wearing glove for protection, the infants’ middle or ring finger was cleansed with a disinfectant wipe and the side of it was picked by using a lancet. After wiping away the first 2–3 drops of blood, light pressure was re-applied toward the fingertip and a drop of blood was collected directly into the testing cuvette and was filled in one continuous process but not overfilled. The filled cuvette was placed into the cuvette holder immediately, lot number was given to the cuvettes, and hemoglobin reading was recorded. Measurements were then adjusted for altitude (1,500 m above sea level) by subtracting 0.5 (WHO, 2011).

2.5. Preparation and formulation of complementary foods with high and low fiber content

The most frequently consumed cereals were identified as maize and pea in an earlier study that used meal observations. These grains were used for the formulation of the high and low fiber complementary foods.

2.5.1. Formulation of complementary food with high and low fiber content

The complementary food formulations were calculated with ALICOM software to meet the current recommendations for most macro and micronutrient contents in fortified complementary foods (Lutter & Dewey, 2003). The complementary food formulations were based on locally available cereal and legume blends, with the addition of oil, sugar and vitamin-mineral premix in adequate proportions (Table 1). The macronutrient contents of the blended flours were analyzed. As the maize and pea had high water absorption it was seen that the porridge was strongly thickened after few
minutes of preparation. 0.002% of alpha-amylase enzyme (Novozymes, BAN 800) was added to both blends to liquefy and improve the consistency as well as the energy density of the porridge.

2.5.2. Flour preparation
Forty kg of maize and 30 kg of pea were purchased from Merkato, Addis Ababa. As indicated below (Figure 2) both the maize grains and peas were sorted out to clean and separate unwanted

| Ingredient                  | High Fiber (wet basis %) | Low Fiber (wet basis %) |
|-----------------------------|--------------------------|-------------------------|
| Maize (Whole)               | 45.81-                    | -45.32                  |
| Decorticated Maize          |                          |                         |
| Husk                        | 2                        | -                       |
| Roasted and split field pea | 27.79                    | 27.81                   |
| Milk powder                 | 11.52                    | 11.53                   |
| Sugar                       | 9.09                     | 9.10                    |
| Palm oil                    | 3.06                     | 3.52                    |
| Soy oil                     | 1.68                     | 1.68                    |
| Iodized salt                | 0.56                     | 0.56                    |
| Premix-Nutrifaso            | 0.27                     | 0.27                    |
| CaCO₃                       | 0.21                     | 0.21                    |
| Amylase                     | 0.002                    | 0.002                   |

Figure 2. Preparation of high fiber and low fiber flour.
materials. Peas were lightly roasted (not more than 2 min). Maize grains (15 kg) were decorticated using wooden mortar and pestle by two women, who had the traditional skills of processing maize. The decortication lasted until the flour reached 75% extraction rate, at Food science and nutrition laboratory, Addis Ababa University, Ethiopia. Three litre of water was added to each 2 kg of maize grain for the initial conditioning to facilitate decortications. Then the decorticated maize was dried and moisture content was analyzed. The remaining 15 kg of maize was used to prepare high fiber flour, which was prepared from undecorticated maize with the addition of 2% maize husk.

2.6. Energy estimation of the formulated flour
The nutritional composition of the formulated was analyzed using the AOAC (2000) method and energy value was estimated using Atwater’s conversion factors taking in to account fiber provides 2 kcal/g (FAO Food Energy, 2003).

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\text{Total energy (Kcal/100g)} = [(\% \text{ available carbohydrate} \times 4) + (\% \text{ protein} \times 4) + (\% \text{ fat} \times 9) + (\% \text{ fiber} \times 2)]
\]

2.7. Preparation of standard porridge and training of data collectors on how to prepare porridge using standardized procedure
To better isolate the effect of feeding style, fiber content and better control for confounders such as food characteristics, energy density and macronutrient composition, standard complementary foods with the same macronutrient composition (except fiber) and the same energy density were prepared.

Prior to the actual trial, demonstration on the preparation of standardized porridges with appropriate consistency and texture that is thick enough to stay on a spoon and 25% of dry matter content was demonstrated. Ten Data collectors who have completed grade ten and able to communicate with mothers were recruited. The data collectors were intensively trained for seven consecutive days on how to prepare porridge using standardized procedure. Special emphasis was given to transfer messages of hygienic practices and demonstrate adequate consistency of complementary foods. The same kitchen utensils like kitchen scale (precision of 1 g), pan with its cover, spoon, bowl, beaker and sachets were purchased from the market and were provided to the data collectors to minimize errors during weighing. The constant amount of water and flour was determined to meet the appropriate amount of porridge that can be given to infants in the age range of 9–11 month which should be no lower than 200 g per day (PAHO/WHO, PAHO, WHO, 2003).

2.8. Formulations of culturally-adapted responsive feeding messages
Culturally-adapted responsive feeding messages were developed based on the analyses of video-taped meal observations among 106 infants (aged 9–11 months) conducted in an earlier study in Mecha district as follow.

- Message 1: Eye to eye contact -face to face position, verbal encouragement
  - Message 2: Sensitization to appropriate portion size
  - Message 3: Feed patiently but with regular rhythm.
  - Message 4: Avoid too much distraction during feeding,
  - Message 5: Allow the child to self-feed by giving him a second spoon

2.9. Fiber and responsive feeding trial
Before the feeding trial, there were 4 days of adaptation period to the high (HF) and low fiber (LF) complementary foods. A supply enough for 4 days (60–80 g of each CF) were provided to the caregivers so that they serve their infants each formulation (high/low fiber) for at least twice a day.
### Table 2. Experimental design of the trails on the effect of CF fiber content and responsive feeding on food intake

| Adaptation | ARF (Intake Measurements (g)) | RFT | PRF (Intake measurements (g)) |
|------------|-------------------------------|-----|-------------------------------|
| D1         | D2                            | D3  | D4                            | D5 | D6 | D7  | D8  | D9  | D10 | D11 | D12 | D13 | D14 | D15 | D16 | D17 | D18 |
| Group 1    | HF                            | HF  | HF                            | HF | LF | LF  | LF  | HF  | HF  | LF  | LF  | HF  | LF  | LF  | LF  | LF  | LF  |
| Group 2    | LF                            | LF  | LF                            | LF | HF | HF  | HF  | LF  | LF  | LF  | LF  | LF  | LF  | LF  | LF  | LF  | LF  |

G: group  
D: day  
HF: High fiber complementary food with high fiber  
LF: low fiber complementary food with low extraction rate  
PRF: presence of responsive feeding and  
ARF: Absence of responsive feeding  
RFT: responsive feeding training
For the feeding trial, each day, trained data collectors carried a sachet of the formulated CF flour to prepare the CFs in the households following a standardized procedure. A clean cloth was also provided to data collectors to clean up child’s hand, face, mouth and porridge droppings during feeding. The effect of fiber content on the infants’ intake per meal was evaluated in-home using a within subject cross over design. Food intake was evaluated by recording intake of the test meal (satiation). Intakes were measured by subtracting the left over from the initial weight of the complementary food using a kitchen scale equipped with a high precision strain gauge sensor system (Electronic kitchen scale, SF, 400).

As indicated in Table 2 the study had two phases. In the first phase, infants were given the porridge without responsive feeding and the experimental meals were coded as high fiber no responsive feeding (HFNR) & low fiber no responsive feeding (LFNR) while the second phase was with responsive feeding and the experimental meals were coded as high fiber with responsive feeding (HFR) & low fiber with responsive feeding (LFR). Each of the four combinations of CF type and feeding style (i.e., HFNR, LFNR, HFR, LFR) were repeated three times (three experimental CF meals, one per day on three consecutive days).

**2.10. Training on responsive feeding messages**
A pictorial poster that is easily understandable by uneducated mothers was prepared. The messages were also written explicitly below each picture. Caregivers and data collectors were trained for two days which was held at an open field. Before training is commenced, the field researcher asked motivating questions developed in Peru (Creed-Kanashiro, 2009). The trainings were given at the end of the first period of the feeding trial (on days 11 and 12); the effect of responsive feeding behaviors on food intake was evaluated.

**2.11. Data analysis strategies**
The generated data were double entered into SPSS statistical software (SPSS version 20). The two entries were electronically compared; all extreme and otherwise susceptible values were confirmed or corrected. Results of continuous variables (i.e., intakes) are presented as mean ± standard deviation (SD). Statistical significance was set at P < 0.05. Descriptive analysis was performed on socio-demographic variables. Significance of the effects of feeding style or fiber contents as

**Table 3.1 Socio-demographic and household characteristics of mother-child (9–11 months) pairs (n = 32) in Mecha district, West Gojam, Ethiopia (actual trial)**

| Variables                              | Mean±SD | Frequency (%) |
|----------------------------------------|---------|---------------|
| Male headed household                  | 30(93.8)|               |
| Farming households (farmer)            | 28(87.5)|               |
| Family size                            | 5.28 ± 1.8|                |
| Educational status of household head (illiterate) | 27(84.4) |             |
| Number of siblings                     | 2.25 ± 1.78|             |
| Boys                                   | 17(53.1)|               |
| Infant age (mo)                        | 10.125 ± 0.833|             |
| Caregiver’s age (years)                | 29.03 ± 5.23|             |
| Caregiver’s education (illiterate)     | 28(87.5)|               |
| Farming land size (hectare)            | 1.2 ± 1.02|               |
| Religion (Orthodox Christian)          | 32(100)|               |
| Have CIS roofing                       | 32(100)|               |
| Owns a radio                           | 18(56.3)|               |

† CIS = corrugated Iron sheet
affected by extraction rate of the flour used in the CFs were assessed using generalized linear model procedure, repeated measure.
3. Result

3.1. Socio-demographic and household characteristics of mother-child

Of the total number of infants (n = 32) 17 were male and the remaining 15 were female. The mean infant's age was 10.3 month (Table 3.1). Most of the households were male-headed farming households (93.8%) with an average land size of 1.2 hectare. Most mothers were in their thirties and had 2 children on average. Almost all mothers except few didn't receive formal education. The average family size was 5.28. All had households with roofing made from corrugated iron sheet and all were a follower of orthodox religion. More than half of the households (56.3%) owned radio.

3.2. Infants' anthropometric measures and feeding practice

The mean weight-for-age, height-for-age, and weight-for-height Z-scores were −0.7 ± 0.88, 0.38 ± 1.062, and −0.72 ± 0.99, respectively (Table 3.2). The infants' mean ± SD hemoglobin level was 10.97 ± 0.7 g/dl after adjusting for altitude (1,500 m).

Table 3.4 Proximate composition of HF and LF

| Nutrient composition of CF formulations g/100 g DM | HF | LF |
|-----------------------------------------------|----|----|
| DM (%)                                        | 6.79 | 7.59 |
| Fat %                                         | 8.44 | 7.12 |
| Protein %                                     | 13.68 | 13.04 |
| Ash (%)                                       | 2.62 | 2.33 |
| Carbohydrates (g)                             | 65.32 | 71.04 |
| Fiber (g)                                     | 9.94 | 6.17 |
| Energy (Kcal)/100 g DM                        | 412 | 413 |

†HF: high fiber LF: low fiber

Table 3.5 Infant’s feeding characteristics during actual trail

| Mean ± SD | Frequency (%) |
|-----------|---------------|
| Who feeds the child | |
| Mother     | 31(96.9)      |
| Sister    | 1(3.1)        |
| Energy gained from CF (Kcal/100 DM) | 412.5 ± 0.5 |
| Average amount of food served (g/meal) | 183.3 ± 9.96 |
| Food intake (g/kg BW/meal) | 10.56 ± 6.23 |
| HF         | 10.83 ± 6.6   |
| LF         |               |
| Food intake (g/kg BW/meal) (HF) | |
| 0–10       | 16(44.4)      |
| 11–20      | 17(47.2)      |
| >20        | 3(8.3)        |
| Food intake (g/kg BW/meal) (LF) | |
| 0–10       | 18 (50)       |
| 11–20      | 15(41.7)      |
| >20        | 3(8.3)        |

†HF: High fiber LF: low fiber BW: body weight CF: complementary food
All of the infants were breastfed till the time of the survey (Table 3.3). More than half of the mothers reported that giving first foods at 6-months old while the remaining 43.7% mothers were introduced their children after the 7-months old. Mothers and occasionally sisters were the most responsible for feeding the child. The caregivers identified crying (93.8%), and the remaining 6.2% reported that looking at bowl as infants' behaviors in response to hunger. In contrast, spitting out food (62.5%), playing (25%), sealing lips/clenching teeth (9.4%), and other (3.1%) were identified as behaviors related to fullness, and mothers' response to child food refusal were identified as try other food (59.4), take food away (21.9%) and other (18.8%). Regarding to reaction to new food, 56.3% of the children had the habit of accepting while the remaining children were identified as not accepting even their home food, let alone a new food. 62.5% of the children had small appetite where as nearly one third of the children were identified with normal appetite. 84.4% of the children were enjoyable at meal time while 15.6% were struggling to eat.
3.3. Proximate analysis of the complementary food

The proximate composition of the complementary food of both blends used for the meal observation was analyzed and the results are presented in Table 3.4. The complementary food (flours) had the following composition (per 100 g on Dry basis): moisture (6.79%, 7.59%), fat (8.44%, 7.12%), protein (13.68%, 13.04%), carbohydrate (65.32%, 71.04%), ash (2.62%, 2.33), crude fiber (9.94, 6.74%) and energy (calculated by difference) of the flours were 412 and 413 Kcal/100 g DM for HF and LF, respectively.

3.4. Infant feeding

Most infants (96.6%) were fed by their mothers, while sisters were also involved in infant feeding (Table 3.5). The complementary food used for the meal observation, had an intermediate consistency. The amount of porridge served to each child was on average 183.3 g. The mean CF intakes during the meal observation were 10.83 and 10.56 for LF and HF, respectively. About 44 and 50% of the infants consumed less than 10 g/Kg BW/meal for HF and LF while none of them could meet the minimum theoretical gastric capacity.

3.5. Food intake of infants from high extraction rate flour and low extraction rate flour

As presented at Figure 3 the mean CF intake during the meal observation was 87.66 and 86.18 g/meal for HF and LF, respectively, which had a significant difference at P < 0.05 which have low adherence to the minimum theoretic gastric capacity.

3.6. Food intake of infants before and after responsive feeding training

As illustrated at Figure 4 the food intake of infants before responsive feeding were 86.18 and 87.66 g/meal for HF and LF, respectively. While after the responsive feeding training the intake of infants was increased by 12.15% and 27.83% for HF and LF, respectively, which had a significant difference at P < 0.05. The food intake of the infants after gaining the responsive feeding training was higher than the usual feeding which clearly shows that responsive feeding training had a significant effect on intake. There was also an interaction between responsive feeding style and fiber content, which had a significant difference at P < 0.05.

4. Discussion

The present study aimed to investigate the effect of fiber and responsive feeding style on food intake of infants aged 911 months. It shows that food intakes of the infants were 10.83 and 10.56 g/BW/meal for LF and HF respectively which is lower than the recommendation however; the average food intake of infants even before receiving responsive feeding training was higher than reported by NFCS (2013). Assuming a gastric capacity of 30 g/BW/day, 206281 g per day of complementary foods with an energy density of 1.071.46 kcal/g would meet the energy needs of infants’ age 9—11 months (PAHO, WHO (2003)).

In the current study, the food intake of infants during the first period (without responsiveness) was not as large as 177 g/meal. Relative to this figure, all infants had food intakes that were inadequate and far below the recommendation. This is in line with previous studies that also reported low food intakes among Ethiopian children. National food consumption survey reported that young children (aged 12–23 months) had food intakes that were below the minimal gastric capacity (NFCS, 2013).

In the present study, two types of factors of children’s food intake were studied: one determinant was linked to the complementary food quality (the fiber content) and the other was linked to feeding style (the short training to five responsive feeding messages).

Although food intake of complementary foods prepared from higher extraction rate (HF) and prepared from lower extraction rate (LF) had significant difference with the usual feeding style of infants (P = 0.02), after receiving responsive feeding training, intake of infants for porridge prepared from LF was much higher significant than HF (p ≤ 0.001).
This study revealed that the fiber content had an effect on food intake. Infants had higher food intake of porridge prepared from low fiber flour as compared to high fiber content porridge (p < 0.05).

According to Gibson et al. (2010) complementary foods in rural parts of developing countries are prepared from high extraction rate. It is proven that complementary food prepared from high fiber foods have higher slower gastric emptying than prepared from low fiber foods. This slower gastric emptying especially in infants contributes to suppress the food intake of the subsequent meal.

A study conducted in adults shown that bread, which had 15.1 g fiber had higher slower gastric emptying than rice pudding (0.9 g of fiber) (Marciani et al., 2013). Likewise, Clark and Slavin (2013) and Tucker & Thomas, 2009), shown that flours with high fiber and whole grains were associated with lower body weight and prevention of weight gain compared to diets low in fiber. IOM (2001) and (IOM, 2002) suggested that fiber delays the gastric emptying of ingested foods into the small intestine, which can result in satiety. This delayed emptying effect also results in decreased appetite and food intake.

It is a common belief that poverty and low access to food and nutrients are the main reasons for under-nutrition, however, “equally important are caring practices, such as infant and young children feeding” (Engle & Lhotská, 1997). Some studies reported that malnutrition is not only due to poverty and lack of food but also due to difficulties in the interactions between caregivers and children (Moore et al., 2006; Ruel et al., 2003 & UNICEF, 2009). This is in line with previous studies that also reported the prevalence of under-nutrition in a food secure region of Ethiopia, which was not far from food insecure regions (Amha et al, 2015 & Teshome et al., 2009). This suggests that inadequate feeding styles may play an important role. More recently, a study conducted by NFCS (2013) reported that inappropriate feeding style (interaction of caregiver and children) was associated with inadequate food intake. The study suggested that among the five feeding behaviors classified by Moore et al. (2006), maternal positive responsiveness was associated with increased energy and food intake of the infants. Similarly, the present study confirmed that maternal responsiveness was evidently associated with food intake.

A cluster randomized trial in India has shown that Indian toddlers that received responsive feeding in addition to the WHO’s recommendations on breastfeeding and complementary foods had higher energy and nutrient intake than those who received the complementary feeding recommendations alone (Vazir et al., 2013). Likewise, a study conducted in Vietnam and Burkina Faso reported that caregivers who encourage their children to eat more have been positively associated with acceptance of food. However, food refusal and low appetite were commonly observed and were associated with low food intake when caregivers were failed to encourage their children (Deardan et al., 2009).

The present study strongly shows that food intake of infants were higher after responsive feeding training, which suggests that responsive feeding is a possible strategy to improve food intake of infants. The study also confirmed that responsive feeding style had an interaction with the fiber content. This suggests that responsive feeding style can enhance the food intake of CF prepared from both HF and LF but when fiber content is too high, the appetite suppressing effect hinders the increase of food intake even after receiving responsive feeding training.

The major strength of this study is the standardization of the complementary food which had the same energy density, was prepared with the same cooking utensil, cooking time and consistency. Besides, data collectors and researcher were arriving early in the morning (6:30 am) at every door step aimed to control breastfied and any infant’s food. Some children were breastfeeding during feeding trial, which was impossible to control during meal time but this was happened before and after responsive feeding in similar way, thus, the impact on food intake remains the same. Another strength of this study was the design of the trial (repeated measures), each infant was served as his/her own control which was used to adjust high inter-subject variability of food intake, then allowing to
obtain significant effects. The study relied on a very narrow age range, and thus findings should not be used to children outside 9–11 months age. However, the objective was to focus on the 9–11 months age range when child starts to develop psychomotor skills but is unable to talk. This age range requires more engagement and responsiveness from the mothers which increases the programmatic implication of the study to be included in the National Nutrition program.

5. Conclusion and recommendation

The findings of this study have identified that fiber content and responsive feeding style had significant effect on food intake. Porridge intake of infants prepared from low fiber was higher than that of porridge prepared from high fiber. An intake of infants after responsive feeding was higher than the usual feeding style. Responsive feeding style can enhance the intake of CF prepared from both HF and LF but when fiber content is too high, the appetite suppressing effect continues to hinder intake of infants even after receiving responsive feeding training. Based on the major findings of this study, the following recommendations are drawn: Mothers should decorticate further the cereal and legume before milling for the preparation of composite flour for their young children. Findings of this study need to be supported with additional studies on larger catchment areas and bigger samples, preferably using a longitudinal study design.

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Author details

Mulubrhan Kahsay Atsbha

E-mail: smulu332@gmail.com

ORCID ID: http://orcid.org/0000-0002-6786-567X

Department of Food Science and Postharvest Technology, Mekelle University, Mek’ele, Ethiopia.

Conflict of interest

The author declares that there is no competing interest.

Ethics approval and consent to participate

The protocol, information letter to the parents/caregivers and informed consent form were approved by Addis Ababa University’s Ethics Committee. Written informed consent was obtained from parents after an explanation of the study procedures.

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