

Maternal Capacities and Child Health Outcomes: Insights from Bangladesh
American Institute of Bangladeshi Studies
Final Report

Amanda Zongrone, MPH, PhD Candidate
International Nutrition, Division of Nutritional Sciences
Cornell University

Specific Aims

The goal of this research is to investigate the factors that influence the use of recommended infant and young child feeding (IYCF) practices and micronutrient powders (MNPs) among mothers in the Alive & Thrive (A&T) multiple platform intervention in Bangladesh. The lens of “maternal capacity” will be used in this analysis. “Maternal capacities” are the characteristics of a mother that directly influence her actual or potential ability to protect, train and nurture a child, including the uptake of new child care interventions. Recently, we developed the Maternal Capacities Framework to provide measurable constructs for maternal capacities that can be applied to population-based interventions. It captures how key characteristics enable or constrain maternal demand for and adoption of interventions to promote healthy child growth. **Through the application of the maternal capacities framework in the analysis of data from the A&T intervention this research will address a major gap in this field, the lack of understanding of how characteristics of mothers shape both the demand and uptake of behavior change in a nutrition intervention aimed at improving child health.**

In Bangladesh, the problems of underweight, stunting, and anemia in children under 2 years old are widespread. Approximately 34% of children under 2 years of age suffer from underweight, 20% are wasted, 32% are stunted and 86% are anemic.^{1, 2} The adoption of efficacious IYCF practices by mothers and other household members could reduce stunting by ~1/3, anemia by ~1/2, and mortality by ~1/4. Efficacious IYCF interventions include the early initiation of breastfeeding; exclusive breastfeeding for the first 6 months of life; adequate, timely, and appropriate complementary feeding from 6-24 months of age; and continued breastfeeding after the introduction of complementary foods.³ In Bangladesh ~50% of the population lives below the international poverty line.⁴ Poverty contributes to the problem of malnutrition, undernutrition, and poor health. Interventions targeting IYCF practices are efficacious working in households with limited resources.

The effectiveness of all of these IYCF interventions depend upon specific actions carried out

by the mother (or primary caregiver) of the child. However, mothers vary in their ability to carry out recommended practices for many reasons, which may include their general social, psychological, and physical aspects as well as such behavior-specific attributes as their goal salience, self-efficacy, and attitude.

In collaboration with the A&T and a sub-study contracted by the Global Alliance for Improved Nutrition (GAIN) in Bangladesh, the Maternal Capacities Framework will be modeled using both quantitative and qualitative methods. This intervention is a national, multi-component IYCF intervention with a majority of program components targeting mothers. It provides an unparalleled opportunity to understand how maternal capacities influence child health outcomes in the context of an intervention with both interpersonal communication strategies to promote proper IYCF practices and the sale of MNPs to reduce childhood anemia. **This research will provide insight into how material resources and knowledge are translated in an intervention working through mother's behaviors to improve child nutritional status.** In this way, we will advance our knowledge of how the uptake and adoption of child health interventions may be constrained by maternal capacities, and shed light on how the design of interventions could be improved to overcome those constraints.

The specific aims of the proposed research are to:

1. Elucidate the influence of maternal capacities in the timely and appropriate introduction of complementary foods and the trial of new technology (MNPs).
 - a. *Through quantitative modeling of the GAIN sub-study endline survey using factor analysis and ordinary least squares regression analysis.*
 - b. *Through a mixed methods analysis of the GAIN sub-study endline survey and household-level, longitudinal, explanatory case studies consisting primarily of qualitative data.*
2. Elucidate how cultural and household contextual factors in combination with maternal capacities influence post-purchase utilization patterns of MNPs.
 - a. *Through analysis of household-level, longitudinal, explanatory case studies consisting primarily of qualitative data.*

The long-term goals of this project are to define and describe how maternal capacity modifies child health outcomes in large interventions in diverse settings and to develop methods to target maternal capacity constraints to improve intervention efficacy.

Background & Literature Review

The Problem & The Intervention

Childhood undernutrition is one of the most important public health challenges facing our world today. When considering all causes of global under-five mortality, it is estimated that 35% of these deaths are attributable to malnutrition.⁵ The critical “window of opportunity” for child growth is in the first two years of life; recent analyses have found that growth faltering during this period is more severe than previously thought.⁶

One strategy to address this issue is to work within the existing community and household resources to change key behaviors that impact child nutritional status. The A&T intervention is targeting behavior change in mothers around the core IYCF feeding practices. This intervention is built upon BRAC’s (a large NGO in Bangladesh) existing essential health care program that includes a system of health workers. Additionally, GAIN is supporting BRAC and Renata Pharmaceuticals to support the sale of MNPs (Sprinkles) by BRAC health volunteers.

A&T Intervention

The A&T intervention is in three countries, Bangladesh, Ethiopia and Viet Nam (www.aliveandthrive.org). In all three countries A&T’s aim is to “facilitate change for improved infant and young child feeding, to document how interventions are delivered and their costs and impact; and to disseminate the evidence and lessons learned so that others can adapt and replicate the cost-effective components.”⁷

Three goals of the A&T intervention are to:

- “Improve the policy and regulatory environment to support IYCF interventions and

practices

- Create, shape, and support demand for improved IYCF social norms and practices at the community and family levels
- Increase supply, demand, and use of fortified complementary foods and related products”⁷

In Bangladesh A&T is working with multiple sectors to achieve these goals including the government, non-governmental organizations, and private initiatives. The leading non-governmental partner is BRAC, a large NGO in Bangladesh. Building upon its Essential Health Care Program (EHC), BRAC is introducing new IYCF specific interventions and strengthening existing components of the program that address IYCF. Frontline health workers (FHWs); health volunteers and health workers are delivering age-appropriate IYCF messages (behavior change communication) and support through home visits, antenatal and postnatal visits, group health forums and community mobilization sessions for key stakeholders and opinion leaders in the community (such as religious leaders and teachers). A new line of health workers have been created with the support of the A&T intervention, IYCF promoters.⁷

A TV and radio campaign has been launched to reinforce the behavior change communication (BCC) delivered by the frontline health workers. The media campaign addresses gaps in current IYCF practices. A&T aims to reach 8 million households with children under 2 years of age through both the community based programs and the media campaign.⁷

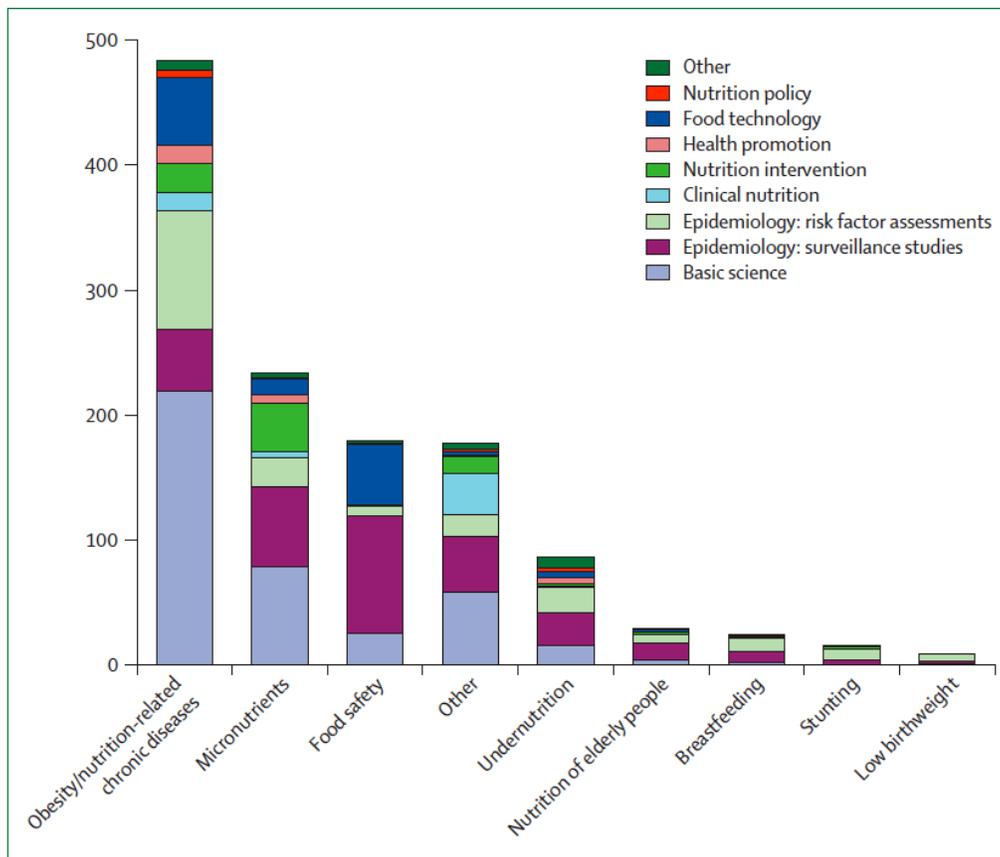
The advocacy component of the intervention works with journalists at the national level through a fellowship and mentoring program. The program is intended to “cultivate IYCF champions and engage decision makers and development agencies in dialogue to raise awareness and investment in nutrition.” This is through increasing competency in IYCF in other health and social sectors such as education and hygiene and sanitation. The overall goal is to increase the advocacy for IYCF at the national political level.⁷

The study presented here will focus on the BCC, community based component of the intervention which includes the partnership with GAIN and Renata pharmaceuticals to support the sale of MNPs through the frontline health workers.

From Efficacy to Scale-Up

Overall, in child nutrition we are moving from efficacy trials to large-scale programs. As Figure 1 depicts, there is a major need for this kind of research across all sectors of nutrition; overall 6.8% of the nutrition related publications added in the second half of 2005 to the CABDirect human nutrition database were about nutrition interventions.⁸

Figure 1: Number of nutrition related publications added to the CABDirect human nutrition database in the second half of 2005, by nutritional problem and disciplinary knowledge area.⁸



The 2008 Lancet Nutrition Series identified key efficacious nutrition interventions.⁹ In 2009 the World Bank identified 13 cost-effective interventions focusing on children under-2 years of age in countries with the highest burden of undernutrition.¹⁰ These evidence-based interventions that were identified include promoting good nutritional practices for breastfeeding and the complementary feeding of infants after 6 mo of age; improved hygiene practices; and the provision of multiple micronutrient powders for young children among others.¹¹

The A&T intervention is targeting these specific efficacious interventions at scale in Bangladesh. Within the process of “scaling-up” nutrition interventions a major knowledge gap is determining how to achieve the same effectiveness we see in smaller, more tightly controlled trials. As part of a Bill and Melinda Gates Foundation call for filling this knowledge gap, A&T has designed and implemented a study that will, through intervention based research, further the understanding of how to effectively implement these efficacious nutrition interventions at scale.

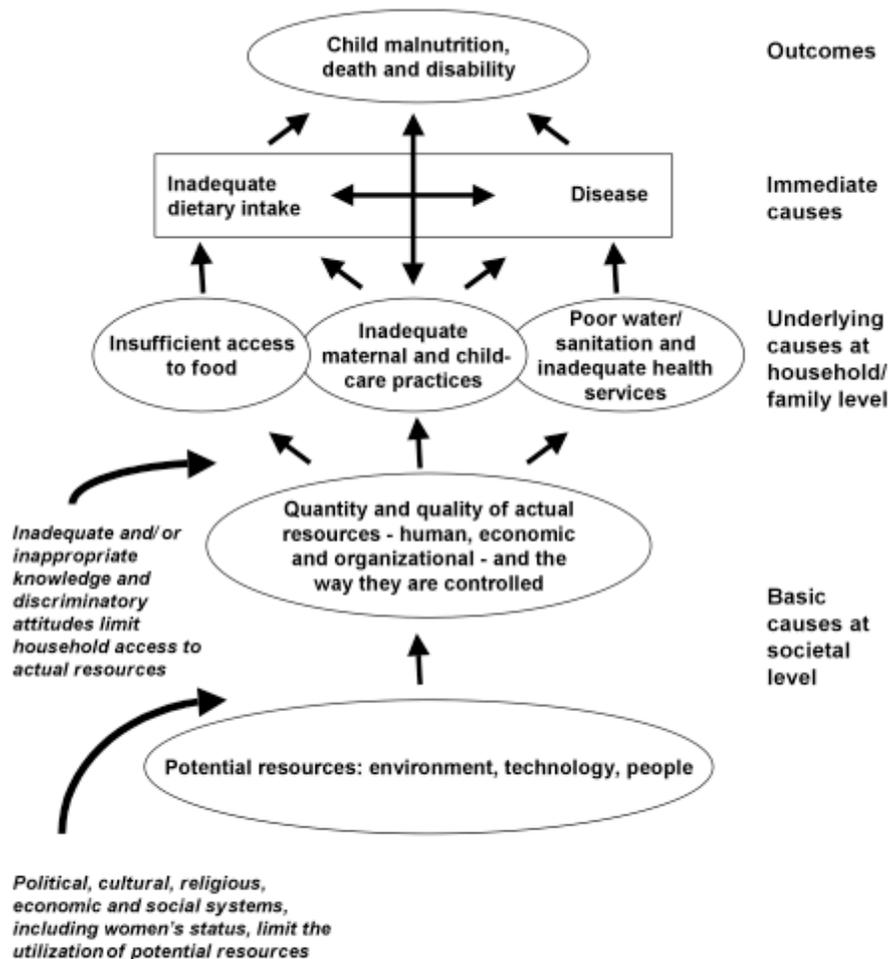
The A&T intervention, like many child nutrition interventions rely upon behavior change of the mother as a major pillar of the program. Interventions rely on mothers to receive, retain and implement appropriate behavior change for their children. However, it is important to consider that mother’s vary in their ability to carry out recommended practices due to multiple influences. These include the general social, psychological, and physical aspects of the mother as well as behavioral specific attributes such as goal salience, self-efficacy, and attitude. Identifying and understanding what the underlying determinants are for a mother to successfully uptake the A&T intervention is an important contribution for the knowledge base for the successful planning and implementation of interventions at scale in the future.

UNICEF Conceptual Framework

The UNICEF conceptual framework is a multi-level social-ecological framework that serves

as a specific elaboration of the Bronfenbrenner Ecological Systems Theory.¹² The UNICEF framework summarizes the key factors that influence childhood malnutrition (Figure 2).¹³ At the basic societal level, potential resources such as the environment, technology, and people impact the quantity and quality of actual resources. These resources are all influenced by the political, cultural, religious, economic, and social systems of the area at the time. This includes gender equality and most specifically, the status of women. At the household/family level, the underlying causes of insufficient access to food, inadequate maternal and child care practices, and poor water/sanitation coupled with inadequate health services are all influenced by the adequacy and appropriateness of knowledge and attitudes. The immediate causes of child malnutrition can be divided into two categories: inadequate dietary intake and disease. Disease and inadequate dietary intake influence each other through the infection-immunity relationship. The final outcome of this cascade of causes is child malnutrition, death and disability. It is important to note that care practices, inadequate dietary intake, disease and the outcome of child malnutrition, death and disability have an integrated relationship as demonstrated by the double arrow.¹³

Figure 2: The UNICEF Framework for Child Malnutrition¹³



Source: The State of the World's Children 1998

The A&T IYCF intervention aims to address child malnutrition at the underlying causes at the household/family level in this framework. It targets access to food, maternal and child-care practices, as well as health care including hygiene and sanitation practices. Although large scale interventions aimed at addressing child malnutrition have been designed and implemented with attention to the basic, underlying, immediate causes described in the UNICEF framework, we still see small gains in efforts to improve child nutritional status.⁵ Additionally, behavior change communication (BCC) strategies have had limited success in

actualizing change among caregivers of young children. Ensuring that health workers sustain efforts to improve child feeding and care practices has proven challenging in many projects.¹⁴ It is our hypothesis that with a greater understanding of maternal capacities, interventions can be more effectively targeted and ultimately have a greater impact on child health. To date, no framework has related maternal capacities to child nutrition either with or in the absence of an intervention.

Several frameworks from the literature in the social sciences have been developed to understand parenting, mothering and family stress in the context of health and nutrition. This literature is largely based in Western constructs of family, time, and resources. The Family Adjustment and Adaptation Response Model (FAAR Model) conceptualizes a family's capabilities to respond to stressful events and how they adjust thereafter. It looks at specific shocks to the household (a death in the family, a loss of income) and parenting capacities.¹⁵ The FAAR model is most applicable in Western contexts and is centered around family emergencies/catastrophic life events.¹⁵ The FAAR framework has also been integrated into another model, family resilience. This combination of the two models further delineates between the outcomes of family systems and family processes that are protective, but still lacks all of the underlying constructs that are incorporated in the maternal capacities framework and is not intended for global application.¹⁶

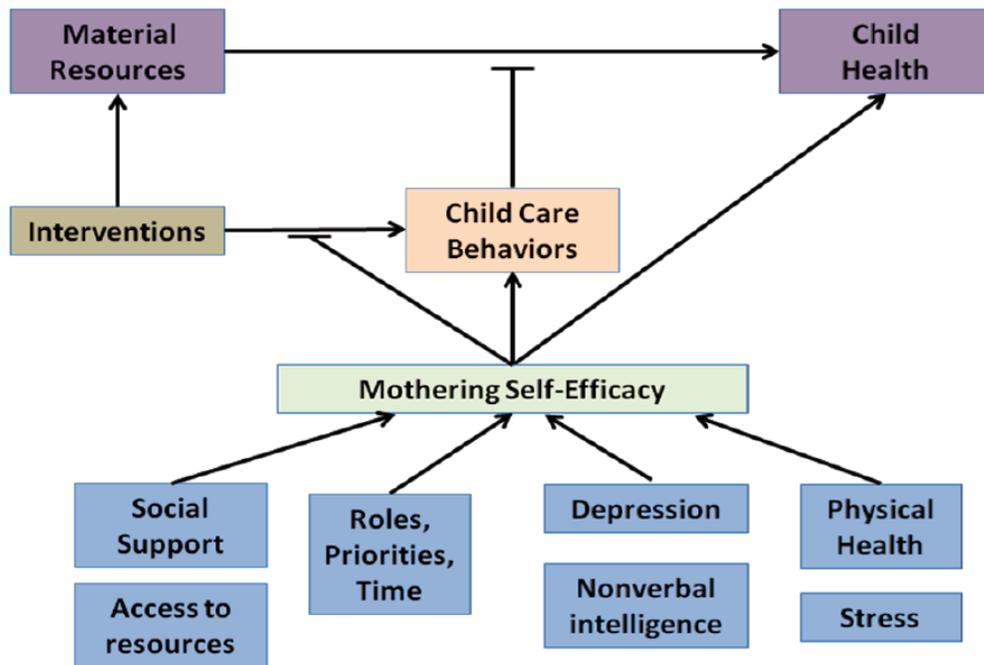
The Developmental Niche model names three basic components of the household that translate into better health. These include physical and social environment, child-care practices, and the psychological health of caretakers.¹⁷ While this framework is applicable across multiple cultures, it does not cover details of maternal characteristics that are essential for child health and intervention uptake. The Theory of Planned Behavior, which includes the Theory of Reasoned Action has been used to explain behavioral intention and the process of using information to achieve behavioral change. Similarly the Transtheoretical Model assesses behavioral intention in three steps; precontemplation, contemplation, and preparation but also asserts that behavior change is a dynamic process for individuals.¹⁸ These two models of behavior change do include aspects of social

support but they do not capture the other aspects of the individual’s capacities that influence the ability to carry out behaviors or successfully adopt an intervention. The maternal capacities framework meets the gap in these theories and provides a globally applicable, measurable model to use in the assessment of populations and population based interventions.

The Maternal Capacities Framework

All of the constructs in the Maternal Capacities Framework (Figure 3) are at the level of the mother, relevant to child caring, modifiable or compensatable, measurable, non-material and not specific to a task.

Figure 3: The Maternal Capacities Framework¹⁹



Each of the constructs can be defined as follows:

- A. Mothering Self-Efficacy—belief about capabilities to produce levels of performance to influence events affecting her child’s health.
- B. Social Support—the size of the relational network; the quality of the network in supporting the woman in her role as a mother.
- C. Non-Verbal Intelligence—the ability to solve logic problems non-reliant on language skills.
- D. Access to Resources—the mother’s ability to access key resources for child care, if they are available at the community or household level.
- E. Depression—state of low mood and aversion to activity that affects thoughts, behavior, and feelings.
- F. Stress—physiologic response to negative aspects of life.
- G. Perceived Physical Health—the overall self-perceived health and energy level to do daily activities, including mothering.
- H. Roles, priorities, and time—the summary of the responsibilities a mother holds; a ranking of how these are valued; and time necessary to meet demands of responsibilities.¹⁹

The Maternal Capacities Framework has four applications that will lead to improvements in child health:

- 1) To describe the variability in maternal capacity between and within communities to advance the understanding of the status of mothers;
- 2) To explain the variability in child health outcomes in contexts that are similar;
- 3) To have predictive power for the variability of the success of child health and nutrition interventions;
- 4) To guide the development of interventions that work to increase maternal capacities and tailor their interventions to meet the maternal capacity constraints in the target population.¹⁹

Elucidating Key Behaviors in the context of the Multifaceted A&T Intervention

For the purposes of this study the behaviors of the timely and appropriate introduction of complementary foods, and the use of MNPs will be examined. The existing literature shows benefits in the health of the child with successful implementation of these behaviors in low resource settings.

Timely and Appropriate Introduction of CF

The optimal duration of exclusive breastfeeding is 6 months (180 days). The introduction of complementary foods (CF) is recommended at 6 months with the continuation of breastfeeding.²⁰ Waiting until 6 months of age to introduce solid foods confers benefits that outweigh any risks of waiting for this time period. Introducing CF too early can minimize the protective effects against infant gastrointestinal infections.²¹ Additionally, growth is not generally improved through the introduction of CF before 6 months of age as breastmilk is often replaced by CF when CF is introduced early.^{22, 23} Waiting too long for the introduction of complementary foods (after 6 months) has negative consequences for the child as a child's nutritional needs can't be met with breastmilk alone after this time period.²⁴ The motor development of the infant at this stage is such that semi-solid and soft foods are appropriate for most infants.²⁵

The Guiding Principles for Complementary Feeding of the Breastfed Child states that “optimal complementary feeding depends not only on what is fed, but also on how, when, where and by whom the child is fed.”³

Maintenance of breastfeeding, responsive feeding, safe preparation and storage of complementary foods, the quantity of food given to the child, the food consistency, the meal frequency and energy density and nutrient content of the complementary foods are all very important components of the appropriate introduction of complementary foods.³

Nutrition education interventions are usually given as a package of BCC that targets the continuum of IYCF practices. It is difficult to distill the effects of the practice of timely and

appropriate introduction of CF as this does not occur in isolation. Interventions that address this recommendation were recently reviewed.²⁶ Among studies that provide nutrition education only²⁷⁻³⁴ overall, the pooled estimates found a significant effect on both child height and weight gain.²⁶

Use of Micronutrient Powders

Most studies have investigated the effect of MNPs on anemia, and/or iron deficiency. A recent Cochrane review on the safety and the effects of home fortification of foods with multiple micronutrient powders for children found an overall reduction of 31% in anemia (Hb \leq 110 g/L) and 51% in iron deficiency (as defined in each individual study) using studies that compared an MNP intervention with either no intervention or placebo.³⁵ Using the GRADE working group grades of evidence³⁶ the authors of this paper found the strength of the evidence for the effect of MNPs to be moderate for anemia and high for iron deficiency. The six studies that provided the evidence for anemia^{35, 37-41} included one study that the authors determined had a high risk of bias,³⁹ thus only providing an overall moderate quality of evidence for the effect on anemia.

Of both biological and programmatic relevance (but not included in the Cochrane review for lack of a non-intervention group), Ip et al., 2009 compared a daily versus a flexible administration of MNPs on both acceptability and Hb status in children 6-24 months of age.⁴² The participants were randomized to three groups, a daily 2-month-long, a flexible 3-month-long, or a flexible 4-month-long supplementation group all with nutrition education. This study found a significant reduction in the prevalence of anemia from baseline to endline in all groups. However, there was not a significant difference in the anemia cure rate between groups at the end of the intervention. Since children who were anemic at the end of the intervention were not included in the 6 month follow up (they were referred for treatment) the authors were only able to compare the differences among those who had reached a Hb \geq 110 g/L. Among those who reached non-anemic status by the end of the intervention the percentage of children who were able to maintain their non-anemic status was significantly greater in the 4-month flexible group compared to the daily

2-month group. These findings can be explained largely by significantly greater adherence in the flexible administration groups. Additionally, the flexible groups had less frequent consumption potentially allowing for more time for the intestinal cells to have mucosal turnover. These children may have had a greater ability to build up iron stores and therefore prevent a recurrence of anemia in the following 6 months.

The effect of MNPs on growth was investigated in two studies.^{37, 39} Neither found any effect on LAZ and WHZ in children who received the supplement for 6 months³⁹ and 12 months³⁷ compared to the placebo group. The study by Adu-Afarwuah et al., 2007 needs to be interpreted cautiously due to issues in random assignment of subjects to intervention and placebo groups. However, Giovanni et al., 2006 randomized well and there was no other risk of bias including randomization, blinding and attrition.

In Bangladesh, a study by Lemaire et al., 2011 did not find an overall effect of the MNP on growth.⁴³ During the intervention growth rate was normal for both placebo and intervention group, however, at the conclusion of the intervention these benefits were no longer seen. This could have been due to the nutrition education that was received by all of the groups and/or the visits from the study staff that may have changed behavior (Hawthorne effect). In their analysis of secondary outcomes, Lemaire et al., 2011 found not only that overall an MNP was non-inferior to the placebo in terms of safety but that also there was evidence of a protective effect of MNP during one phase of the intervention. In Phase 1 of the intervention the MNP group had a significantly lower incidence of episodes of DDL compared to the placebo powder group. This, however, is suggestive and is an indication for the need for future research as this same association was not seen in the second phase of the intervention nor when the results were combined. This trial also faced a potential Hawthorne effect as the overall incidence rates of DDL were lower than expected. The study was powered to see 7 incidences of diarrheal disease and only observed 1-2 per child.⁴³

Approach

The funding from the American Institute of Bangladeshi Studies allowed me to conduct formative research using the method of cognitive testing; conduct an in-country programmatic document review; meet with key members of the A&T team to plan methods and logistics to address my specific dissertation research aims; and establish important relationships with in-country field staff. A summary of the resulting research plans is presented below.

Background, Site, Study Population and Study Staff

For my dissertation research I propose to use both mixed and multiple methods within the parameters of the A&T qualitative research and the GAIN quantitative sub-study data to address my specific aims (discussed below). This study will be conducted in rural Bangladesh. The study sites are characterized by high poverty and undernutrition. The population for the quantitative analysis will be the same study population that is participating in the GAIN endline survey. The population for the qualitative analysis will be selected from intervention areas based on the selection criteria discussed below.

The principal investigator (PI) of this study will be Amanda Zongrone, PhD student at Cornell University. Study staff includes the A&T qualitative research team (7 local anthropologists), a survey data collection team, and additional transcribers and translators (hired from outside A&T as needed).

Aims

The specific aims of the proposed research are to:

1. Elucidate the influence of maternal capacities in the timely and appropriate introduction of complementary foods and the trial of new technology (MNPs).
 - a. *Through quantitative modeling of the GAIN sub-study endline survey using factor analysis and ordinary least squares regression analysis.*
 - b. *Through a mixed methods analysis of the GAIN sub-study endline survey and household-level, longitudinal, explanatory case studies consisting primarily of*

- qualitative data.*
2. Elucidate how cultural and household contextual factors in combination with maternal capacities influence post-purchase utilization patterns of MNPs.
 - a. *Through analysis of household-level, longitudinal, explanatory case studies consisting primarily of qualitative data.*

Methods

Quantitative Methods

This research is nested within the larger GAIN sub-study. The sample that will be available to me will be 800 children who have experienced the A&T intervention (400 with the Sprinkles intervention and 400 without) and 800 who have experienced the Sprinkles intervention (400 with the A&T intervention and 400 without the A&T intervention) available for analysis.

Cognitive Testing

The GAIN endline survey as designed, includes questions that fit the constructs in the maternal capacities framework. Three constructs were not fully developed in the baseline survey: perceived physical health; roles, priorities, and time; and self-efficacy. Table 1 lists the construct and the corresponding module in the survey.

Table 1: Maternal Capacities Construct and Corresponding Module in the GAIN Sub-Study

<i>Maternal Capacities Construct</i>	<i>GAIN Sub-Study Module(s) Containing Relevant Questions / Validated Assessment Tool</i>
Access to Resources	F, J, K
Depression	M / Edinburgh Postnatal Depression Scale
Non-Verbal Intelligence	To be determined
Perceived Physical Health	Developed Summer 2011
Roles, Priorities, Time	Developed Summer 2011
Self-Efficacy	Developed Summer 2011
Social Support	K, L
Stress	M / SRQ20

In the Summer of 2011 existing questions from the US context were adapted and tested using “cognitive testing.” Cognitive testing is a method that can be used to determine how respondents interpret survey questions. This is done through in-depth, semi-structured qualitative interviews. The cognitive testing process follows four stages of the question-response process, comprehension, retrieval, judgment, and response. Table 2 describes the four stages of the question-response process that cognitive testing targets.

Table 2: Stages of Question-Response Targeted During Cognitive Testing⁴⁴**Cognitive Model of Question-Response**

		Cognitive Stage Definition	Response Errors/Question Problems
Stage 1	Comprehension	Respondent interprets the question	Unknown terms, Ambiguous concepts, Long and overly complex
Stage 2	Retrieval	Respondent searches memory for relevant information	Recall difficulty
Stage 3	Judgment	Respondent evaluates and/or estimates response	Biased or sensitive, Estimation difficulty
Stage 4	Response	Respondent provides information in the format requested	Incomplete response options

Questions that relate to the three constructs that were not fully captured in the baseline survey were tested using this process in the Summer of 2011, adapted versions of these

questions will be included in the GAIN endline survey and will be used in the quantitative modeling of maternal capacities (described below).

Ordinary Least Squares Regression

Regression analysis will be conducted using the constructs that best explain maternal capacities to determine how they are associated with the variability in the timely and appropriate introduction of complementary foods and the trial of MNPs. The A&T intervention variable will be modeled using the questions in Module J “The Use of A&T Community Component Services.”

Model 1:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2$$

Where:

x_1 = The A&T Intervention

x_2 = Maternal Capacities

Y = The timely and appropriate introduction of complementary foods

Model 2:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2$$

Where:

x_1 = The A&T Intervention

x_2 = Maternal Capacities

Y = The trial of MNPs

Additional control variables to be added to these models include:

Variable	Unit
Child Sex	Male or Female
Maternal Height	cm
Maternal BMI	kg/m ²
Maternal Education	Primary, Secondary, Highschool or more
Wealth Index	Poorer, Middle, Richer, Richest
Currently Breastfeeding	Yes or No
Number of Children	Continuous
Mother's Age at First Birth	Continuous
Region of Bangladesh	Dummy Variables

STATA statistical analysis software will be used for all analyses.⁴⁵

Qualitative Methods

Case Studies

Case studies will be used to address the questions posed in both Aims 1 and 2. Three parameters that Yin⁴⁶ states makes the use of case studies most appropriate are all fulfilled here.

He states “this method is most appropriate if you want to:

- 1) define research topics broadly and not narrowly
- 2) cover contextual or complex multivariate conditions and not just isolated variables
- 3) Rely on multiple and not singular sources of evidence”⁴⁶

The case studies will generate both descriptive and explanatory data. The descriptive data will contextualize the experience of the participants in the intervention. The explanatory data will suggest important clues to possible cause and effect relationships.⁴⁶

The interview guides and sampling frame will be designed in collaboration with in-country qualitative team. In-depth interview guides for all interviews will be developed with the following modules dependent upon month of interview, timing of introduction of CF and use of MNP:

1) Behaviors

- a. Complementary Food introduction
- b. MNP introduction
- c. MNP sustained use

2) Intentions/Plans

- a. Complementary Food introduction
- b. MNP introduction
- c. MNP sustained use

Future Research Plans

I will be returning to Bangladesh in the Spring 2012 semester to continue my collaborations with A&T and conduct the research plan summarized above. I have been in contact with the AIBS, Dhaka office and upon my return I will give a presentation discussing my research.

The funding received from AIBS helped me to conduct important formative research and establish myself and my dissertation plans within the context of the A&T program. Important connections with key staff members were made. These relationships continue to be fostered and will be an integral factor in the successful completion of my research. I plan on staying connected with AIBS throughout my next stay in Bangladesh and will be joining as an AIBS individual member.

References:

1. NIPORT, Mitra and Associates, Macro International. (2009) Bangladesh: DHS, 2007 - Final Report.
2. WHO. (2011) Vitamin and Mineral Nutrition Information System (VMNIS): WHO Global Database on Anaemia.
3. WHO/PAHO. (2003) Guiding principles for complementary feeding of the breastfed child. Washington, DC: Pan American Health Organization.
4. UNICEF. (2010) Bangladesh: Statistics.
5. Black RE, Allen LH, Bhutta ZA, *et al.* (2008) Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet*. **371**, 243-60.
6. Victora CG, de Onis M, Hallal PC, *et al.* (2010) Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics*. **125**, e473-80.
7. Saha K, Bamezai A, Khaled A, *et al.* (2011) Alive & Thrive, Bangladesh Baseline Survey Report.
8. Morris SS, Cogill B, Uauy R. (2008) Effective international action against undernutrition: why has it proven so difficult and what can be done to accelerate progress? *Lancet*. **371**, 608-21.
9. The Lancet. (2008) Maternal and Child Undernutrition
10. Horton S, Shekar M, McDonald C, *et al.* (2009) Scaling Up Nutrition: What will it Cost? *World Bank*.
11. (2010) Scaling Up Nutrition: A Framework for Action.
12. Bronfenbrenner U. (1986) Ecology of the family as a context for human development: Research perspectives. *Development Psychology*. **22**, 723-42.
13. Pelletier D. (2002) Toward a Common Understanding of Malnutrition: Assessing the Contributions of the UNICEF Framework. Washington, DC. and New York: World Bank and UNICEF.
14. Menon P. (2009) An evaluation of the use of Anuka, a multiple micronutrient supplement, for reducing anemia, encouraging appropriate infant and young child feeding (IYCF) practices and improving child growth in Chattisgarh State in India. *IFPRI*.
15. Patterson J. (1988) Families Experiencing Stress I. The Family Adjustment and Adaptation Response Model II. Applying the FAAR Model to Health-Related Issues for Intervention and Research. *Family Systems Medicine*. **6**.
16. Patterson J. (2002) Integrating Family Resilience and Family Stress Theory. *Journal of Marriage and Family*. **64**.
17. Harkness S, Super C. (1994) The developmental niche: a theoretical framework for analyzing the household production of health. *Social Science and Medicine*. **38**, 217-26.
18. Humphreys A, Thompson N, Miner K. (1998) Assessment of breastfeeding intention using the Transtheoretical Model and the Theory of Reasoned Action. *Health Education Research* **13**.
19. Stoltzfus R, Pelto G, Habicht J, *et al.* (2011) The Maternal Capacities Framework. *Unpublished Work*.
20. WHO. (2005) Guiding principles for feeding non-breastfed children 6-24 months of age. ed.
21. Kramer MS, Kakuma R. (2002) Optimal duration of exclusive breastfeeding. *Cochrane Database Syst Rev*. CD003517.

22. Cohen RJ, Brown KH, Canahuati J, *et al.* (1994) Effects of age of introduction of complementary foods on infant breast milk intake, total energy intake, and growth: a randomised intervention study in Honduras. *Lancet*. **344**, 288-93.
23. Dewey KG, Cohen RJ, Brown KH, *et al.* (1999) Age of introduction of complementary foods and growth of term, low-birth-weight, breast-fed infants: a randomized intervention study in Honduras. *Am J Clin Nutr*. **69**, 679-86.
24. WHO/UNICEF. (1998) Complementary Feeding of Young Children In Developing Countries: a review of current scientific knowledge. *WHO/Nut/981*.
25. Naylor A, Morrow A. (2001) Developmental readiness of normal full term infants to progress from exclusive breastfeeding to the introduction of complementary foods. *Linkages/Wellstart International*.
26. Imdad A, Yakoob MY, Bhutta ZA. (2011) Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. *BMC Public Health*. **11 Suppl 3**, S25.
27. Bhandari N, Bahl R, Nayyar B, *et al.* (2001) Food supplementation with encouragement to feed it to infants from 4 to 12 months of age has a small impact on weight gain. *J Nutr*. **131**, 1946-51.
28. Bhandari N, Mazumder S, Bahl R, *et al.* (2004) An educational intervention to promote appropriate complementary feeding practices and physical growth in infants and young children in rural Haryana, India. *J Nutr*. **134**, 2342-8.
29. Penny ME, Creed-Kanashiro HM, Robert RC, *et al.* (2005) Effectiveness of an educational intervention delivered through the health services to improve nutrition in young children: a cluster-randomised controlled trial. *Lancet*. **365**, 1863-72.
30. Santos I, Victora CG, Martines J, *et al.* (2001) Nutrition counseling increases weight gain among Brazilian children. *J Nutr*. **131**, 2866-73.
31. Shi L, Zhang J, Wang Y, *et al.* (2009) Effectiveness of an educational intervention on complementary feeding practices and growth in rural China: a cluster randomised controlled trial. *Public Health Nutr*. **13**, 556-65.
32. Roy SK, Fuchs GJ, Mahmud Z, *et al.* (2005) Intensive nutrition education with or without supplementary feeding improves the nutritional status of moderately-malnourished children in Bangladesh. *J Health Popul Nutr*. **23**, 320-30.
33. Guldán GS, Fan HC, Ma X, *et al.* (2000) Culturally appropriate nutrition education improves infant feeding and growth in rural Sichuan, China. *J Nutr*. **130**, 1204-11.
34. Kilaru A, Griffiths PL, Ganapathy S, *et al.* (2005) Community-based nutrition education for improving infant growth in rural Karnataka. *Indian Pediatr*. **42**, 425-32.
35. De-Regil LM, Suchdev PS, Vist GE, *et al.* (2011) Home fortification of foods with multiple micronutrient powders for health and nutrition in children under two years of age. *Cochrane Database Syst Rev*. **9**, CD008959.
36. Balshem H, Helfand M, Schunemann HJ, *et al.* (2011) GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol*. **64**, 401-6.
37. Giovannini M, Sala D, Usuelli M, *et al.* (2006) Double-blind, placebo-controlled trial comparing effects of supplementation with two different combinations of micronutrients delivered as sprinkles on growth, anemia, and iron deficiency in cambodian infants. *J Pediatr Gastroenterol Nutr*. **42**, 306-12.
38. Sharieff W, Bhutta Z, Schauer C, *et al.* (2006) Micronutrients (including zinc) reduce diarrhoea in children: the Pakistan Sprinkles Diarrhoea Study. *Arch Dis Child*. **91**, 573-9.

39. Adu-Afarwuah S, Lartey A, Brown KH, *et al.* (2007) Randomized comparison of 3 types of micronutrient supplements for home fortification of complementary foods in Ghana: effects on growth and motor development. *Am J Clin Nutr.* **86**, 412-20.
40. Menon P, Ruel MT, Loechl CU, *et al.* (2007) Micronutrient Sprinkles reduce anemia among 9- to 24-mo-old children when delivered through an integrated health and nutrition program in rural Haiti. *J Nutr.* **137**, 1023-30.
41. Lundeen E, Schueth T, Toktobaev N, *et al.* (2010) Daily use of Sprinkles micronutrient powder for 2 months reduces anemia among children 6 to 36 months of age in the Kyrgyz Republic: a cluster-randomized trial. *Food Nutr Bull.* **31**, 446-60.
42. Ip H, Hyder SM, Haseen F, *et al.* (2009) Improved adherence and anaemia cure rates with flexible administration of micronutrient Sprinkles: a new public health approach to anaemia control. *Eur J Clin Nutr.* **63**, 165-72.
43. Lemaire M, Islam QS, Shen H, *et al.* (2011) Iron-containing micronutrient powder provided to children with moderate-to-severe malnutrition increases hemoglobin concentrations but not the risk of infectious morbidity: a randomized, double-blind, placebo-controlled, noninferiority safety trial. *Am J Clin Nutr.* **94**, 585-93.
44. UNESCAP. (2011) What is Cognitive Testing? How is it useful? Available from: <http://www.unescap.org>.
45. STATA Corp LP. (2010) STATA Data Analysis and Statistical Software. ed.
46. Yin R. (2003) *Applications of Case Study Research. Applied Social Research Methods Series.* Thousand Oaks, California: Sage Publications, Inc.
47. Arimond M, Daelmans B, Dewey K. (2008) Indicators for feeding practices in children. *Lancet.* **371**, 541-2.