



**Analysis of Nutrition Specific Intervention by
Supplementing Super Cereal Plus and Management of
Moderately Acute Malnourished Children on 6-59
Months of Age in Ali Akber Dail Union of Kutubdia,
Cox's Bazar**

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Roll:-0120/03

Reg. No.: 832

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**A thesis submitted in the partial fulfillment of the requirements for the degree of
Master of Science in Applied Human Nutrition & Dietetics**

**Department of Applied Food Science and Nutrition Faculty of Food Science and
Technology**

Chattogram Veterinary and Animal Sciences University

Chattogram-4225, Bangladesh

November-2022

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November 2022

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ABBREVIATION

TSFP	Targeted Supplementary Feeding Programme
GMP	Growth Monitoring and Promotion
SC	Super Cereal
WHO	World Health Organization
UNICEF	United Nations International Children's Emergency Fund
WAZ	Weight for Age Z score
CSB	Corn Soya Blend
GNC	Global Nutrition Cluster
MDG	Millennium Development Goals
SDG	Sustainable Development Goals
NIPORT	National Institute of Population Research and Training
GAM	Global Acute Malnutrition
IMCI	Integrated Management of Childhood Illness
CMAM	Community based Management of Acute Malnutrition
SAM	Severe Acute Malnutrition
MAM	Moderate Acute Malnutrition
MUAC	Mid-Upper Arm Circumference
SPSS	Statistical Package for Social Sciences
WFP	World Food Programme
IYCF	Infant and Young Child Feeding
SHED	Society for Health Extension and Development

Abstract

Malnutrition is a foremost reason for mortality and morbidity in children aged less than 5 years, particularly in underdeveloped countries. Compared to children who are not malnourished and those who are moderately acute malnourished children have different nutritional needs. One of the main strategies for treatment of children with moderately acute malnutrition (MAM) is to use a readily available and suitable supplementary food. The purpose of this study to assess the efficacy of super cereal plus provided for the treatment of moderately acute malnourished children at 6-59 month age and identify the weight gain of children from Ali Akber Dail union, Kutubdia upazila of Cox's Bazar. Anthropometry measurements were conducted to identify the nutritional status of children aged 6 to 59 months. A total 542 respondents were assessed for this study. 255 respondents were receiving super cereal plus and 207 respondents were getting counselling only. The daily ration size was 200g for intervention group. We analyzed weight gain of children among two groups. Socio-demographic data were analyzed by chi-square test where significance level for all analysis were set at $p < 0.05$. This study showed that 18% of mothers had no institutional education, 67% mothers had only primary school education, 9% had secondary education and 6% mothers had higher secondary education in group 1. On the other hand 22% of mothers had no institutional education, 45% of mothers were only primary school pass, 18% mothers had secondary education, 4% mothers had higher secondary education and 3% mothers were honours pass in group 2. The mean weight gain after 4 months in two groups-Group 1(Super cereal plus) & Group 2(Counselling) are (1.1976 ± 0.36) and (0.58 ± 0.28) respectively. After 4 months of enrollment period, the weight gain rate is higher for Group 1(Super cereal plus) child in compare to Group 2(Counselling) child. However, the significance level is less than $P=0.05$.

Keywords: Moderate Acute Malnutrition, Children, Nutritional status, Super cereal plus, Counselling, Growth Monitoring and Promotion.

Chapter 1

Introduction

Child malnutrition is a prominent worldwide health issue that raises to death rates and morbidity, decreased intellectual abilities and productivity, and raises the sickness in adulthood (Black et al., 2008). Early-life malnutrition produces immediate negative health effects and damages long-term health and abilities. Early malnutrition increases a child's chance of death, makes them more prone to illness, and can cause growth and developmental delays (Black et al., 2017). UNICEF recently published latest information on the nutritional status of children under the age of five from all nations. Globally, the frequency of stunting in children under the age of five decreased from 32.5 to 21.9% between 2000 and 2018. Nonetheless, over 149 million children under the age of five continued to experience stunting in 2018. At the same period, 40.1 million (5.9%) children were overweight and 49.5 million (7.3%) were wasting. South Asia has the maximum ratio of stunting (34.4%) and wasting (15.2%) (UNICEF, 2018). Under nutrition is a crucial risk factor for child mortality, accounting for about 28% of mortality in children below 5 years (Black et al., 2008).

Currently, Bangladesh is facing a serious health and welfare problem with malnutrition on child below the age of five (NIPORT, 2016). Bangladesh is estimated to be in a dire situation with over 35% of child facing one or more forms of malnutrition and therefore over 50% of under-five infant mortality rates being linked to malnutrition (Chowdhury et al., 2016a). To resolve sustainable development goal (SDG-2); end hunger, achieve food security, advance nutrition and improve sustainable agriculture, a lot of effort would be done (Chowdhury et al., 2016a; Bhutta, 2017). In the past 20 years, it has made some progress toward achieving MDGs 1 (ending severe hunger and poverty) and MDGs 4(decreasing child mortality). Malnutrition is associated with a higher chance of passing away from any cause, as well as a higher chance of death from measles, pneumonia, and diarrhoea (Black et al., 2013). The World Food Programme (WFP) defines malnutrition as a condition in which a person's physical ability is so impaired that he or she is not able to keep up optimal physiological functions, such as growth, pregnancy, lactation, physical work, and disease resistance (WFP, 2000). A malnourished youngster develops

physically and cognitively more slowly as a result, as well as a higher risk of illness and mortality than their counterparts who are receiving adequate nutrition (WFP, 2000; Fishman, 2003). A weight-for-height z-score between -2 and -3 or a mid-upper arm circumference (MUAC) between 115 millimeters and less than 125 millimeters are indicators of moderate acute malnutrition (WHO, 2012). Bilateral pitting oedema, WHZ <-3, MUAC less than 115 millimeters, or both are indicators of severe acute malnutrition (WHO, 2013). Global acute malnutrition (GAM) is a measure of nutritional situation at the population and a sign of the seriousness of an emergency situation; it is defined as the combination of MAM and SAM (GNC, 2014). Malnourished children are more likely to contract illnesses, which can boost metabolism and cause weight loss through a reduction in food intake and absorption (Guerrant et al., 2008; Petri et al., 2008). Acute malnutrition is thought to be caused by illnesses, persistent food insecurity, deprivation, and poor eating habits and limited access to household food (Tessema et al., 2013). If the problem is not properly addressed, children with moderate acute malnutrition (MAM) may progress to severe acute malnutrition (SAM). It is well known that SAM has a huge impact on infant mortality and morbidity around the world. Hence, nutrient-rich diets must be used to treat MAM in children in order to stop the progression of the potentially fatal condition (James et al., 2016; WHO, 2012).

A targeted supplementary feeding program (SFP) in healthcare facilities has been undertaken by the country government of Bangladesh since 2012 with help from the World Food Programme (WFP). By adding food contributions to the diet of children aged 6 to 59 months who are moderately underweight, the program aims to keep them from becoming severely underweight. The WFP oversees the program once a month, concentrating on the transportation, distribution, and use of food donations, while the county government is in charge of evaluating the program's results (WFP, 2014). Initiatives to increase supplementary feeding have the potential to reduce child mortality and morbidity since they are intended to treat MAM and stop it from developing into SAM (WFP, 1999). In 2014, the Community-Based Management of Acute Malnutrition (CMAM) Forum released a technical brief that echoed the WHO recommendations and covered dietary advice for child with MAM, methods for guiding guardian and a

framework for picking suitable supplementary feeding program (SFP) techniques (Annan et al., 2014). The most popular meals utilized in supplementary feeding programs are fortified blended flours, including corn-soya blend (CSB), prepared as porridge (Dewey and Adu-Afarwuah, 2008).

❖ **Objectives**

- To determine the effects of super cereal plus on children with moderate acute malnutrition (6-59 months).
- To determine the weight gain of children (6-59 months) as influenced by TSFP.

Chapter 2

Review of literature

2.1 Supplementary feeding and Super Cereal

Supplemental feeding is an intervention used to improve the nutritional status or prevent the nutritional decline of the population of interest. It is described as providing extra food to children or families over and beyond the usual proportion of their home diets (Beaton and Ghassemi, 1982).

For the supplementary feeding of moderately malnourished children, mixes of cereals and legumes that reflect the indigenous diet and are cooked similarly to staple foods are frequently advised (Maleta et al., 2004). Effective supplementary feeding can help children who are moderately malnourished in experimental settings by enhancing their nutritional status (Rivera et al., 1991).

Supplementary foods also include specially prepared, ready-to-eat, or milled foods (such as fortified blended foods), which are modified in their calorie content, protein, lipids, or nutrient content to help meet the nutritional needs of specific populations (WHO, 2012). Supplemental diets are not designed to a population's sole source of nutrition (WHO, 2012). These are distinct from dietary supplements, which are nutritional substances that come in unit-dose forms (including tablets, pill, granules, and mixtures), and are unrelated to this review (WHO, 2012). Infants and young children recovering from moderate acute malnutrition may not be able to consume a diet that satisfies their nutritional requirements if there is a food shortage or if certain nutrients are not sufficiently available in the local diet. Emergencies, droughts, or migration scenarios may enhance this vulnerability to dietary insecurity. In such cases, specially made supplemental foods are typically necessary to enhance the regular diet and contribute to a boost in nutrient absorption (De Pee and Bloem, 2009).

Super Cereal (SC), a combination of maize and soy flour supplemented with vitamins and minerals, is the standard food supplied in supplementary feeding programs. Overall, SC is a suitable food option for these programs due to its reasonable cost and nutritional

value. In addition, it may be locally made and acquired and is well-accepted by the majority of recipients in developing nations (De Pee and Bloem, 2009).

According to Golden (2009), the nutritional requirements of child with MAM are distinct from those of both children with SAM and healthy children. This resulted in the conclusion that SC was nutritionally incorrect and insufficient for the treatment of MAM in terms of the calorie content of the cooked mush (about 0.5 kcal/g, when the recommended is at least 0.8 kcal/g). Therefore, SC needs the addition of vegetable oil to achieve the essential fatty acid and energy requirements (De Pee and Bloem, 2009).

2.2 Importance of Supplementary feeding

Supplemental foods are used to help meet the nutritional needs of specific groups are ready-to-eat or milled foods that have had their calorie density, protein and fat content, or micronutrient composition altered (WHO, 2012). The Supplementary Feeding Program (SFP) is a part of IMAM that purpose to treat moderately malnourished people or stop a decline in their nutritional condition in those who are by attending to their extra needs, those who are most at danger, with a particular emphasis on young children, pregnant women, and nursing mothers (UNHCR/WFP, 1999).

The WFP's nutrition goal is to work with implementing partners to prevent malnutrition by confirming that those who lack it have physical and financial access to a healthy and age-appropriate diet and by helping households and communities make the best use of food. To fulfill its role in Bangladesh, the WFP assist both general and targeted SFPs. By giving an additional ration to every member of the affected group, blanket SFPs aim to reduce widespread malnutrition and the attendant mortality in nutritionally vulnerable communities, while targeted SFPs concentrate on those who have MAM (WFP, 2012).

The WFP provides food supplies to SFPs, but it is the government, through the Ministry of Health, that is in charge of carrying out the programme at the level of specific healthcare facilities. SC+ supplements have not been shown to be particularly effective at preventing stunting and micronutrient deficiencies unless they are given to populations who are food insecure (those who make less than \$1.25 per day) and used in conjunction

with other initiatives to enhance access to safe water, sanitary conditions, healthcare, and nutritional education (Bhutta et al., 2013).

2.3 Importance of Complementary feeding

In order to meet child nutritional needs after the first six months of life, additional meals should be added to the child's food (Moghaddam et al., 2015). a minimum of two years of exclusive breastfeeding. Children's health is improved by the practice of responsive feeding. For instance, be gentle and quiet when serving the child, encourage them to eat without coercing them, talk to them while maintaining eye contact, ensure correct food handling, and provide enough hygiene. Start the child started with two to three teaspoons of food at six months, and as they get older, progressively increase the amount. Increase the food's variety and consistency gradually. Infants should occasionally consume fortified foods or vitamin-and-mineral supplements. 6 to 8-month-old babies need three to four meals a day, plus an additional snack or two (WHO and UNICEF, 2015). A child's growth and development must pass through a critical stage when they switch from breast milk to family food. Supplemental feeding should limit the amount of protein it contains while meeting the child's needs for both micro and macronutrients in order to promote healthy weight gain and development during childhood and lower the risk of obesity (Monteiro et al.,2005; Ong et al., 2006).

2.4 Health education to caregivers

Gradually increase the food's diversity and consistency. Infants should occasionally take vitamin and mineral supplements or foods that have been fortified. Babies who are 6 to 8 months old require three to four meals per day in addition to an extra snack or two (WHO and UNICEF, 2015). When a youngster transitions from breast milk to family food, they must go through a crucial stage in their growth and development. In order to encourage healthy weight gain and development during childhood and reduce the risk of obesity, supplemental feeding should be limited in the amount of protein it includes while providing the child's needs for both micro and macronutrients (WFP, 2009). Supplemental feeding programs frequently include instruction on nutrition for parents or

other caregivers. This could involve providing instruction on how to prepare and administer the additional foods offered by the program, with an emphasis on the use of clean water. Some organizations don't provide additional meals; they only provide nutrition education.

2.5 Services for Growth Monitoring and Promotion

The majority of growth monitoring tools use a weight chart to graphically display a child's weight in relation to age. A child who is underweight or ill will gain weight more slowly than a child who is fit and well-fed. Early detection of growth retardation is possible by charting a child's weight at regular intervals and comparing the growth pattern to reference curves of healthy children. It provides an early alert message and a catalyst for action (UNICEF, 2008; Ann et al., 2008).

Even though no food was actually provided, the role of education throughout the breastfeeding phase shown that providing women with information on supplemental feeding was effective in boosting weight gain (Gerardo et al., 2008).

A GMP session is a gathering set up in a community or health center when preventive and promotional actions are put into practice to promote and maintain child health and nutrition. Observing, charting, and analyzing growth curves in relation to WHO growth Z-scores to identify growth failures early and take the necessary measures. Promotional measures including counseling tailored to their needs and growth patterns, therapy services and referrals, and lastly follow-up would be provided to guarantee that the underlying causes of growth retardation at home are addressed (Garner et al., 2000; Griffiths and Del Rosso, 2007).

The company is described using Garner's five-point model for GM: HCWs regularly determine a child's age and measure their weight and height; if growth is abnormal, they begin the necessary family intervention. If a serious illness is identified early, the prognosis is better. Despite the fact that this simple model of growth monitoring is widely accepted, empirical data shows that even in highly developed countries, real practice is inadequate (Garner et al., 2000; Sankilampi et al., 2013).

2.6 Factors associated with utilization of GMP services

The mother's work and educational background were strongly associated with her usage of GMP. Moms with a secondary education or above were more likely to use GMP than illiterate mothers, but women with an elementary education or less were more likely to use GMP. Farmers were more likely than housewives to use GMP depending on the mother's line of work.

Mothers with appropriate knowledge of child nutrition and development charts were more likely to use GMP than those with little knowledge (Luwam, 2017).

The majority of mothers had attended all of the GMP sessions, which showed a strong association between mothers' knowledge and practices surrounding child feeding. Nonetheless, moms of infants aged 6 to 8 months made up the largest group (46.2%) of those who had missed one or more sessions (Sandra et al., 2014).

According to a Kenyan study, moms with greater socioeconomic status were more likely to follow GMP, probably because they could manage to get to medical facilities. In this study, parental knowledge of GMP had a positive impact on the practice of GMP going forward. Poor coverage for ongoing GM, with children aged 12 to 24 months having the lowest coverage (Musyoki, 2013).

An additional qualitative study carried out in southern Ethiopia found that the use of growth monitoring and promotion services was significantly correlated with the young index child age, facility - based delivery, middle and upper class income level, a big family, and rate of consistent growth monitoring and promotion (Feleke et al., 2017)

Another qualitative study carried out in the Tigre region found that a variety of barriers were highlighted by mothers and healthcare professionals, including a lack of understanding of malnourishment and the GMP programme and the unavailability of any obvious advantages. Moms aren't concerned about their kids' well-being; instead, they're looking for extra food, and GMP was thought to occur anywhere between once a week and twice a month (Selamawit et al., 2014).

The most important goals of growth assessment are to foster frequent communication with mothers, to educate them about their child's development, and to act as a springboard for counseling and bargaining about behavior modification to boost growth and prevent chronic malnutrition. The program should focus more on interpreting the measurement of a child's growth, on providing quality services, as well as counseling and negotiating for behavioral change. As a result, growth measuring methods should be developed and used with these aims in mind (Jane, 2015; Lucy and Julie, 2012).

The malnutrition and/or survival rate of children is improved when their growth is tracked, their moms are given nutrition and health counseling, and they have permit to basic child health care services (Gerardo et al., 2008).

Children's rights are also closely tied to observing their development. Malnutrition in children is forbidden by the United Nations Convention on the Rights of the Child. The World Summit for Children (1990) recommended states to formalize child growth monitoring and programmes as one preventative step against malnutrition. This is because a youngster with good growth won't be undernourished, and growth is a trustworthy predictor of a child's wellbeing. Parents are entitled to information on their child's growth normally or not. Governments and professionals must create policies and technologies that let communities and families successfully promote children's healthy growth (UNCRC, 1989).

According to a large-scale Brazilian program, participation in growth monitoring imparts a significant benefit on nutritional status that is unrelated to vaccinations and economic background. Evidence from India and Bangladesh, on the other hand, shows that growth monitoring has little to no impact on nutrition when there is insufficient nutrition counseling in large-scale programs. The visual representation of growth has been shown to have no additional benefits when mothers are visited at home every two weeks and get leisurely counseling, according to a randomized investigation carried out in Tamil Nadu. Some research suggests that growth tracking can increase the use of health services (Dominique et al., 2005; Mebratu, 2014).

Because improvements in children's nutrition dependent on altering feed and childcare habits at home, nutrition education is an essential part of growth monitoring and promotion (GMP). An successful and efficient GMP is built on individualized nutrition counseling. The method of regularly measuring and evaluating a child's growth offers the opportunity for individualized nutrition teaching or counseling with targeted messages addressing the child's growth, health, what and how often the child eats, and the caregiver's resources and motivation. Genetic engineering should be brought up in regard to this child's development, wellbeing, and diet. Moreover, growth data aids in pinpointing areas that need attention and shows how new behaviors affect outcomes (Gerardo et al., 2008; Griffiths and Del Rosso, 2007).

Chapter 3

Materials & Methods

3.1 Experimental Area

This study was carried out at Ali Akber Dail union, located in Kutubdia Upazila of Cox's Bazar district of Bangladesh. Information were gathered from the mothers who visited at community clinics & also door-to-door visits in cluster area from February 2022 to July 2022. Kutubdia Upazila (Cox's Bazar District) area are 215.8 square km, situated among 21°43' and 21°56' north latitudes and among 91°50' and 91°54' east longitudes. It is enclosed by the Bay of Bengal on the north,west and south; Kutubdia Channel, Banshkhali, Pekua and Moheshkhali upazilas on the east.



Figure 1: Kutubdia Upazila mapping

3.2 Study Design

The study was regarded as randomized, unblinded, controlled trial study that evaluated the treatment of MAM children, used a controlled randomized design with parallel allocation for super cereal plus and nutritional counselling. Children who met the inclusion criteria were enrolled and got biweekly provisions of super cereal plus and who were participated in GMP programme get nutritional counselling.

3.3 Inclusion Criteria

- Moderately acute malnourished children 6 to 59 months of age, who were admitted in the TSFP at least received 4 months services.
- Participants ranged in age 6 to 59 months and met the WHO criterion of moderately acute malnutrition.

3.4 Exclusion Criteria

- Beneficiaries of TSFP who received services for less than 4 months
- Beneficiaries on the TSFP whose guardians refused to grant their authorization for the children to participate in the study.
- Children who had MUAC <11.5 cm, oedema and any complications.

3.5 Target Group

The main target group for a TSFP is moderately acute malnourished children between the ages of 6 to 59 months and those who are enrolled in GMP between 6-59 months age of children.

3.6 Sample Size Determination

The following formula is used to calculate sample size for this study (Bhalerao and Kadam, 2010).

$$n = z^2 p(1-p) / E^2$$

Where,

n= preferred sample size.

z=statistics for confidence level, usually considered 1.96 at 95% confidence interval.

p= Prevalence of under nutrition among child (According to ACF Survey report_2021 of Kutubdia) is 14.9%.

E=Estimated error in the study 3%(0.03)

By this formula,

$$\begin{aligned} \text{Sample size, } n &= [(1.96)^2 \times 0.149(1-0.149)] / (0.03)^2 \\ &= 541.23 = 542 \end{aligned}$$

3.7 Selection and Training of Research Assistants

Two research assistant (Community Nutrition Volunteer) was recruited to assist in the study. Data collection-experienced research assistant selected from the host community. They were taught in the research's aims and data collecting techniques, as well as in the administration of questionnaires to guardians and the collection of anthropometric information from nutrition center records. The hiring process placed a high value on the candidate's proficiency in the local tongue. Data were collected from the mothers who visited at different 9 community clinics & also door-to-door visits. To evaluate the accuracy and reliability of the inquiries, the questionnaires were checked and validated on current TSFP beneficiaries. The questionnaire was then revised. The standard procedure includes participation exercises to assist research assistants in deciding who may or may not belong to the study. A consistent method of data collection, including how to question people and gather verbal responses, was also covered in their training.

The proper way to calibration equipment every day to avoid measuring error was also taught to the research assistants.

3.8 Anthropometric measurement

The most common method for determining whether and how severe a protein-energy shortage is anthropometry. An examination of physical traits is known as anthropometry, which is used to gauge nutritional status. A group's nutritional status can be assessed using anthropometry, as well as an individual to evaluate if they need nutrition assistance. The mid upper arm circumference, height, and weight are all anthropometric measures (MUAC).

3.8.1 Measuring Mid-Upper Arm Circumference (MUAC)

The measurement of the left upper arm's circumference at the point where the shoulder blade and elbow joint meet in the middle is known as the "Mid Upper Arm Circumference". The MUAC test measures nutritional status. In multiple studies, it performed every another anthropometric factor in enumerate child mortality. When the period of follow-up was brief, MUAC was most beneficial. The MUAC measurement is easy and requires minimal equipment, thus even the most handicapped individuals are able to perform it. Employees should be trained in measurement techniques, although even poorly qualified healthcare professionals and community volunteers can pick up the right technique. MUAC is advised for use in evaluating acute energy insufficiency in adults during famine and with children between the ages of 6-59 months.

The technique for MUAC measurement is as follows (UNICEF, 2020):

- By keeping our work at eye level, we can maintain a comfortable working atmosphere. As soon as you can, take a seat. Mothers regularly give extremely young newborns commands when using this strategy. Lift the mother up to remove the baby's left arm's coverings.
- Using our fingers, find the children's shoulder's top and determine their left upper arm. The child's elbow needs to be bent to make a straight angle. As shown by the two arrows, start the tape at zero on the top of the shoulder, and then stretch it straight down past the elbow. To the closest centimeter, measure the amount at

the elbow's point. Calculating the point involves multiplying the range by two. Alternately, you can gauge the midpoint by bending the tape to the halfway point. Then, with the aid of a helper, mark the midway of the arm with a pen.

- Once the children's arm is straight, wrap the MUAC tape around it in the middle. Make certain that the digits are in the right sequence. Make sure the MUAC tape is applied gently to the skin.
- Check to make sure the tape is not too tight or loose enough.
- After placing the measuring tape on the arm with the correct tension, evaluate and declare the measuring to the closest centimeter.
- Strip the children's arm's adhesive MUAC tape off.
- Write down the measurement right away on the survey.

3.8.2 Weight measurement procedure (UNICEF, 2022) is outlined below.

- Before being weighed, remove the child's clothing but keep them warm with a blanket or cloth. To keep the youngster from getting cold, cover the scale pan with a cloth.
- Zero out the scale while the fabric is in the pan. (With the slinger pants on and a scale, set the scale to zero.)
- Carefully place the infant, who is naked, in the pan (or in the sling or pants). Let the kid calm down so the weight can settle.
- Weighing as exactly as is practical, down to the nearest 0.01 kg (10 g).
- Immediately make a note on the questionnaire.
- Wrap the infant in a blanket to rewarm them right away.

3.8.3 Standardize the weight scale (followed by UNICEF, 2022)

Scales should be calibrated every day or every time they are moved.

- The scale should be set to 0.
- Weigh three known objects at 5, 10, and 15 kg each, and note the findings. A sealed container holding stones can be utilized (if the Weight is known).
- Measure these things' weights once more and note the results.

- If there is a difference of at least 0.01 kg (10 g) between duplicate weighs or if a measured weight deviates by at least 0.01 kg from the designated standard, inspect the scales and alter or replace them.

3.9 Interventions

With added of sugar and milk, super cereal plus is made with fortified wheat and soy flour, vegetable oil, vitamins, and minerals. For the treatment of moderate acute malnutrition in young children aged 6 to 59 months, super cereal plus (WSB++) is preferred. Two times a day, 100g of this food supplement were to be cooked and served by caregivers. Table 1 displays the nutritional breakdown of the supplemental items per 100 g of ration. Michiels fabrieken nv-vincent SQ 9870, Zulte, Belgium is the producer and supplier of super cereal plus. Children in the GMP program who are between the ages of 6 and 59 months received counselling.

Table 1: Nutrient composition of super cereal plus per 100 g powder

Nutrient Content	Per 100g Powder
Energy(kcal)	400
Energy(kj)	1674
Total Fat(g)	9
Of which saturated(g)	0.1
Carbohydrate(g)	62.0
Of which sugar	11.8
Protein(g)	17
Dairy Protein(g)	2.8
Sodium(Na)(mg)	42.5
Retinol(Vit A)(mcg RE)	800
Thiamine(Vit B1)(mg)	0.4
Riboflavin(Vit B2)(mg)	1.6
Niacin(Vit B3)(mg)	10
Pantothenic acid(Vit B5)(mg)	2.0
Vitamin B6(mg)	0.8
Biotin(Vit B7)(µg)	8.0
Folate(Vit B9)(µ DFE)	160
Cobalamin(Vit B12)(µg)	2.0
Vitamin C(mg)	60
Vitamin D(µg)	8.0
Vitamin E(mg aTE)	8.0
Vitamin K(µg)	20
Calcium(Ca)(mg)	420

Iodine(I)(μg)	40
Iron(Fe)(mg)	9.0
Phosphorus(P)(mg)	400
Potassium(K)(mg)	650
Zinc(Zn)(mg)	8.0

Source: WFP specialize nutritious foods sheet (Super Cereal Plus).

3.10 Outcomes

The study outcome includes the rate of weight gain and WAZ score changes.

3.11 Data Analysis

The data were analyzed using by Statistical Package for Social Science (SPSS) version 25 IBM. Chi-square test was used to evaluate socio-demographic data and a significance level of $p < 0.05$ was established for all analyses. For continuous variables, the independent sample t test (also known as the student t test) was employed to test for equality of variances.

3.12 Research Ethics

Chattogram Veterinary and Animal Sciences University and SHED administration were consulted for permission to conduct the study. In Bangladesh, the Ministry of Health has approved the SFP program. The goal of the study was communicated to the respondents before their agreement was collected, and respondents were guaranteed that the data they supplied would be kept private. It guarantees that all data was gathered with absolute confidentiality and was solely used for the study.

Chapter 4

Result

A total 542 respondents were assessed for eligibility and 462 respondents were eligible for study after randomization. The final number of respondents were 255 in super cereal plus(Group 1) and 207 in counseling(Group 2). Age, sex, anthropometric measurements, parental education & job and fathers' household income did not differ between the 2 groups at the baseline.

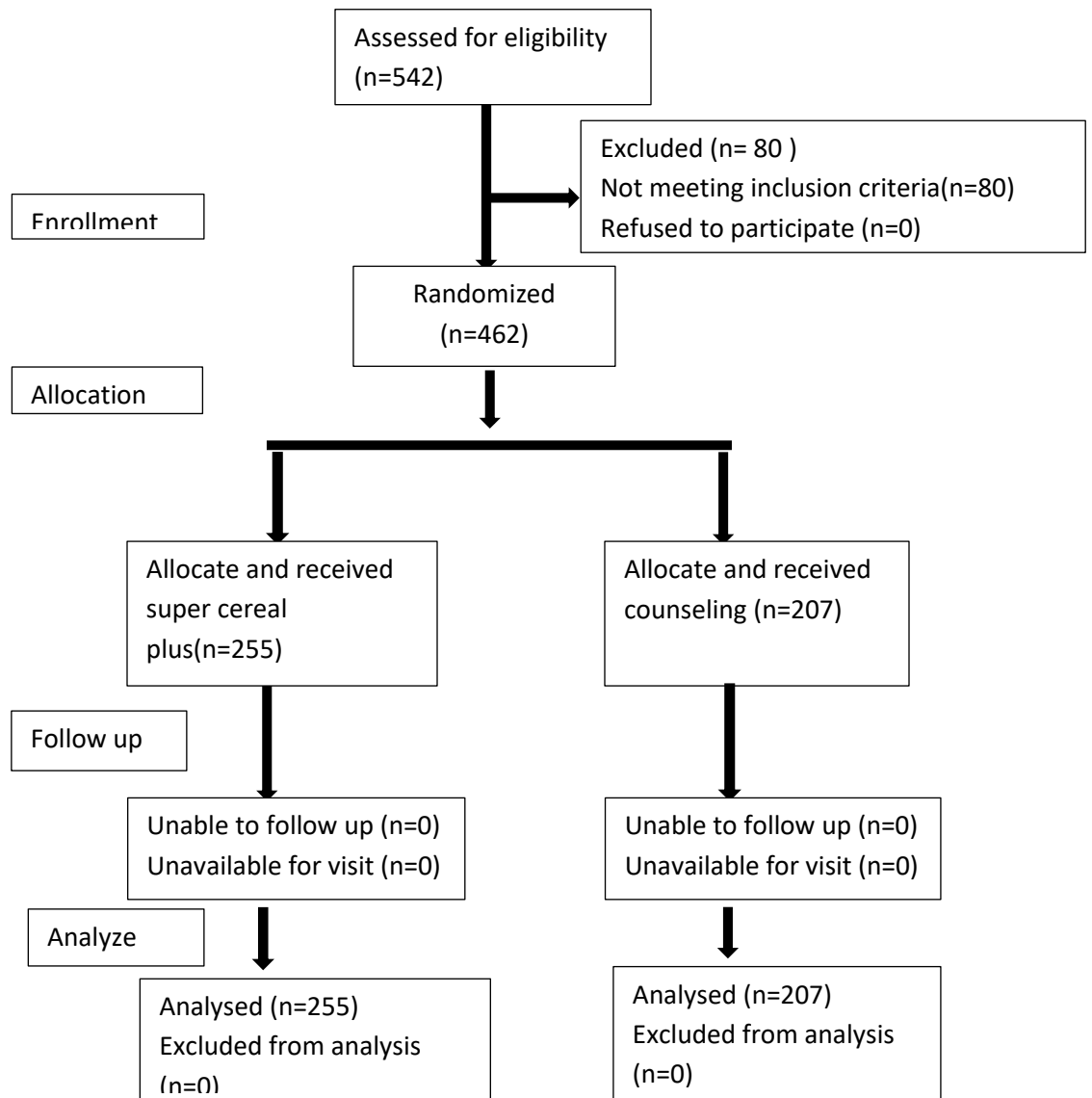


Figure 2:CONSORT flowchart of participants.

4.1 Socio-demographic data for Group 1(Super cereal plus) and Group 2(Counselling).

Female respondents were more than male respondents in both group. In Group1, mother education level were 18.4% illiterate, 66.7% primary, 9.4% secondary and 5.5% higher secondary. In group 2, mother education level were 22.2% illiterate, 44.6% were primary, 17.8% were secondary, 12% were higher secondary and 3.4% were honours pass.

Table 4.1 Socio-demographic data for both Group 1 and Group 2.

Variable		Group 1 (Super cereal plus)		Group 2 (Counselling)	
		Frequency	Percentage	Frequency	Percentage
Sex	Female	154	60.4	109	52.7
	Male	101	39.6	98	47.3
	Total	255	100.0	207	100.0
Mothers Education	Higher secondary	14	5.5	25	12.0
	Honours	0	0	7	3.4
	Illiterate	47	18.4	46	22.2
	Primary	170	66.7	92	44.6
	Secondary	24	9.4	37	17.8
	Total	255	100.0	207	100.0
Fathers education	Higher Secondary	5	2.0	32	15.5
	Honours	5	2.0	14	6.7
	Illiterate	105	41.2	59	28.5
	Primary	128	50.1	86	41.5
	Secondary	12	4.7	16	7.8
	Total	255	100.0	207	100.0
Occupation of fathers	Auto driver	26	10.2	12	5.8
	Businessmen	5	2.0	4	1.9
	Employee	2	0.8	40	19.3
	Farmer	68	26.7	53	25.6
	Fishermen	87	34.1	38	18.3
	Labourer	45	17.7	36	17.3
	Teacher	3	1.2	0	0.0
	Shopkeeper	19	7.5	24	11.6
	Total	255	100.0	207	100.0

4.2 Descriptive statistics of father yearly income of respondents in two groups.

Maximum father of participants were fisherman, farmer, labourer, auto driver. Some of respondents father were teacher and businessman. In group 1, minimum yearly income of father were 70000 BDT and maximum yearly income 180000 BDT. In group 2, minimum yearly income of father were 70000 BDT and maximum yearly income 150000 BDT.

Table 4.2 Descriptive analysis of father's yearly income of respondents.

Statistical Analysis (income)					
Variables	N	Minimum	Maximum	Mean	Std. Deviation
Yearly Income of Father(Group 1)	255	70000	180000	86721.570	25514.179
Yearly Income of Father(Group 2)	207	70000	150000	97191.920	29328.068

4.3 Descriptive statistics of respondents age in two groups.

Target respondents were malnourished children age between 6-59 months of age and who received super cereal plus and counseling. In group 1 minimum age category were 7 months and maximum age child were 56 months. On the other hand in group 2 minimum age category respondents were in 7 months and maximum age were 54 months.

Table 4.3 Descriptive statistics of respondents age in two groups.

Descriptive Statistics (age in months)					
Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age in months(Group 1)	255	7	56	15.420	10.288
Age in months(Group 2)	207	7	54	17.860	10.164

4.4 Type of participants and Integrated Management of Childhood Illness (IMCI) danger sign

Table 4.4 shows that 83.92% participants had no IMCI danger sign and 16.08% participants had IMCI danger sign during admission in Group1(Super cereal plus).On the other hand, 18.84% participants had IMCI danger sign and 81.16% had no IMCI danger sign during enrollment in Group2(Counselling).

Table 4.4 Type of participants and IMCI danger sign

Type of participants IMCI danger sign(Y/N)					
		IMCI Danger sign(Y/N)		Total	Significance
		N	Y		
Type of participants	Group1 (Super Cereal Plus)	214	41	255	0.316
	Group2 (Counselling)	168	39	207	
Total		382	80	462	

The observed significance level for the chi-square statistic is 0.316, which is greater than customary 0.05. It indicates that there is no significant difference between Group1(Super cereal plus) and Group2(Counselling) for the IMCI danger sign(Y/N).

4.5 Differences in anthropometry from baseline to end

Table 4.5 shows differs in anthropometric measurements from baseline to end of participants. A total 462 children were finally involved in this study. From the total sample, 255 children were moderately acute malnourished child of 6-59 month age and received super cereal plus; 207 children were moderately acute malnourished child of 6-59 month age were getting counselling.

Table 4.5 Differences in anthropometry from baseline to end

Participants type	Body weight in kg (Mean \pm SD)		
	During Enrollment	After 2months	After 4months
Group 1(Super Cereal Plus)	7.10 \pm 1.42	7.68 \pm 1.42	8.30 \pm 1.42
Group 2(Counselling)	8.84 \pm 1.97	9.15 \pm 1.96	9.42 \pm 1.97

*In Group 2, the mean value shows higher during enrollment due to the participants were maximum older age child than young child.

The Mean \pm SD of weight during admission (kg) in two groups- Group1 (Super Cereal Plus) & Group2 (Counselling) are 7.1 \pm 1.42 and 8.84 \pm 1.97 respectively. Weight after 4 months 8.30 \pm 1.42 and 9.42 \pm 1.97 respectively. Weight levels are increased in these two groups after 4months of intervention.

The Levene test for equivalent variances

		F	Sig.
Weight during admission	Equivalent variances assumption	29.457	.000
	Equivalent variances not assumption		
Weight after two months	Equivalent variances assumption	27.129	.000
	Equivalent variances not assumption		
Weight after four months	Equivalent variances assumption	24.009	.000
	Equivalent variances not assumption		

4.6 Type of participants and Weight for Age Z score status during enrollment

Table 4.2 shows that in Group1, according to WFA Z score 20% child were mild, 47% child were moderate and 33% child were severe during enrollment. In Group 2, according to WFA Z score 78% child were mild, 22% child were moderate and there were no severe child during enrollment.

Table 4.6 WFA Z score status during enrollment in both group.

Type of participants WFA Z score during enrollment						
		WFA Z score during enrollment			Total	Significance
		Mild	Moderate	Severe		
Type of participants	Group 1(Super cereal plus)	51	119	85	255	0.000
	Group2(counselling)	162	45	0	207	
Total		213	164	85	462	

The observed significance level for the chi-square statistic is less than customary 0.05. It indicates the WFA Z score status During Enrollment is significantly different in Group1(Super Cereal Plus) and Group2(Counselling).

4.7 Type of participants and WFA Z score status after 4 months.

Table 4.7 shows that in Group1, according to WFA Z score; 81% child were mild, 10% child were moderate and 9% child were severe after 4 months. In Group 2, according to WFA Z score 62% child were mild, 38% child were moderate and there were no severe child after 4 months.

Table 4.7 WFA Z score status after 4 months in both group

Type of participants * WFA Z score After 4 months						
		WFA Z score After 4 months			Total	Significance
		Mild	Moderate	Severe		
Type of participants	Group1 (Super cereal plus)	206	26	23	255	0.0001
	Group2 (counselling)	128	79	0	207	
Total		334	105	23	462	

The observed significance level for the chi-square test is 0.0, which is less than customary 0.05. It indicates the WFA Z score status after 4 months of intervention is significantly different in Group1(Super Cereal Plus) and Group2(Counselling)

4.8 Weight gain after 4 months

The mean weight gain per kilogram of body weight after 4 months in two groups-Group 1(Super cereal plus) & Group 2(Counselling) are 1.1976 ± 0.36 and 0.58 ± 0.28 respectively. This table indicates that after 4 months of enrollment period, the weight gain rate is higher for group 1 children in compare to group 2 children. However, the significance level is 0.001 which is less than $P=0.05$.

Table 4.8 Weight gain after 4 months

	Type of participants	N	Mean \pm SD
Weight gain after 4 months	Group 1(Super cereal plus)	255	1.1976 ± 0.366
	Group 2(counselling)	207	0.5848 ± 0.279

Independent samples t test

Variable	Df	T	Sig. (2-tailed) P
Weight gain after 4 months	462	19.53	0.001

Chapter 5

Discussion

The outcome of this research shows that receiving super cereal plus is more effective for weight gain on moderately acute malnourished children than counselling alone. In contrast to our study, a research endeavor in southern Ethiopia revealed that moderately acute malnourished children who received RUSF (Supplemental Plumpy:Nutraset) recovered faster than MAM children who received CSB (Karakochuk et al., 2012).

Comparable to our findings, another study conducted in the same country (Malawi) revealed that children with MAM who got CSB++ had comparable recovery rates to those who received RUSF products. According to this study, CSB++ is the first enriched mixed flour that is equally effective as RUSF in treating moderately acute malnourished children (Manary and Chang, 2012).

Our study shows that the highest percentage of moderate and severe underweight (WFA z score) child are affected in moderate acute malnutrition. Similar to our findings, the proportion of child with a low weight for age or MUAC <12.5 cm may be sign of wasting, stunting, or both (WHO, 2017).

The nutritional status of children is influenced by a variety of environmental and socioeconomic factors, including low incomes at home and mother educational backgrounds (Adnan and Muniandy, 2012). Our study shows that 18% of mothers had no institutional education, 67% mothers had only primary school education, 9% had secondary education and 6% mothers had higher secondary education in Group 1. On the other hand 22% of mothers had no institutional education, 45% of mothers were only primary school pass, 18% mothers had secondary education, 4% mothers had higher secondary education and 3% mothers were honours pass in Group 2. In a previous study on the impact of socioeconomic factors on young children's eating habits in rural Sudan, it was shown that parents with low levels of education made poor food decisions, which in turn increased the likelihood of nutritional anemia and wasting. The study also revealed that one of the major factors contributing to nutritional anemia was a lack of variety in diet due to home poverty and a lack of funds (Abdalla et al., 2009).

Weight, MUAC, WFA z score were changes significantly in this study. Many studies have demonstrated distinct changes in linear development following treatments lasting longer than six months (John C and Gopaldas T, 1993; Phu et al., 2012).

The period of intervention in our study was 112 days. To effectively height growth, additional long-term intervention might be required. Studies with the same intervention period as ours did not find any significant differences in LAZ (Phuka et al., 2009).

Our study carried out to examine effectiveness of super cereal plus among moderately acute malnourished child with counselling who enrolled in GMP. The effectiveness of supplemental blended diets produced from various ingredients, such as maize and soy or rice and soy, in the treatment of moderately acute malnourished has been the subject of several studies (Matilsky et al., 2009; Krebs et al., 2012).

Chapter 6

Conclusion

This study find out weight gain of moderate acute malnourished children who received super cereal plus and counseling. The mean weight gain per kilogram of body weight is more than 50% higher in Group 1(super cereal plus) than Group 2(Counseling).

According to WFA Z score, 20% child were mild, 47% child were moderate and 33% child were severe during enrollment in group 1. After 4 months intervention of super cereal plus in Group 1, 81% child became mild, 10% child became moderate and 9% child became severe. In Group 2, according to WFA z score 78% child were mild, 22% child were moderate. After 4 months in Group 2; 62% child became mild, 38% child became moderate.

Poor maternal education and lower income of fathers responsible for a child becoming malnourished. So, health facility and nutritional management should be developed in rural area for both mother and children.

Chapter 7

Limitations & Recommendation

Limitations

- The primary limitations of this trial were the absence of another supplemented control group and the failure to track the children's nutritional consumption throughout the treatment. A better indicator of how the program affected nutritional status would have been the weight for height (W/H) measurements but in this study only showed weight for age (W/A) measurement and MUAC for detection of malnutrition. Sharing of super cereal plus with other family members may have limited to impact on cure from MAM.

Recommendation

- This research involved only one union of the country and smaller size data. Further research is advised to cover a wider geographic range in order to increase the validity of findings. A larger sample size for the study could produce more precise data about the prevalence and contributing causes of childhood malnutrition. Further research on malnutrition is advised to include weight for height measurement for better results.
- Combination of super cereal plus and counselling will more appropriate for management of moderate acute malnutrition.
- WASH facility must be improve in this study area because it is crucial to human health and well-being.

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Appendix-1: Questionnaire

Analysis of nutrition specific intervention by supplementing super cereal plus and management of moderately acute malnourished children on 6-59 months of age in Ali Akber Dail union of Kutubdia, Cox's Bazar.

Consent of the participator:	
a. Yes	b. NO

Section 1: General information:

Name of the child:	
Sex:	
Father's name:	
Mother's Name:	
Village:	
Income of father:	
Father's occupation & Education	
Mother's occupation & Education:	
	6-23m
	24-59m
Age confirmation:	Birth Certificate
	Vaccine card
Any Disabilities:	Yes
	No
If yes which types of disabilities? (according to Washington questionnaires) :	Have any difficulties in seeing?
	Have any difficulties in hearing?
	Have any difficulties in walking / climbing?
	Have any difficulties in Remembering / Concentrating
	Have any difficulties in Speaking

Section 2: Anthropometric assessment:

Oedema	
MUAC	
Weight (in kg)	
WFA Z score	
Visible sign of wasting	
IMCI danger Sign:	
Recent history of Diarrhoea	

Section 3: Types of Nutrition service received from NGOs

Does she/he Admitted any nutrition facility ?	Yes	
	No	
If yes than in which component?	OTP	
	TSFP	
	BSFP	

Section 4: IYCF Practice for (for 6-24m age child)

Does mother breast feed her child?	Yes	
	No	
Did Colostrum feed to the child within 1 hour of birth	Yes	
	No	
Is regular foods are taken along with Super Cereal Plus	Yes	
	No	

Section 5: Hygiene practice

	Preparation of food	
	Before feeding	
	Before eating	
Does the care giver wash the child hand with clean water and soap before s\he eat?	Yes	
	No	
Environmental hygiene		
Source of drinking water		
Facility of sanitary latrine		

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Reg.: 832

Applied Human Nutrition and Dietetics, Dept. of Applied food Science and Nutrition.

Appendix-2: Steps of MUAC measurement

Arm circumference "insertion" tape



<p>1. Locate tip of shoulder</p>	<p>2. Tip of shoulder 3. Tip of elbow</p>	<p>4. Place tape at tip of shoulder 5. Pull tape past tip of bent elbow</p>	<p>6. Mark midpoint</p>
<p>7. Correct tape tension</p>			
<p>8. Tape too tight</p>			
<p>9. Tape too loose</p>			

Appendix-3: Steps of weight measurement

Position head and feet as illustrated with child standing as straight as possible.

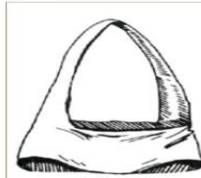


Weight:

Remove heavy clothing and shoes and weigh using class III clinical electronic scales in metric setting.



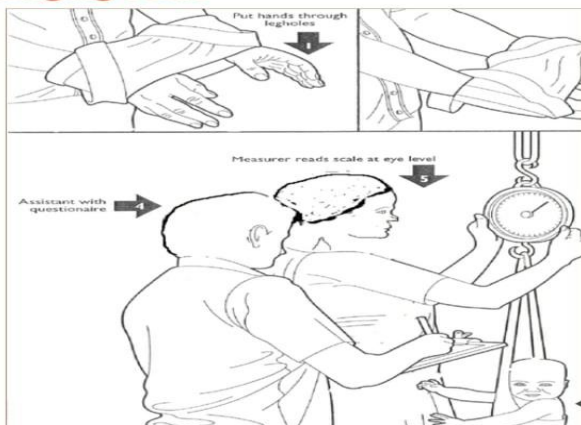
Weight Pants



Spring (Salter) scale



Salter hanging scale



Appendix-4: Photo gallery (Anthropometric measurement)



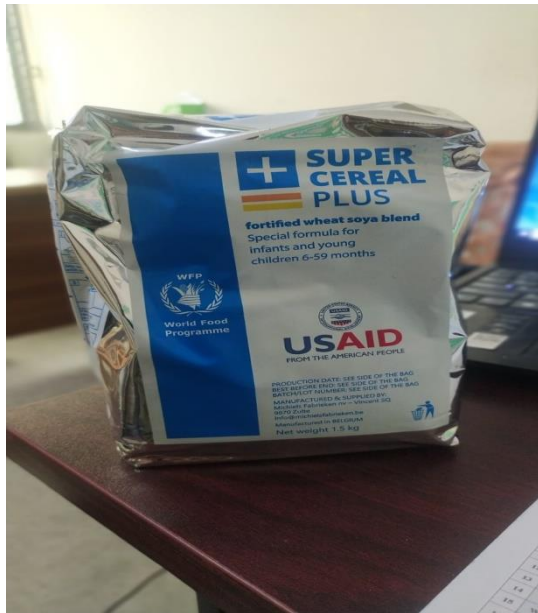
MUAC measurement



Weight measurement



Counselling to caregivers



Super Cereal Plus

Appendix-5: Ethical Approval

Directorate of Research and Extension



Chattogram Veterinary and Animal Sciences University

Zakir Hossain Road, khulshi, Chattogram-4225, Bangladesh
Tel.: +88-023-34466224 (Direct), Fax : 88-031-659620
E-mail : drecvasu@gmail.com, Website: www.cvasu.ac.bd

Memo no.- CVASU/Dir(R&E)EC/2023/500/13

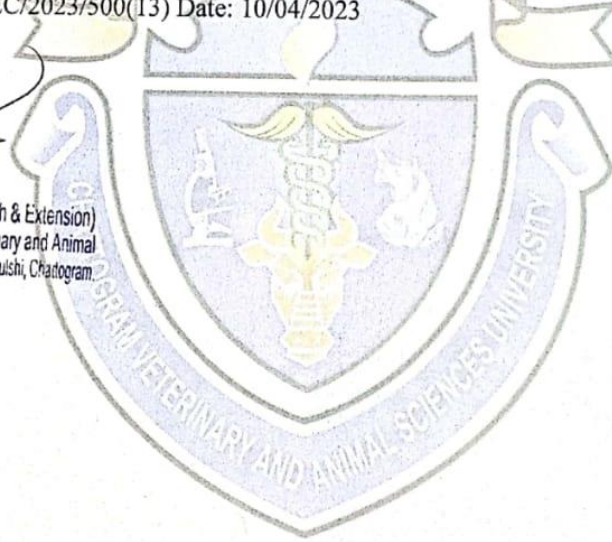
Date: 10/04/2023

Ethics Committee (EC) of CVASU

This is to certify that, the project "Analysis of nutrition specific intervention by supplementing super cereal plus and management of moderately acute malnourished children on 6-59 months of age in Ali Akber Dail union of Kutubdia, Cox's Bazar" being investigated by Arshadul Islam, MS Student, Applied Food Science & Nutrition, CVASU has met the necessary requirements of Chattogram Veterinary and Animal Sciences University Ethics Committee. The CVASU Ethics Committee approves the proposed study with retrospectively from the date of commencement of the activities. The CVASU Ethics Committee approval number for the project is Memo no.- CVASU/Dir(R&E)EC/2023/500(13) Date: 10/04/2023

Member Secretary
CVASU-EC

Director (Research & Extension)
Chattogram Veterinary and Animal
Sciences University, Khulshi, Chattogram.



Brief Biography of the Student

This is Arshadul Islam son of Shafar Mulluk and Shakera Begum. He has passed the Secondary School Certificate Examination in 2011 from Bheola Manik Char High School, Cox's Bazar and then Higher Secondary Certificate Examination in 2013 from Cox's Bazar Government College, Cox's Bazar. He obtained his B.Sc. (Honors) in Food Science and Technology from the Faculty of Food Science and Technology at Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh. Now, he is a candidate for the degree of Masters of Science in Applied Human Nutrition and Dietetics under the Department of Applied Food Science and Nutrition, Chattogram Veterinary and Animal Sciences University (CVASU). He has an immense interest to work in improving the health status of people through proper guidance and suggestions and to create awareness among people about food safety and nutrition.