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Joan Sara Thomas   22 April 2011

Attitude, self-efficacy, knowledge and intention to exclusively breastfeed among
pregnant women in rural Bangladesh

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Master of Public Health

Global Health

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Committee Chair

Attitude, self-efficacy, knowledge and intention to exclusively breastfeed among pregnant women in rural Bangladesh

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2006

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An abstract of

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Abstract

Attitude, self-efficacy, knowledge and intention to exclusively breastfeed among pregnant women in rural Bangladesh

By Joan Sara Thomas

Background: Malnutrition is responsible for 60 percent of the 10.9 million deaths that occur annually among children. Over two thirds of these deaths are directly associated with inappropriate feeding practices and occur during the first year of life. Although breastfeeding is almost universal in Bangladesh, exclusive breastfeeding is less consistently practiced with a stagnant national prevalence of 42-46 percent for twelve years. Intention to exclusively breastfeed is influenced by socioeconomic status, maternal self-efficacy, knowledge and empowerment issues. Identifying those factors in a mother's life that would influence her to engage in appropriate infant feeding practices is important information for program development.

Objective: This thesis examines the associations among knowledge, attitudes, self-efficacy and exclusive breastfeeding intention among pregnant women in rural Bangladesh, using the Theory of Planned Behavior as a framework.

Methods: Data were analyzed on rural Bangladeshi women who were interviewed in their third trimester of pregnancy, as part of CARE's Window of Opportunity project. A cohort of 800 women was interviewed between 12 January 2011 and 4 February 2011. Indices of maternal attitudes, self-efficacy and knowledge were created by using principal components analysis. The association between intention to exclusively breastfeed and the three indices was assessed using logistic regression.

Results: High levels of positive attitude (OR: 2.30; 95% CI 1.14 - 4.66) and self-efficacy (OR: 3.91; 95% CI 1.91 – 8.00) towards exclusive breastfeeding were associated with intent to exclusively breastfeed. However, in a multiple regression model, higher level of knowledge was only modestly associated with intent to exclusively breastfeed (OR: 1.12; 95% CI 0.74-1.71).

Discussion: In this cohort, positive attitudes and self-efficacy were strongly associated with intent to exclusively breastfeed, while a higher level of knowledge was only modestly associated with intent to exclusively breastfeed. These findings contribute to the limited existing literature on determinants of exclusive breastfeeding in Bangladesh. This analysis reaffirms the need for further population-specific research to identify modifiable causes of intent to exclusively breastfeed. The results of this analysis will be used to inform the Window of Opportunity program.

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1. BACKGROUND

1.1 INTRODUCTION

Malnutrition is responsible for 60 percent of the 10.9 million deaths that occur annually among children. Well over two thirds of these deaths are directly associated with inappropriate feeding practices and occur during the first year of life.[1] A mere 38 percent of the infants worldwide are exclusively breastfed during the first six months of life; complementary feeding is inappropriately introduced either too early or too late and often with nutritionally inadequate or unsafe foods. For those who survive past infancy and childhood, a life time of challenges await them including frequent bouts of sickness and impaired development.[2]

The issue of breastfeeding is complex, relevant not only to matters of infant nutrition, but also greatly reflective of a woman's condition and position. A woman's survival, health and nutrition are all major determinants of her child's long-term welfare. Exclusive breastfeeding is associated with several health benefits. International guidelines recommend that women exclusively breastfeed their infants for the first six months of life. The American Academy of Pediatrics (AAP) states that exclusive breastfeeding should be the 'reference or normative module against which all alternative health, development and all other short- and long-term outcomes must be measured.'[3] The World Health Organization (WHO) states that breastfeeding 'is the normal way of providing young infants with the nutrients they need for healthy growth and development.'[4]

Breastfeeding is an important and cost effective public health promotion initiative for both maternal and child health with the potential to prevent and improve early infant

in appropriate infant feeding practices provides important information, useful to program development.

1.2 RATIONALE AND PUBLIC HEALTH SIGNIFICANCE

Approximately 10% of the disease burden in children under the age of 5, an estimated 1.4 million child deaths and 44 million DALYs (Disability Adjusted Life Years) lost, is attributable to sub-optimal breastfeeding practices, specifically non-exclusive breastfeeding in the first 6 months of life.[5] In Figure 1 below, suboptimal breastfeeding practices is ranked as number 13 out of 19 leading mortality risk factors with the majority occurring in low income countries.

Figure 1 Deaths attributed to 19 leading risk factors, by country income level, 2004[1]

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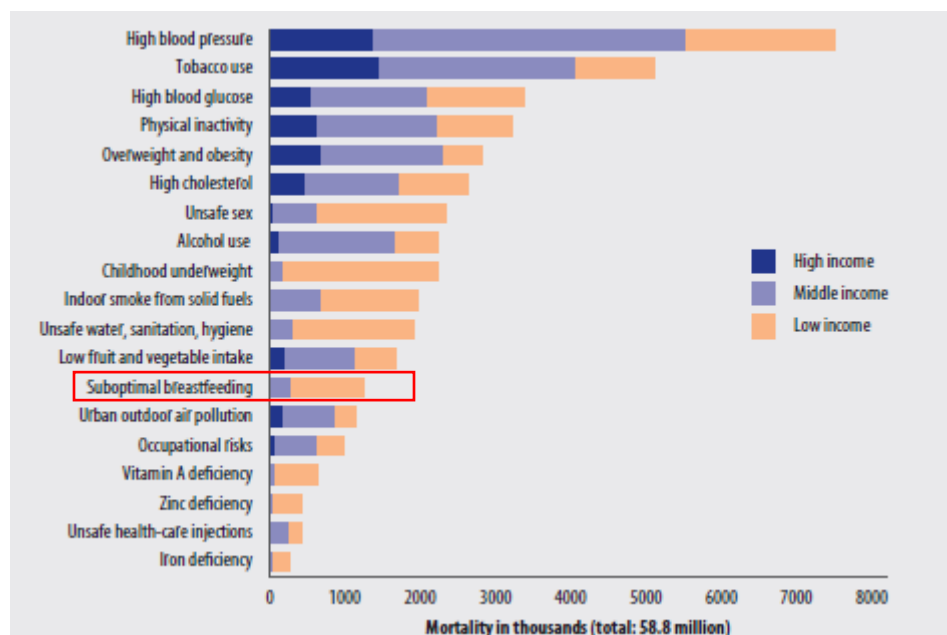
[1] WHO Report 2009 Global Health Risks: Mortality and burden of disease attributable to selected major risks

However when considering the percentage of disability-adjusted life years (DALYs) attributed, (Figure 2) suboptimal breastfeeding practices quickly moves up in the ranks to position 7 out of the 19 leading mortality risk factors with the majority of the burden resting in low income nations.

Figure 2 Percentage of disability-adjusted life years (DALYs) attributed to 19 leading risk factors, by country level income, 2004[2]
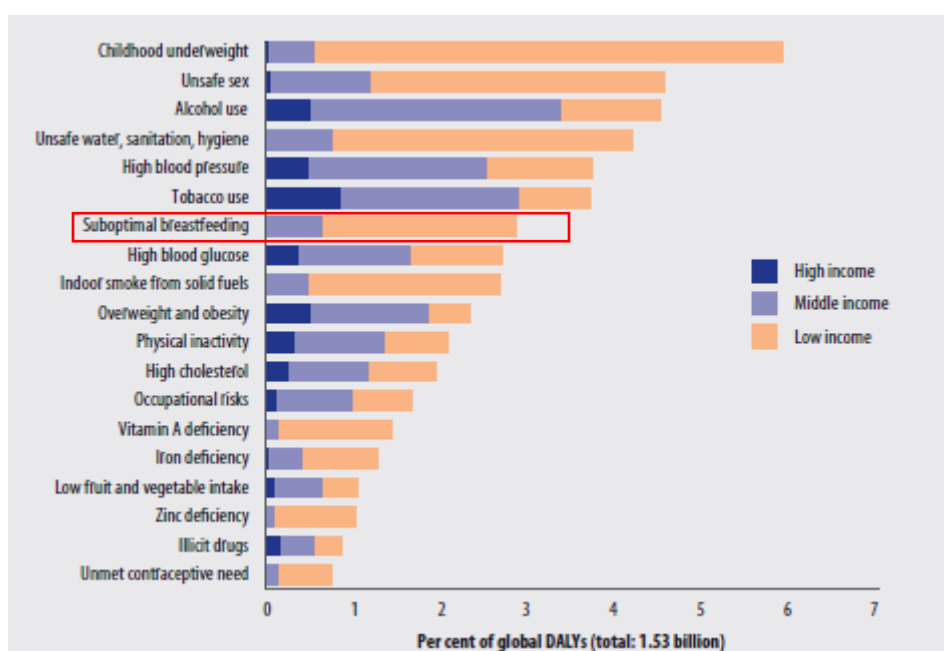
Not only does optimal breastfeeding practices have the potential to prevent unnecessary morbidity and mortality and improvements in maternal health it can also contribute towards achieving set targets for the millennium development goals. Figure 3 below describes how breastfeeding contributes towards each of the MDGs

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[2] WHO Report 2009 Global Health Risks: Mortality and burden of disease attributable to selected major risks

Figure 3 Breastfeeding's contributions towards the Millennium Development Goals[3]

MDG	Contribution of Breastfeeding
Goal 1: *Eradicate Extreme Poverty and Hunger*	Breast milk is a free, high quality, sustainable food supply which substantially reduces early childhood feeding costs. Exclusive and continued breastfeeding for up to two years is associated with a reduction in underweight among children under five years of age.
Goal 2: *Achieve Universal Primary Education*	Breastfeeding and adequate complementary feeding have positive implications for improved cognitive ability. The long chain fatty acids and micronutrients in breast milk and appropriate complementary foods have been associated to specific neurological development important for later school performance.
Goal 3: *Promote Gender Equality and Empower Women*	Most differences in growth between sexes begin as complimentary foods are added to the diet and gender preferences begin to influence feeding decisions. In addition, breastfeeding empowers women by contributing to increased birth spacing and protects against possible maternal depletion.
Goal 4: *Reduce Child Mortality*	Breastfeeding can reduce child mortality by about 13%, and improved complementary feeding can reduce child mortality by about 6%. An estimated 50-60% of under 5 child mortality is caused by malnutrition due to poor breastfeeding practices, inadequate complimentary foods along with low birth weight. The impact is increased in unhygienic settings.
Goal 5: *Improve Maternal Health*	Breastfeeding is associated with decreased maternal postpartum blood loss, breast cancer, ovarian cancer and endometrial cancer. Breastfeeding also increases the duration of birth intervals, reducing the risk of maternal nutritional depletion. Breastfeeding promotes return of the mother's body to pre pregnancy status, including more rapid involution of the uterus and post partum weight loss.
Goal 6: *Combat HIV/AIDS and other diseases*	Based on extrapolation of published literature on the impact of exclusive breastfeeding on parent to child transmission (PTCT) of HIV, exclusive could be associated with a significant and measurable reduction in PTCT.
Goal 7: *Ensure environmental sustainability*	Breastfeeding is associated with industrial waste and use of fire wood/fossil fuels for alternative feeding preparation as well as industrial energy needs and transportation.
Goal 8: *Global partnership for development*	The protection and promotion of appropriate infant and young child feeding (IYCF) requires not only in-country multi-sectoral collaboration but global partnerships that regulate inappropriate developments and create environments where the rights of every women and child are upheld.

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[3] Table adapted from the *infant and Young Child Feeding (IYCF) National Plan of Action 2009-2011* proposed by the Institute of Public Health Nutrition (IPHN) , Directorate General of Health Services, and Ministry of Health and Family Welfare

In Bangladesh, inappropriate infant and young child feeding practices, particularly in the first few months of life, are a serious obstacle to adequate nutritional status contributing greatly to the high national levels of malnutrition. Annually, approximately 260,000 deaths among children under-five in Bangladesh are associated with inappropriate feeding practices during the first year of life.[1] Infant feeding intention is influenced by many factors. The weight attributed to each of these factors varies by socio-cultural context. Although Bangladesh has a strong culture of breastfeeding, the prevalence of exclusive breastfeeding is far less impressive. Health behavior theories show that intentions precede actual behavior.[6-9] Using health behavior models to illuminate specific cultural determinants of intention formation in Bangladesh may improve the development of interventions that can move Bangladesh past its present stagnant prevalence in exclusive breastfeeding. Health behavior theories have often been applied to breastfeeding research; however few of these analyses have been focused on Bangladesh.

1.3 PURPOSE STATEMENT

1.3.1 MAIN OBJECTIVES

This thesis describes the relationships among knowledge, attitudes, self-efficacy and intention to exclusively breastfeed among pregnant women in rural Bangladesh. The data for this analysis were obtained from the first data collection point of a two-year cohort study in Bangladesh, a key part of the evaluation process of the Window of Opportunity (Window). The Window project is a CARE global initiative underway in five countries and three regions focused on promoting, protecting and supporting infant, young child and maternal nutrition in order to improve the nutritional status of children under the age

of two. It is hoped that the findings of this study will add to the current knowledge and inform future maternal-child health program development in Bangladesh.

1.4 STUDY SETTING: THE PEOPLE'S REPUBLIC OF BANGLADESH

Bangladesh is located in the northeastern part of South Asia. Surrounded almost entirely by India, Bangladesh is bordered by Myanmar (formerly Burma) to the southeast and the Bay of Bengal to the south. Influenced by both the Moguls and the British, Bangladesh's history is marked by a series of political transformations. In 1947, following the end of British rule, the area of land known as Bangladesh today separated from India and became East Pakistan. A relatively young nation it was established as a sovereign state and only officially named Bangladesh in March of 1971 after a nine-month war of liberation with Pakistan.

Figure 4: Map of Bangladesh[4]

The majority of Bangladesh lies within the broad, low-lying Ganges-Brahmaputra River Delta. This extensive network of large and small rivers is central to the socioeconomic life of the nation. An extremely flat and low-lying, highly rich alluvial plain; Bangladesh is one of the most fertile areas in the world.

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[4] https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html

With about 150 million people in only 147,570 square kilometers Bangladesh is one of the most densely populated countries in the world. With a large proportion of young people, rapid population growth is forecasted to continue in Bangladesh.[10] Literacy measured according to the Demographic and Health Survey's method of assessing ability to read part of or a full sentence found that 57 percent of ever married men and 55 percent of ever married women were literate.[10] The majority of young Bangladeshis are literate. Close to 90 percent of Bangladeshis are Muslim. Hindus account for the remaining 9 percent with other faiths (namely, Buddhist and Christian) constituting the remaining 1 percent.[11]

The Human Development Index (HDI) a composite measure of progress focused on three dimensions--health, education and income ranks countries according to their relative level of development separating them into 1) high development: value>0.8 2) middle development: value 05-0.8 and 3) underdeveloped: value <0.5.[12] According to the 2010 HDI Report, Bangladesh is ranked 129th out of a total of 162 nations with a corresponding HDI value of 0.469 reflecting low levels of human development below the regional average of 0.516 and far below the world average of 0.624.[13]

Poverty and development are self-reinforcing dynamics which in turn impact health outcomes. Between 2000-2008, an estimated 50 percent of Bangladeshi's were living below the income poverty line and 40 percent were living below the national poverty line representing a very heavy burden of poverty.[12] These figures reflect the low levels of development identified by the HDI and caution of severe challenges to health development.

1.5 STUDY SITES: KARIMGANJ AND KATIADI, TWO SUB-DISTRICTS IN THE DISTRICT OF KISHOREGANJ

This study analyzed data collected from the district of Kishoreganj in the Haor region in the northeast of Bangladesh. The two-year cohort, which is part of the evaluation process of the Window of Opportunity project, is a CARE-USA funded initiative with technical support from Emory University. CARE's Window team is collaborating with Emory University and the International Center for Diarrheal Disease Research, Bangladesh (ICDDR,B), to facilitate a longitudinal cohort study to explore the intentions and follow-through of breastfeeding and complementary feeding of mothers. The Haor region was specifically chosen due to extremely poor performance on key nutrition and poverty indicators. A predicament exacerbated by severe challenges of food and health service security.

The data analyzed for this thesis were collected from interviews conducted in two sub-districts identified by the Window project, in the district of Kishoreganj. Windows identified the sub-district (or *upazila*) of Karimganj as the intervention site, as several pre-existing interventions were active in this area. Karimganj has a population of 320,906 people living in 68,570 households with an average family size of 4.68 individuals with children less than 5 years old representing approximately 17 percent of the total population. The second sub-district of Katiadi was identified as the non-intervention comparison site. Katiadi has a population of 346,140 people living in 74,600 households with an average family size of 4.64 individuals with children less than 5 years old representing approximately 15 percent of the total population. The two sites are rural communities, with fishing and agriculture as the main source of labor. The households in

both *upazilas* are classified as socio-economically underprivileged and maternal health related issues were anticipated to be poorer than that of other areas in Bangladesh.

Figure 5: Map of the district of Kishoreganj and sub-districts Karimganj and Katiadi[5]
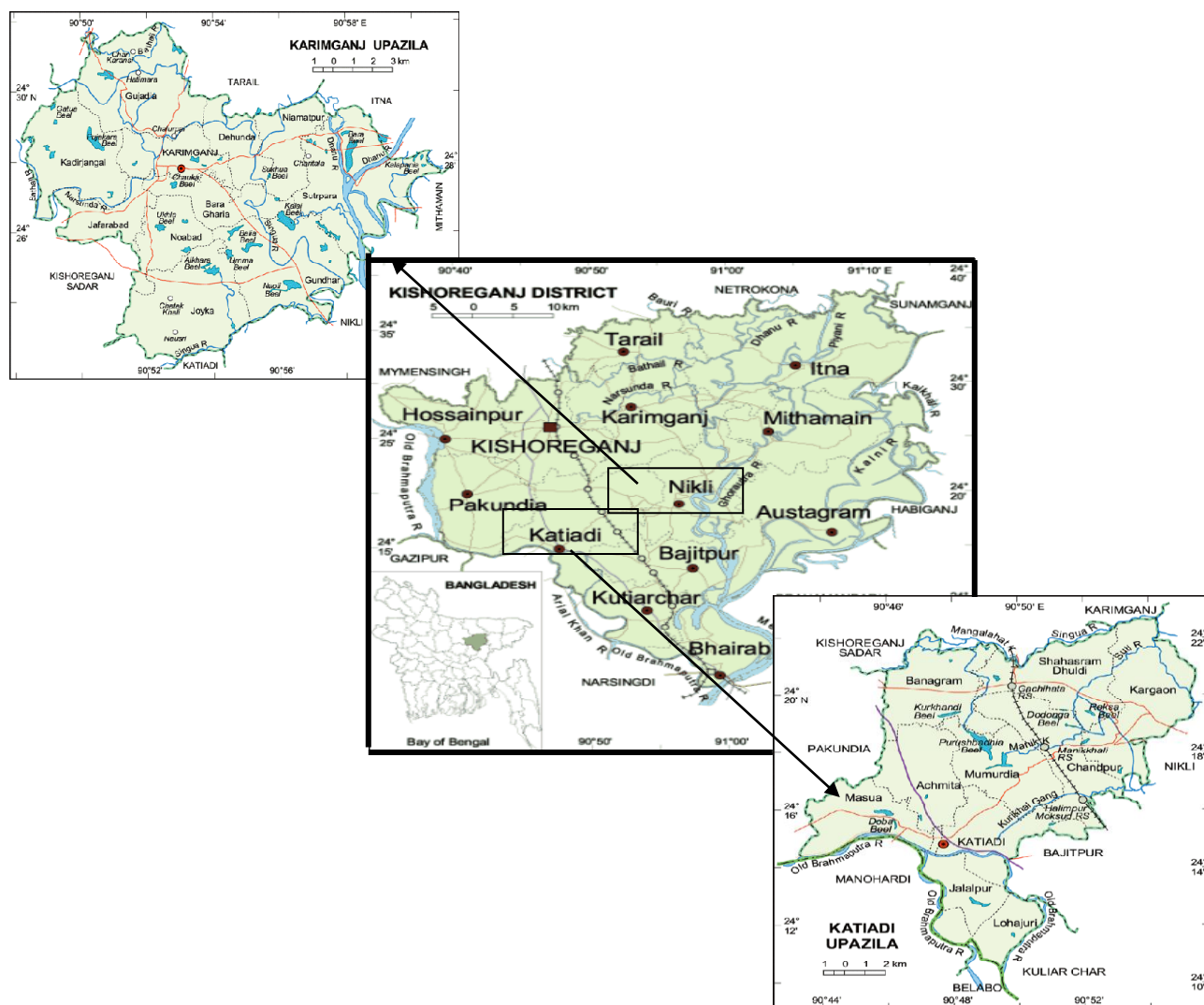
1.6 KEY HEALTH INDICATORS IN BANGLADESH

Although health indicators in Bangladesh have improved substantially since independence, significant progress remains to be made. The 2009 Millennium Development Goals Progress Report on Bangladesh, published by the United Nations Development Program (UNDP), found that only two MDGs are on track; MDG 4: Reduce Child Mortality and MDG 6: Combat HIV/AIDS, malaria and other diseases and all others require urgent attention in order to meet set targets for 2015. Overall there have been upward trends across the majority of the MDGs, however given the present pace at which these improvements are being made; the goals set for 2015 are at risk of not being met. Conflicting development challenges compromise the progress of key goals. For instance, although sub-goals relating to MDG 1 (eradicating extreme poverty and hunger) have shown improvements less significant advances have been made to reduce the proportion of those living below the poverty line.[14] Poverty has implications for both nutrition and development. The two may be seen to have a reinforcing relationship with good nutrition as a determinant of economic development as well as an outcome. This relationship applies equally to malnutrition and poverty.[15]

Bangladesh has made significant progress with regard to child survival over the past few decades. A success realized by the efforts of several initiatives including comprehensive immunization programs, vitamin-A supplementation and effective control of diarrhoeal disease- an effort headed by the ICDDR,B. Nevertheless, these advances are greatly decelerated by significant inequalities and extreme poverty.[14] The Bangladesh Demographic and Health Survey (BDHS) 2007 reports the under-five mortality rate to be

43 per 1,000 live births for the richest quintile and 86 per 1,000 live births, a rate almost twice as high for the poorest quintile.[10] Furthermore, 77 percent of all under-five deaths occur in rural areas compared to 63 percent in urban areas.[16] Over 25 percent of all under-five deaths are caused by diarrhoreal diseases (5 percent) and Acute Respiratory Infections (ARI) (21 percent). [9] Birth asphyxia, pre-maturity, neonatal sepsis, pneumonia and diarrhea are the top five causes of death among Bangladeshi children.[17] The large number of neonatal deaths occurring in Bangladesh remains an additional challenge to reducing child mortality (MDG 4). Neonatal deaths account for 57 percent of all under-five deaths and 70 percent of all infant deaths. Young mothers (under 20 years of age) are at particularly high risk with neonatal death rates of 55 per 1,000 live births. A UNICEF report illustrates the magnitude and severity of this challenge stating that every hour, 14 babies under one month of age die.[18]

Figure 6: Rates of reduction in under-five, infant and neonatal mortality in Bangladesh[6]
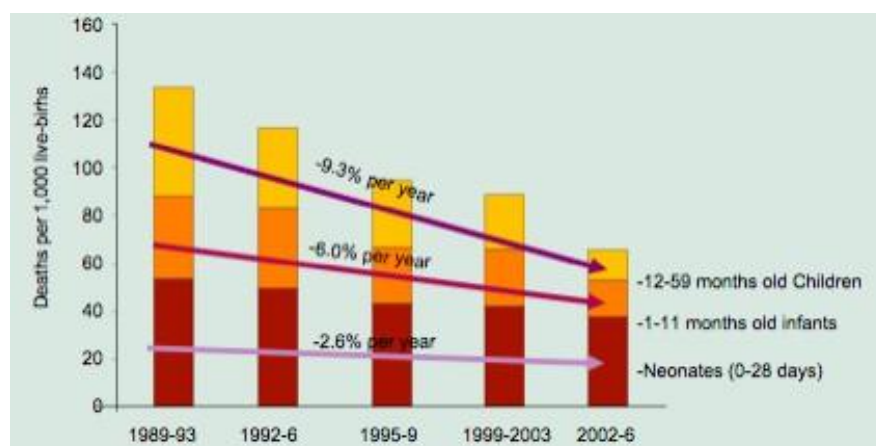
Reducing maternal mortality in Bangladesh is another area in need of progress. Bangladesh's maternal mortality rate is estimated to be 348 per 100,000 live births, much higher than their 2015 goal of 144 per 100,000 live births.[14] The 2011 WHO Report assessed the state of family and community health issues in Bangladesh and found that fewer than 12 percent of deliveries take place in the presence of a medically trained person and less than 50 percent of pregnant women had at least one antenatal care checks. Additionally, 80 percent of maternal deaths in Bangladesh, take place at home as more than 90 percent of deliveries occur at home with only approximately 75 percent of these home based deliveries attended to by traditional birth attendants.[19]

The national prevalence of malnutrition in Bangladesh remains among the highest in the world.[20] Based on data from the 2007 BDHS the prevalence of stunting was 36 percent, underweight was 46 percent and wasting was 16 percent. Anemia in children aged 6 to 23 months was 64 percent.[10] Malnutrition in Bangladesh contributes not only to widespread failure towards meeting the first MDG of reducing poverty and hunger, but also undermines efforts to reach other MDGs such as those related to maternal and child health, HIV/AIDS, education and gender equity.[21]

According to the 2007 DHS report, almost all (98 percent) Bangladeshi children are breastfed for some period of time. A much lower proportion of children, (45 percent) were ever put to breast within one hour of birth of which 89 percent were reported to start breastfeeding within the first day. On average children are breastfed for 33 months, ranging from 26 to 37 months by region. Less impressive is the prevalence of exclusive

breastfeeding up to 6 months which has remained stagnant at approximately 43 percent for the past 15 years.

Gender inequity is an additional challenge to development in Bangladesh. Countries with high levels of gender inequality tend to also have unequal distributions of human development and vice versa. The UNDP 2010 Report on International Human Development Indicators calculated a gender inequality index which measured the loss of achievements due to inequality between genders; based on three dimensions of human development—reproductive health, empowerment and the labor market activity. Bangladesh was ranked at position 129 out of 168 nations, with a value 0.734 on a 0-1 scale. A value closer to 1 indicates higher levels of gender inequality.

With a sex ratio favoring females (93 males for every 100 females), gender focused development is critical for Bangladesh. Disregarding the importance of female empowerment would be a costly oversight and significant threat to the nation's progress with losses in productivity resulting from the lack of effective participation and leadership of over half of the Bangladeshi population. [12]

2. REVIEW OF THE LITERATURE

2.1 BREASTFEEDING

Appropriate IYCF practices play an key role in determining optimal development of infants.[10] Poor IYCF practices are often reflected in high rates of infant mortality and childhood malnutrition.[1] The three main hallmarks of breastfeeding are timely initiation of breastfeeding which is recommended within one hour of birth, exclusive breastfeeding

which is recommended for 0 to < 5.9 months and complementary feeding from 6 months until 23.9 months or <24 months of age.[22] The following discussion focuses on exclusive breastfeeding and the challenge of terminology in research.

Exclusive breastfeeding is recommended by the WHO and includes initiation of breastfeeding within the first hour of life, allowing only breast milk without any other food or drink (not even water) with an exception of required vitamins and medicines. It requires that the baby is fed on demand—that is as often as needed during the day and night. The fact that an infant does not need to consume water during the first six months of life is not easily believed by many mothers. According to current recommendations, proper practice of exclusive breastfeeding requires the exclusion of water from an infant's diet. This recommendation is based on the knowledge that water is in fact not necessary to an infant's diet even in hot climates, and that risk of using dirty water or bottles are greatly detrimental to an infant's health.[4]

A clear consensus on the definition of exclusive breastfeeding had not been reached among researchers for many years.[23] In 1988, the first meeting focused on creating clear and standard definitions for breastfeeding was held by the Interagency Group for Action on Breastfeeding (IGAB), an ad hoc working group of representatives from various

organizations including UNICEF, the United States Agency for International development (USAID), the Swedish International Development Agency (SIDA), the WHO as well as other experts in the field of nutrition and infant feeding. All of these groups came together to define breastfeeding terms with the aim to reduce the confusion of interpretation of research findings and program implementation. By definition, exclusive breastfeeding was considered to be achieved if 'no other liquid or solid from any other source enters the infant's mouth.'[24] However, shortly after this first meeting the definition of exclusive breastfeeding was expatiated by the WHO/UNICEF requiring that 'the infant has received only breast milk from the mother or a wet nurse, or expressed breast milk, and no other liquids or solids with the exception of drops or syrups consisting of vitamins, mineral supplements or medicines.[22]

Various authors have highlighted the difficulties in interpreting results of breastfeeding studies due to variations in terminology and methodologies.[23, 25, 26] In an effort to standardize these definitions, the WHO developed a set of definitions and indicators to be used in assessing breastfeeding practices including exclusive breastfeeding.[27] These definitions were specifically intended for use in surveys employing the 24-hour methodology; mothers would be asked to recount the kinds of food given during the previous 24 hour period. The validity of data on exclusive breastfeeding based on single 24-hour periods have often been questioned as this method fails to take into account the possibility that infants may have received other foods or drinks at an earlier time period prior to the 24 hour period in question.[28] Additionally, it is inherently difficult to measure the actual amount of breast milk an infant receives, as considerable differences result due to varying breastfeeding practices and beliefs. Accounting for these variances continues

to be another challenge to this field. In order to assess intake, researchers are often left to rely on a mother's report of her infant's diet, which is often complicated and fraught with biases such as recall and social desirability.

An additional challenge and an issue of on-going debate is the appropriate length of time of exclusive breastfeeding. Remaining consistent with duration of time recommendations is essential for the effective measurement of exclusive breastfeeding across and within populations. Currently, the WHO recommends exclusive breastfeeding for up to 6 months of age; specifically 0-5.9 months.[29] The WHO's current standard indicator of exclusive breastfeeding (as described above) aims to capture the proportion of infants 0-5 complete months of age who are fed exclusively breast milk.[22] Establishing clear and consistent definitions will help bridge gaps not only within science but also between science and practice at the community-level. The table below presents the current definitions agreed upon at the Global Consensus Meeting on Indicators of Infant and Young Child Feeding in November of 2007.

Figure 7 Criteria that define selected infant feeding practices[7]

Breastfeeding Method	Requires that the infant receive	Allows the infant to receive	Does not allow the infant to receive
Exclusive Breastfeeding	Breast milk (including milk expressed or from a wet nurse)	ORS, drops, syrups (vitamins, minerals, medicines)	Anything else
Predominant Breastfeeding	Breast milk (including milk expressed or from a wet nurse as the predominant sources of nourishment)	Certain liquids (water and water-based drinks, fruit juice), ritual fluids and ORS, drops or syrups (vitamins, minerals, medicines)	Anything else (in particular, non-human milk, food-based fluids)
Complementary foods	Breast milk (including milk expressed or from a wet nurse) and solid or semi-solid foods	Anything else: any foods or liquid including non-human milk and formula	N/A
Breastfeeding	Breast milk (including milk expressed or from a wet nurse)	Anything else: any foods or liquid including non-human milk and formula	N/A

2.2 BREASTFEEDING AS A BASIC HUMAN RIGHT

The Convention of the Rights of a Child was adopted in 1989 and since then has been ratified in 193 nations. One of its four basic principles is a child's inherent right to life, survival and development. This has direct implications for efforts to reduce infant mortality, increase life expectancy, reduce malnutrition and the severity of illness and epidemics. The importance of breastfeeding is specifically stated in Article 24 highlighting the importance of ensuring a child's right to the highest attainable standard of health.

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[7] *Indicators for assessing infant and young child feeding practices -Part 1: Definitions* WHO, 2008

The United Nations (UN) General Assembly adopted the Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW) in 1979. The Convention defines the constituents of discrimination against women and sets up an agenda for national action to end such discrimination. Article 12, specifically emphasizes the basic support and respect a woman requires during pregnancy and lactation.

These two Articles highlight the process and importance of breastfeeding as a basic human right. Article 12(2) of the CEDAW further stresses the importance of providing adequate support to women during pregnancy and in the post-natal period, particularly with an emphasis on adequate nutrition during pregnancy and lactation.[30] Complementing this, the right of an infant to nutritious food is enshrined in the Convention on the Rights of the Child.[31] The challenge facing public health professionals today lies in the act of balancing and respecting these two human rights on a global scale in varying socio-political, cultural and economic settings.

2.3 A GLOBAL MOVEMENT TOWARDS BREASTFEEDING PROTECTION

Commercial infant formula companies were in operation as early as the mid 1800s. Henri Nestlé of Nestlé foods developed the first commercial infant food, which was made of dried cow's milk combined with cereals and sugars in response to the need for a safe substitute for breast milk for babies who could not be fed at the breast. At the turn of the century in England, not being breastfed meant almost certain death.[32] During this time maternity care was shifting from home-based care to one orchestrated by the medical

profession which tended to simultaneously promote and hinder optimal breastfeeding practice.

The period following the First World War brought with it a renewed demand for women to enter the workforce. As a result, the demand for breast milk substitutes grew and manufacturers responded by developing and marketing commercial formulas. In many industrialized nation, artificial feeding became integrated into mainstream norms and the spread of this new method of feeding to communities worldwide began.[33] Unregulated manufacturers used various media outlets to promote their products, at times aggressively and often not explicitly stating the health benefits of breast milk over these substitutes.[33]

In 1939 Dr. Cicely Williams, a renowned international public health pediatrician and epidemiologist, delivered a speech entitled 'Milk and Murder' to the Singapore Rotary Club highlighting the severity of the decline in breastfeeding and raising awareness regarding the implications of suboptimal IYCF practices on infant and child health.[33]

2.4 THE INTERNATIONAL CODE OF MARKETING OF BREAST MILK SUBSTITUTES

Concerns regarding the decline in breastfeeding prevalence and increase in malnutrition in infants and young children began to be raised by an increasing number of health professionals, scientists, nutritionists and volunteer groups throughout the 1960s and 70s. In May of 1980 at the 33rd World Health Assembly (WHA), member states endorsed in their entirety, statements and recommendations agreed to, by consensus, to promote and support breastfeeding. The WHO and UNICEF instigated this effort aimed at lowering the prevalence of malnutrition through an international code developed to regulate

marketing of competing breast milk products. The International Code of Marketing of Breast-Milk Substitutes[34] was formed, revised and finally adopted on May 21st 1981, at the 34th WHA. This fourth draft of the International Code of Breast-Milk Substitutes was to serve as a recommendation of the 'minimum requirement to protect and promote appropriate feeding for infants and young children'.[35] Despite this effort, aggressive marketing continues today and often to the most disadvantaged populations; those struggling with low levels of education and knowledge, high prevalence of food insecurity, and considerable water and sanitation challenges—a combination that has the potential of catastrophic consequences for infant nutrition and subsequent health.

2.5 BREASTFEEDING AND MATERNAL AND INFANT HEALTH

The health and nutritional status of mothers and children are intimately linked. The biological and social unit formed early in development connects a mother's health experience to that of her child. As infant nutrition begins with the mother as the provider, infant and young child nutritional health outcomes are entirely dependent on maternal behavior and health status. However, breastfeeding is not only beneficial to the infant alone but rather is also an integral part of the reproductive process with significant implications for the health of mothers.

2.5.1 BREASTFEEDING AND MATERNAL HEALTH

When assessing the affects of breastfeeding on maternal health it is important to note that the majority of data collected on these relationships are risk estimates based on lifetime duration across all pregnancies rather than duration of feeding for each individual pregnancy.[36] Additionally, the majority of evidence in this area of research tend to be

from observational studies, which are subject to design weaknesses such as confounding of the effect by other health behaviors thus reducing the ability to determine causality.

Nevertheless, much research has shown that breastfeeding has a significant affect of various aspects of maternal health. Breastfeeding is associated with post partum amenorrhea which occurs in the interval between the birth of a child and the resumption of menstruation during which the risk of pregnancy is very low. Exclusive breastfeeding is associated with strong suppressive affects on fertility, particularly during the first 3 months of infant feeding.[37] This post partum protection from conception is known as lactational anovulation. Lactation results in a prolongation of postpartum amenorrhea extending the inter-birth intervals to periods as long as 35 months.[38] In addition to longer pregnancy intervals, lactational amenorrhea allows the mother to be more fully replete from the physiological demands of pregnancy and delivery as well as allowing her more time to care for her infant before another child is born. However, although the lactational amenorrhea method (LAM) is commonly used as a form of contraception, it is not a fail-safe method of pregnancy prevention and its effectiveness is strongly influenced by other lifestyle and behavior factors such as cultural beliefs of abstinence from sexual intercourse until weaning and maternal age.[10, 38]

Secondly, breastfeeding benefits maternal health by reducing risk of extreme obstetric hemorrhage. Post partum hemorrhage is a significant and increasing contributor to maternal morbidity and mortality.[39] Obstetric hemorrhage (mostly postpartum) is the world's leading cause of maternal mortality resulting in an estimated 25 percent of maternal deaths annually.[40] In developing nations, post partum hemorrhage is the most

common type of obstetric hemorrhage and accounts for approximately 60 percent of all maternal deaths. Breastfeeding plays a role in the prevention of post-partum hemorrhaging and has the potential to save the many women's lives.[41] Early initiation of breastfeeding followed by exclusive breastfeeding stimulates the release of oxytocin, which is a hormone pivotal to the production and release of breast milk as well as in the prevention of postpartum hemorrhage. Oxytocin increases uterine activity (such as uterine involution) thereby reducing the risk of heavy bleeding and infection.[39]

Thirdly, and perhaps one of the most well known maternal benefits of breastfeeding is the reduction in risk of cancer, specifically breast and ovarian cancers. Breast cancer is the most common cancer in women globally and is on the rise particularly in developing countries where the majority of cases are diagnosed in the latter stages. Lactogenesis is hypothesized to reduce the risk of breast cancer primarily through two mechanisms, the differentiation of breast tissue and the reduction of the lifetime number of ovulatory cycles.[42] Several studies carried out in a range of countries found that the longer women breastfed the more they ware protected against breast cancer.[36, 43, 44]

Lastly, breastfeeding requires a substantial metabolic expenditure. Exclusive breastfeeding requires women to expend approximately an additional 500 kcal d^{-1} to produce breast milk.[36] This metabolic expenditure is hypothesized to facilitate loss of weight gained during pregnancy[45, 46] although studies have shown mixed results suggesting that varying levels of caloric intake, physical activity[47] as well as the intensity of breastfeeding all impact this relationship. Furthermore, some studies have shown evidence of an association between breastfeeding and improved glucose levels, lipid

metabolism and blood pressure, of which epidemiological studies suggest may persist after completion of breastfeeding, improving maternal health in the long run.[48] Nevertheless, evidence on this remains scarce and relationships unclear.

2.5.2 BREASTFEEDING AND INFANT HEALTH

The WHO estimates that the promotion of effective exclusive breastfeeding for the first 6 months of life could avert the death of 1.3 million infants globally each year.[49] Many studies have investigated the positive effects of exclusive breastfeeding on preventing infant morbidities and reducing deaths from common infectious diseases.[49-53] A particularly well-researched association is that between breastfeeding and reduced risk of gastrointestinal infections (GI) specifically those related to diarrhoeal infections. Data from the Promotion of Breastfeeding Intervention Trial (PROBIT), a randomized and controlled trial aimed to increase duration of breastfeeding found that infants in the control group were 1.7 times more likely to develop GIs than those in the intervention group.[54]

In Bangladesh, regular flooding and high risks of diarrhoea disease have posed a serious threat to infant and young child survival. The findings from studies conducted in both rural and urban areas of Bangladesh show that the practice of exclusive breastfeeding alone can reduce rates of morbidity.[55, 56] In countries, like Bangladesh, with a moderate or high infant mortality rate, research has found that artificially fed infants are at least 14 times more likely to die from diarrhoea than exclusively breastfed children [50, 57] consistent with previous evidence regarding the protective effects of exclusive breastfeeding on infant health.

Studies have also shown that breastfeeding, in particular exclusive breastfeeding, is protective against Acute Respiratory Illness (ARI). A study carried out in Bangladesh reported higher overall infant mortality rates among infants who were partially breastfed or not breastfed at all as high as 2.23 times greater than those infants who were exclusively breastfeed.[56] Another study of infants in Mexico mirrors these results. Infants who were exclusively breast-fed for up to four months had a lower incidence of ARI, a smaller percentage of days ill and episodes of shorter duration than those infants who were bottle-fed. The number and severity of ARI was negatively associated with the duration and intensity of breastfeeding.[58] These findings are consistent with other studies claiming a similar protective effect of breastfeeding against ARI in both developed and developing nations.[59-63] Part of this protection may be explained by the specific and innate immune factors present in maternal breast milk. Antibodies specific to antigens in the mother-infant dyad's immediate surroundings provided through the breast milk, is hypothesized to confer specific protection against local pathogens.[36]

Epidemiological studies examining the longitudinal benefits of breastfeeding suggest that children who are breastfed in infancy are less likely to become obese[47, 64, 65] or develop type II diabetes.[47, 64, 66] Other studies extend these positive effects to reductions in the risk of cardiovascular disease and lower blood pressure later in life however, the results of these studies remain mixed and thus the association unclear. Proposed explanations surrounding the risk of obesity and related cardiovascular diseases are based on the differences in composition between breast milk and milk substitutes, feeding practices (such as quality and timing of complementary foods), self-regulation of intake by infant[67]

and the possible role of adipokines in regulating energy intake and related obesity risk later in life.[68]

2.6 NATIONAL INITIATIVES FOR EXCLUSIVE BREASTFEEDING IN BANGLADESH

Two assessments of the infant and young child feeding (IYCF) situation were conducted in 2005 using a tool developed by WHO and LINKAGES to assess national practices, policy and programs in Bangladesh. Bangladesh scored well placing it second highest among eight South Asian countries.[69] The work Bangladesh has done on developing a national code of marketing of breast milk substitutes (referred to as the Code) as well as implementing the Baby-friendly Hospital Initiative (BFHI) was rated high. Nevertheless the assessment highlighted the following areas in need of improvement 1) to establish a clear mechanism for coordination at the national level, 2) to secure adequate funding, 3) to adopt a plan of action 4) to develop infant feeding and HIV policy and 5) to ensure sufficient focus on IYCF content and skills in training and curricula. This section will provide an overview of key IYCF policies, plans and programs currently in effect in Bangladesh.

2.6.1 DHAKA DECLARATION

Seen as an early adopter of good IYCF policies, Bangladesh's support for breastfeeding can be traced back to the early 1980s culminating in 1984 with the Ordinance XXXIII on Regulation of Breastmilk Substitutes (also known as the Code). Five years later, the nation launched its Campaign for Protection and Promotion of Breastfeeding, which strongly advocated for exclusive breastfeeding for five complete months. In November

1991, breastfeeding officially became one of the national health priorities with the signing of the Dhaka Declaration by the President and Prime Minister of Bangladesh. This served to increase visibility of the issue as well as support for the 1990 operational targets of the International Innocenti Declaration which prioritized the ten steps to successful breastfeeding in baby friendly maternities, enforcement of the Code, and maternity protection legislation. Additionally, the Dhaka Declaration called for the establishment of a national society for the promotion and protection of breastfeeding, religious teaching in support of breastfeeding, an incorporation of breastfeeding promotion within primary health care and child survival as well as recognized the importance of providing basic and refresher training; all of which were significant political steps towards improving IYCF practices for the nation.

2.6.2 BANGLADESH BREASTFEEDING FOUNDATION

The call made by the Dhaka Declaration for the national society for the promotion and protection of breastfeeding was answered in 1995, by the creation of the Bangladesh Breastfeeding Foundation (BBF), an intiative supported largely by donor funds. Under the Bangladesh Integrated Nutrition Project-- currently known as the National Nutrition Program (NNP), the BBF was mandated to lead the nation's breastfeeding promotion activities. The BBF was instrumental in advocating for six months of exclusive breastfeeding. Unfortunately BBF's central role in the National Nutrition Program ended around 2007 due to financial constraints. Despite financial difficulties BBF continues to protect and promote breastfeeding through funding from other sources.

2.6.3 COMPREHENSIVE NUTRITION PROGRAMS

The Ministry of Health and Family Welfare created Bangladesh's first comprehensive nutrition intervention program in 1995—the Bangladesh Integrated Nutrition Project (BINP). This World Bank supported five-year project's main aims were to make real improvements in nutrition ranging from protection and promotion of breastfeeding and improvement of inter-sectoral program activities. Structural changes have transferred BINP's activities to the National Nutrition Program (NNP), which is part of the Health, Nutrition and Population Sector Program. However, concerns remain from key IYCN organizations, particularly the BBF, that IYCF has become one of the most neglected components of the NNP activities.

2.6.4 NATIONAL IYCF STRATEGY

In 2002, UNICEF and the WHO developed and endorsed the Global Strategy for IYCF, a move which served as a strong impetus for many countries like Bangladesh, to revitalize and streamline their own national IYCF programs. In 2004, bringing together a consortium of key public health nutrition organizations, Bangladesh began the development of it's own national IYCF strategy. The Secretary of the Ministry of Health and Family Welfare officially launched the national strategy three years later, in 2007. Consistent with the Global Strategy, the National Strategies goals and overall progress are summarized in Figure 8 below.

Figure 8 National progress made towards achieving key IYCF 2010 goals[8]

National Strategy Goal	Status as of 2009[9]	Overall Progress (2007-end of 2009)
Increasing the percentage of newborns breastfed within 1 hour from 25 percent to 50 percent	43 %	25% → 43% On track: below goal but considerable progress made
Increase exclusive breastfeeding from 42 percent to 60 percent	43 %	42% → 43% Not much progress
Maintain continued breastfeeding at 20-23 months at 90 percent	91 %	90% →91 % On track
Increase the percentage of children 6-9 months old who are breastfed and receive appropriate complementary foods to 50 percent (no baseline)	74 %	74% passed goal of 50% On track

2.7 BREASTFEEDING IN BANGLADESH

Bangladesh has a strong breastfeeding culture. As illustrated in the table above, it is not unusual for children to continue to receive breast milk up to the age of 2 years. However, sub-optimal feeding practices continue perpetuating the nation's already grave malnutrition levels. The Bangladesh Bureau of Statistics conducted a survey focused on Child and Mother Nutrition in 2005 which covered 3797 children aged 0-59 months and 3050 mothers living in rural and urban households and found that approximately 29 percent of all children under five were moderately underweight and close to 11 percent

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[8] Goals extracted from *infant and Young Child Feeding (IYCF) National Plan of Action 2009-2011* proposed by the Institute of Public Health Nutrition (IPHN) , Directorate General of Health Services, and Ministry of Health and Family Welfare

[9] UNICEF Statistics for Bangladesh http://www.unicef.org/infobycountry/bangladesh_bangladesh_statistics.html#73

were severely underweight.[15] Prelacteal feeding, delayed initiation, non-exclusive breastfeeding and bottle-feeding are practiced inhibiting improvements of exclusive breastfeeding prevalence while increasing risk of malnutrition. However improvements have been made, between 1994 to 2007 the rates of initiation of breastfeeding within one hour of birth increased from 9 to 24 percent and timely feeding of complementary foods to infants 6-9 months improved from 28 to 74 percent.[70] The mean duration of any breastfeeding showed no signs of declining, but rather increased from 28 months in 1994 to 32 months in 2004. Figure 9 below provides an overview of IYCF practices in Bangladesh.

Figure 9: Infant and Young Child Feeding Practices in Bangladesh BDHS 2004, 2005, 2007[10]
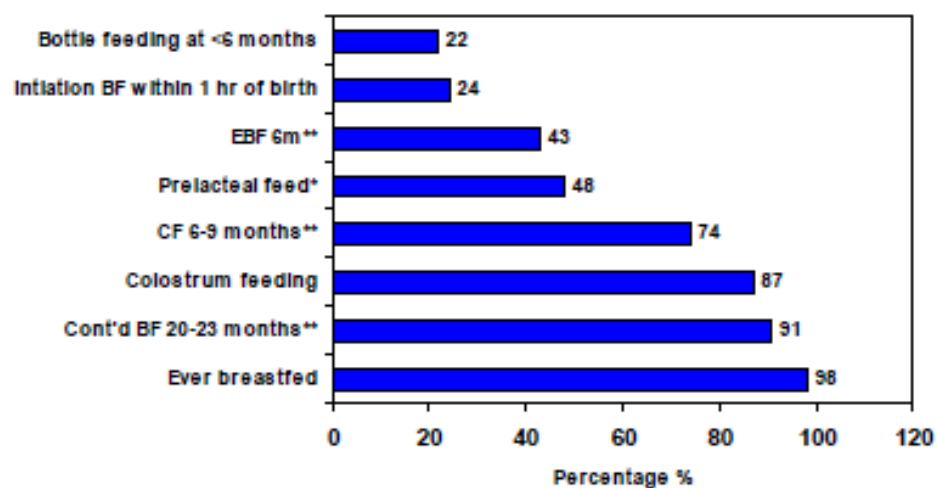
On the contrary, improvements in exclusive breastfeeding practice remain insubstantial. For greater than a decade the prevalence of exclusive breastfeeding has shown very little

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[10] Infant and Young Child Feeding Programme Review Case Study: Bangladesh p.8

improvement ranging from 42-46 percent.[10] Figure 10 illustrates data on infant feeding practices from the BDHS 2007. Sixty-four percent of infants below the age of 2 months were exclusively breastfeed a figure which steadily declines over the first six months of life. Only 23 percent of infants aged 4-5 months of age were reported to be exclusively breastfed with 59 percent reporting complementary feeding and other milk.[70] The mean and medium duration of exclusive breastfeeding in Bangladesh is estimated at 3.3 and 1.8 months, respectively.[10]

Figure 10: Infant Feeding practices by age in months, Bangladesh DHS 2007[11]
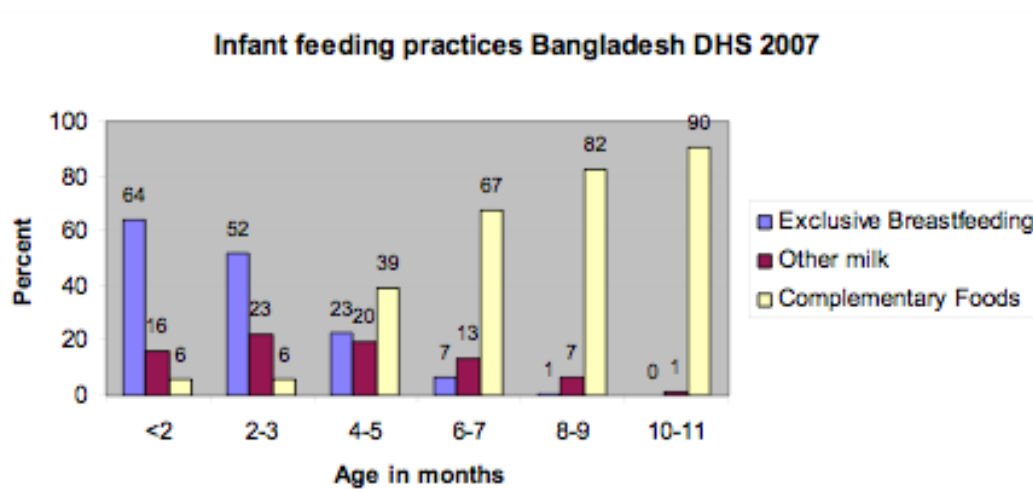
The Bangladesh DHS 2007 reaffirms this trend of stagnating exclusive breastfeeding rates, observing that 'the various efforts at improving the exclusive breastfeeding practice in Bangladesh [have] had no impact'.[12] Investigating Bangladeshi women's attitudes and control beliefs of self-efficacy around exclusive breastfeeding could provide insight into

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[11] Infant and Young Child Feeding Programme Review Case Study: Bangladesh p.8

[12] Bangladesh Demographic and Health Survey 2007 p. 261

why rates are not increasing. Positive attitudes and self-efficacy along with knowledge of exclusive breastfeeding may be seen to be determinants of intentions to exclusively breastfeed. However, this relationship is not simple and is at risk of being confounding by many factors. Though research in this area remain scarce, one study carried out in Dhaka examining the effectiveness of breastfeeding promotion messages reported that many women perceive exclusive breastfeeding to be positive and that the most commonly reported benefits were that it is good for the baby, convenient and protects from illness.[71] Identifying key predictors of intention formation and examining their associations with intention would contribute to current understanding of why low levels of practice persist despite positive perceptions. However, this requires a shift away from a traditional analysis with exclusive breastfeeding practice as the final outcome to one that seeks to understand what influences the process of intention formation.

2.8 EXCLUSIVE BREASTFEEDING INTENTIONS AND BEHAVIORAL HEALTH MODELS

Breastfeeding intention and health models can facilitate current understanding by identifying population specific predictors of exclusive breastfeeding intentions. Identification of these factors is an essential part of developing successful breastfeeding promotion interventions.

A behaviorally oriented, theoretically informed approach to the study of breastfeeding intention has the potential to strengthen interpretation of evidence creating new opportunities for research, more effective promotion and implementation of cost-effective breastfeeding interventions and ultimately better public health practice.[8] Identifying the

factors underlying breastfeeding intention formation allows for the recognition of modifiable aspects which would serve to inform the development of appropriate methods for accomplishing specific changes.

According to health behavior theories merely increasing a woman's knowledge about the benefits of breastfeeding is insufficient to prompt action.[8] This disconnect often occurs as traditionally the primary focus of breastfeeding education was largely to exclusively impart knowledge. Although women know of the benefits of exclusive breastfeeding few succeed in putting their knowledge into daily practice. The fact that the decision and practice of breastfeeding is not realized in a vacuum but rather is subject to the woman's socio-demographic, cultural and psycho-physiological context has made a strong case to put health behavior research back into the foundational steps of policy and action formation.

The following sections examine two established health behavioral models applied to the case of exclusive breastfeeding intention formation. First, the Theory of Reasoned Action (TRA) is discussed followed by the Theory of Planned Behavior (TPB).

2.8.1 THEORY OF REASONED ACTION AND THE THEORY OF PLANNED BEHAVIOR

The Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) both focus on constructs that are concerned with individual motivational factors as determinants of the likelihood of performing a specific behavior.[7] The TPB is not an independent theory, but rather an extension of the TRA with the addition of an extra construct of perceived behavioral control (or self-efficacy) over performance of the

intended behavior. Noteworthy in the two theories is the assumption that all other factors, specifically those related to demographics and the environment do not act independently on intention formation but rather operate via the model constructs to influence the likelihood of performing the behavior. If this were applied to the case of intention to exclusively breastfeed, the fact that a woman is poor and has limited or no education would not *directly* impact intention formation but rather they would exert an *indirect* affect on intention formation through their influence on attitude formation, social norms and self-efficacy which would then exert an *direct* affect on the formation of intentions to exclusively breastfeed and subsequent practice.

2.8.2 THEORY OF REASONED ACTION

The Theory of Reasoned Action (TRA) proposed in 1975 by Ajzen and Fishbein, assumes that individuals are rational and that there are underlying reasons that determine one's motivation to perform a behavior. They propose that these underlying reasons are determined by both behavioral and normative beliefs. These determine our 'attitude and subjective norm regardless of whether these beliefs are rational, logical or correct by some objective standard.'[13] The TRA has been used successfully to predict and explain a number of health behaviors ranging from breastfeeding to contraceptive use, HIV or sexually transmitted disease (STD) prevention behaviors. These findings have often been useful in informing behavior change interventions.[72, 73]

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[13] *The Transtheoretical Model and Stages of Change Health Behavior and Health Education: Theory, Research and Practice* By: Glanz K. RB, Lewis FM p.76

Application of the TRA framework is relevant to exclusive breastfeeding as it facilitates the identification of key behavioral and normative beliefs behind intention formation and allows for a deeper understanding of what motivates a mother to exclusively breastfeed.

The TRA asserts that the most important determinant of behavior is a person's intention toward carrying out that behavior. A person's attitude towards performing the behavior and their subjective norm associated with the behavior are direct determinants of their behavioral intention. Attitudes are determined by an individual's beliefs about the outcomes as well as the process of performing the behavior. In other words, a mother who believes that exclusive breastfeeding will have positive outcomes for herself and her infant will have a positive attitude towards it and intend to practice it. Similarly, a person's subjective norm is formed by their normative beliefs. These refer to whether or not they feel important referent individuals approve or disapprove of a behavior combined with their own motivations to meet the expectations of those referents. For instance, if a woman's mother-in-law approves of exclusive breastfeeding and she strongly values her mother-in-law's opinion, the TRA predicts that she will be more inclined and motivated to exclusively breastfeed her child. As such the TRA assumes a causal chain that links behavioral beliefs and normative beliefs to behavioral intention and subsequent behavior via attitudes and subjective norms.

2.8.3 THEORY OF PLANNED BEHAVIOR

The Theory of Planned Behavior (TPB) was first proposed by Icek Ajzen in 1985 as an extension of the Theory of Reasoned Action (TRA). In the earlier TRA, it was posited that an individual's attitude towards a behavior and their subjective perceptions and

motivation to comply with social expectations of behavior (subjective norm) all influenced intention formation and in turn these behavioral intentions directly predict the performance of the specific behavior. A central assumption of this more parsimonious TRA is that of complete volitional control over behavior. However, given the somewhat non-volitional nature of breastfeeding, application of the TRA to breastfeeding is not always appropriate. Breastfeeding can be argued to not be completely under volitional control as multiple factors relating to both infant and mother influence it altering initiation, practice and continuation. More applicable to this practice is the TPB, which contrary to the TRA, assumes that behavior is located along a continuum from complete volitional control to no volitional control.

This thesis analyzes data on a sample of rural Bangladeshi women in their third trimester of pregnancy. An application of the framework of the Theory of Planned Behavior is used to examine the relationship between key predictors and intention to exclusively breastfeed.

3. MANUSCRIPT

ATTITUDE, SELF-EFFICACY, KNOWLEDGE AND INTENTION TO EXCLUSIVELY BREASTFEED AMONG PREGNANT WOMEN IN RURAL BANGLADESH

CONTRIBUTION OF STUDENT

The Window of Opportunity (Window) is a CARE global initiative focused on promoting, protecting and supporting infant and young child feeding (IYCF) and related maternal nutrition (IYCF + rMN) practices in order to improve the nutritional status of children under two. The Window initiative is currently underway in six countries in three regions of the world. The data analyzed for this thesis were from an observational study embedded within the longitudinal two-year cohort evaluation study (Window-Bangladesh) with collaboration from CARE (USA-Bangladesh), Emory University and the International Diarrhoeal Disease Research Center, Bangladesh (ICDDR,B). Along with assisting in the development of Window's study protocol and other required documents, I developed the 12-module questionnaire that was administered to pregnant women during their seventh month of pregnancy; the first data collection point of the Window cohort study. This was the source of the data analyzed for this thesis. The questionnaire included questions related to socio-demographics, diet and nutrition, past pregnancy experience, access to antenatal care and other sources of breastfeeding support, breastfeeding knowledge, intentions to breastfeed, breastfeeding attitudes as well as aspects of empowerment.

Although all data collection was completed by field workers trained by the ICDDR,B, I was able to spend a short time in the field during a two-week trip in January 2011. During this trip, I was able to assist with the questionnaire piloting process, monitoring and assuring data quality and observe data collection. Once the first round of data collection was complete I analyzed the data, developed the figures and tables and completed this thesis with the support and advice from my advisor at Emory, Dr. Aryeh Stein (Associate Professor) and my supervisor at CARE-USA, Abigail Beeson (Technical Advisor for Nutrition: Child Health and Nutrition Team).

ABSTRACT.

Background: Malnutrition is responsible for 60 percent of the 10.9 million deaths that occur annually among children. Over two thirds of these deaths are directly associated with inappropriate feeding practices and occur during the first year of life. Although breastfeeding is almost universal in Bangladesh, exclusive breastfeeding is less consistently practiced with a national prevalence stagnant at 42-46 percent for twelve years. Intention to exclusively breastfeed is influenced by socioeconomic status, maternal self-efficacy, knowledge and empowerment issues. Identifying those factors in a mother's life that would influence her to engage in appropriate infant feeding practices is important information for program development.

Objective: This thesis examines the associations among knowledge, attitudes, self-efficacy and exclusive breastfeeding intention among pregnant women in rural Bangladesh, using the Theory of Planned Behavior as a framework.

Methods: Data were analyzed on rural Bangladeshi women who were interviewed in their third trimester of pregnancy, as part of CARE's Window of Opportunity project. A cohort of 800 women was interviewed between 12 January 2011 and 4 February 2011. Indices of maternal attitudes, self-efficacy and knowledge were created by using principal components analysis. The association between intention to exclusively breastfeed and the three indices was assessed using logistic regression.

Results: High levels of positive attitude (OR: 2.30; 95% CI 1.14 - 4.66) and self-efficacy (OR: 3.91; 95% CI 1.91 – 8.00) towards exclusive breastfeeding were associated with intent to exclusively breastfeed. However, in a multiple regression model, higher level of knowledge was only modestly associated with intent to exclusively breastfeed (OR: 1.12; 95% CI 0.74-1.71).

Discussion: In this cohort, positive attitudes and self-efficacy were strongly associated with intent to exclusively breastfeed, while a higher level of knowledge was only modestly associated with intent to exclusively breastfeed. These findings contribute to the limited existing literature on determinants of exclusive breastfeeding in Bangladesh. This analysis reaffirms the need for further population-specific research to identify modifiable causes of intent to exclusively breastfeed. The results of this analysis will be used to inform the Window of Opportunity program.

INTRODUCTION

Although breastfeeding is a common cultural practice in Bangladesh, exclusive breastfeeding is less consistently practiced with a national prevalence stagnant at 42-46 percent for close to twelve years.[15] The WHO estimates that the promotion of effective exclusive breastfeeding for the first six months of life could avert the death of 1.3 million infants globally each year.[49] Malnutrition is responsible for 60 percent of the 10.9 million deaths that occur annually among children worldwide. Well over two thirds of these deaths are directly associated with inappropriate feeding practices and occur during the first year of life.[1] In Bangladesh, inappropriate infant and young child feeding practices during the first few months of life, pose a serious obstacle to achieving adequate nutritional status inflating already high national levels of malnutrition. Breastfeeding is an important and cost effective public health promotion initiative for both maternal and child health with the potential to prevent and improve early infant illnesses and reduce malnutrition rates in developing nations.[74]

Exclusive breastfeeding is recommended by the WHO and includes initiation of breastfeeding within the first hour of life, allowing only breast milk without any other food or drink (not even water) with an exception of required vitamins and medicines. It requires that the baby is fed on demand—that is as often as needed during the day and night. In order to improve exclusive breastfeeding practice it is necessary to understand and identify the factors which influence exclusive breastfeeding intention. Infant feeding intention is influenced by a range of issues including socioeconomic status, maternal nutritional status, familial support and maternal self-efficacy and empowerment issues.

The weight attributed to each of these factors varies by socio-cultural context. Health behavior models can be used to examine these relationships and aid in identifying key predictors of exclusive breastfeeding intention. Although health behavior theories have often been applied to breastfeeding research to understand determinants of breastfeeding intention; few of these analyses have been focused specifically on Bangladesh.

Investigating the cumulative association of all possible maternal indicators on the formation of exclusive breastfeeding intentions separately would be cumbersome and difficult. Therefore, principal component analysis (PCA) was used to create indices. PCA is a statistical tool that is used to condense several variables into a single dimension.[75] It is a commonly employed analysis technique, often used in the creation of indices of wealth by the DHS. Several studies have highlighted the benefits of applying the Theory of Planned Behavior to better understand maternal breastfeeding intention formation.[8, 9] This analysis applies the Theory of Planned Behavior as a guide to understanding the nature of predictors of intention to exclusively breastfeeding. Therefore three aspects -- maternal knowledge, self-efficacy and attitudes were examined to increase our understanding of how these particular dimensions influence a mother's intention to exclusively breastfeed. The use of health behavior models to elucidate culturally relevant factors associated with exclusive breastfeeding intention formation not only increases understanding but also allows for the identification of key modifiable factors that can be strategically targeted by future interventions aimed at improving the prevalence of exclusive breastfeeding in .Bangladesh.

METHODOLOGY[14]

DATA SOURCE AND STUDY POPULATION

THE WINDOW OF OPPORTUNITY PROJECT

Study participants were recruited from the first data collection point of the Window of Opportunity's two-year cohort evaluation study. This project is a CARE global initiative focused on promoting, protecting and supporting infant and young child feeding (IYCF) and related maternal nutrition (IYCF + rMN) practices in order to improve the nutritional status of children under two. Figures 1 and 2 illustrate the overall project timeline as well as recruitment dates of the 4 cohorts.

Data was collected from two sub-districts within the larger district of Kishoreganj. The sub-district of Karimganj was identified as the intervention area as various initiatives are active in the area including the European Union's Food Security for the Ultra Poor (FSUP) initiative and women's empowerment initiatives such as the Behavior Change Communication (BCC) intervention lead by CARE-Bangladesh. The non-adjacent sub-district of Katiadi served as the non-intervention site. It is similar to Karimganj in socio-demographic characteristics however not served by any food security and nutrition interventions of CARE, the government nor other NGOs.

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[14] All tables and figures referenced from this point on, may be found in the List of Manuscript Figures and Tables section following the References

STUDY POPULATION

This thesis will focus on data from a sample of 800 women (Cohort 1 of the Window of Opportunity Project). Four hundred women were successfully recruited from each sub-district, Karimganj and Katiadi. Sample size calculations took into account the expected reproductive rate in the area as well as budget. Considering birth rates and sub-district population size, an estimated 500 pregnant women were calculated to be eligible for recruitment in each sub-district; a combined total of 1,000 women in the two sub-districts. Inclusion criteria required the woman to be residing in one of the two sub-districts and to be in her third trimester of pregnancy; specifically between weeks 26-32 of pregnancy and that she must agree to the informed consent process. Approval of the consent form was obtained from the local Ethic Review Board and Research Review Board of the International Center for Diarrhoeal Disease Research, Bangladesh.

DATA COLLECTION

Data were collected by 20 field workers trained by the ICDDR,B. The team consisted of an almost equal distribution of men (11) and women (9) with varying backgrounds and with strong fieldwork experience from all over Bangladesh. Recruitment was carried out concurrently in both areas. Karimganj and Katiadi are made up of 11 and 10 unions respectively. Unions to be sampled from in each sub-district were determined at random from a non-alphabetized list that had been submitted with the original study protocol. The list included details about the population distribution of each union in each of the two sub-districts. Considering the total population of women of reproductive age in each union it was decided that sampling from the first 6 unions listed for each sub-district would result in a sufficient number of eligible pregnant women.

Identification of eligible households and maintenance of registries in Karimganj, the intervention area, were facilitated by CARE's sub-district office. Local child health nutrition workers (CHNW), working with CARE, were in charge of updating lists of all pregnant women in Karimganj. The list recorded maternal information including the name of each pregnant woman, her age, her last menstrual period, name of the father to be, maternal address and a mobile phone number. Using this information, eligible women who fell within the desired 26-32 week pregnancy window were short-listed as potential participants. Sub-district village maps facilitated household visits in Karimganj.

Identification of eligible women and collection of data were more challenging in the non-intervention area of Katiadi, specifically due to the fact that CARE is not active in this area and that this sub-district has a less organized health infrastructure compared to that found in Karimganj. Consequently, the data collection team did not have access to any pre-existing lists of pregnant women. In response to this challenge, field workers were trained to recruit on the spot while traveling household to household. They utilized recruitment techniques such as snowballing recruitment as well as word of mouth and discussions with other women in the locality to identify possible study participants. Additionally, efforts were made simultaneously to strengthen networks in Katiadi by identification of local antenatal clinics (ANCs) and NGO partners with the aim of consolidating available information into a registry of all eligible pregnant women within the sub-district. These networks would not only serve to facilitate recruitment throughout the lifetime of the Window project but could also be used in the long run to strengthen the health monitoring infrastructure within this sub-district.

INSTRUMENTS DEVELOPMENT

A 12-module questionnaire, developed in English was translated into Bangla and field-tested in both sub-districts prior to the start of official data collection. The instrument was piloted on non-eligible women in order to preserve the pool of eligible pregnant women for the study. The questionnaire's development was informed by a baseline survey administered by the ICDDR,B for CARE in the same district, the 2007 Bangladesh Demographic and Health Survey (BDHS) as well as other validated tools used in literature.[15] The modules covered a range of topics including demographic and socio-economic status, household characteristics, food security and maternal diet and nutrition, pregnancy, access to antenatal care services and other breastfeeding support, breastfeeding knowledge and attitudes, intentions to breastfeed, women's empowerment and social capital.

The questionnaire was piloted concurrently in each sub-district, over a period of 3 days in early January 2011. De-briefings and focus group discussions were done daily by ICDDR,B, to collect feedback from field workers and appropriate revisions were made accordingly. Standard operating procedures were developed to ensure that explanations offered in clarification of questions remained comparable in both sub-districts. Once the questionnaire was fully revised, it was back translated into English.

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[15] Bangladesh Alive & Thrive Baseline Survey 2010: Household Questionnaire (International Food Policy Research Institute—IFPRI, BRAC, Data Analysis and Technical Assistance Limited (DATA)), Bangladesh, SHOUHARDO a Title II program of USAID: Final Evaluation Report- December 2009, Infant feeding Intentions Scale by Laurie Nommensen-Rivers and Kathryn G Dewey.

MAIN OUTCOME: INTENTIONS TO EXCLUSIVELY BREASTFEED

The main outcome of this study is intention to exclusively breastfeed. Intenders and non-intenders were identified based on the responses of women to the question "Do you plan to (only) exclusively breastfeed your baby?" The following definition of exclusive breastfeeding was given prior to asking this question, "Exclusive breastfeeding is termed as not giving anything (no water, other milk, honey, mustard oil, sugar…) other than breast milk to your baby for the first six complete months of life."

SOCIO-ECONOMIC VARIABLES

The socioeconomic background variables were maternal illiteracy (illiterate, literate),[16] religion (Muslim, Hindu), highest level of education of head of household (none, primary, secondary, higher and religious)[17] and a wealth score. The wealth score was used as a measure of socio-economic status (SES).[18] The wealth score was calculated by assigning 1 point for each variable contributing to the wealth of a household. The total

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[16] A mother was defined as illiterate if she could not read.

[17] Highest level of education of household head was used as a measure of household exposure to education as data on maternal education was unable to be extracted clearly at this point.

[18] The included variables were hand washing practices (washing agent used: before food preparation, before taking a meal, before feeding the child, after helping in defecation of the child, and after using the toilet), number of households sharing toilet facility, ownership of household assets (yes or no format: electricity/solar/generator, television, non-mobile telephone, almirah, chair, motorcycle, animal-drawn cart, boat with motor, radio, mobile telephone, refrigerator, table, watch, bicycle, car/truck, rickshaw/van, cot, tempo/shollow, power tillar/tractor and sewing machine), where cooking is done (in a separate room in the same building, in a room used for living or sleeping, in a separate building used as a kitchen or outdoors), ownership of animals (yes or no), and ownership of land (yes or no). For hand washing practices the options included water, mud, ash and soap, not applicable. Based on previous research women who used mud, ash or soap scored a point and those who used only water or who did not wash received a 0. (**76.** Hogue BA., Briend A. A comparison of local handwashing agents in Bangladesh. *Journal of Tropical Medicine and Hygiene.* 1991;94(1):61-64.)

score was calculated per respondent and categorized into low wealth (0-6 points), medium wealth (7-13 points) and high wealth (14-21 points). Having a continuous score for wealth allows for easy comparison between respondents as each 1-point increase indicates a corresponding one unit increase in wealth.

ANTE-NATAL CARE AND BIRTH VARIABLES

The antenatal care and birth history variables include number of prior births (none, one, more than one), number of child deaths (0, 1-2, 3+), antenatal care visit during this pregnancy (yes, no), exclusively breastfed last child (yes, no), and when decision to breastfeed was taken for this pregnancy (before pregnancy, during first trimester, second trimester, third trimester, no decision taken).

DEMOGRAPHIC VARIABLES

The demographic variables include total number of household members (1-5, 6-10, 11-15 and 16+) and maternal age (years).

MATERNAL INDICES

Principal component analysis (PCA) facilitates the investigation of the cumulative association of several maternal factors simultaneously. PCA condenses a specific collection of variables into a composite index to represent a particular maternal dimension. It is a standard procedure employed by the Demographic and Health Survey (DHS) in its creation of a wealth index when income and expenditure data are not available.[75]

Indices were created to represent the Theory of Planned Behavior (TPB) constructs of maternal attitudes and self-efficacy. Figure 3 shows the conceptual framework for this thesis. Questions relating to each of these constructs were identified from the questionnaire. The PCA extraction method used a varimax (orthogonal) rotation. Based on examination of the scree plots, principal factors (those with eigenvalues >1) were identified as accounting for the maximum amount of variance. Questions found to be strongly uncorrelated with others, or did not load cleanly on one of the identified principal components, were considered to not be contributing significantly to the total variance and were therefore not included in index. Factor based scoring was applied to both maternal self-efficacy and attitude indices.

The maternal knowledge index was scored according to accuracy of responses, with a score of 1 for an answer reflecting any correct breastfeeding knowledge, and a score of 0 for incorrect responses. Each respondent's score was determined by summing the individual scores of each question included in the index. Variables condensed into principal components of each index constructed as well as the total variance accounted for by each component is summarized in Table 1. The association between each index and intention to exclusively were analyzed. Indices identified as statistically significant were noted for inclusion into the final logistic model.

Three different components were extracted by PCA analysis all attitude questions included in the questionnaire. The three different components extracted related to 1) time management 2) privacy and 3) positive view of exclusive breastfeeding. The index of self-efficacy factored into two components reflecting two different aspects of the

construct 1) emotional and 2) objective. The mean scores for each component extracted as well as of the indices as a whole were calculated and a t-test was used to compare the scores between intenders and non-intenders. This analysis identified which principal components were statistically related to exclusive breastfeeding intention. The components identified as statistically significant were noted for possible inclusion into a logistic model.

DATA ANALYSIS

Using SAS 9.2 variables were analyzed with respect to their association to intention to exclusively breastfeed. Categorical variables were analyzed using chi-square analysis. Fisher's exact test was used when considering analysis that involved variables with low counts. T-test were used to analyze continuous or interval variables. A simple descriptive analysis of all variables was first conducted to describe the population and each variable was assessed against maternal intentions to exclusively breastfeed. The maternal attitudes, self-efficacy and knowledge indices, all individual principal components of each index as well as all variables found to be significantly associated to intention to exclusively breastfeed were entered into a multivariate logistic regression model. Correct knowledge on questions specifically relating to exclusive breastfeeding was analyzed and each question was modeled against the intention to exclusively breastfeed generating odds ratios and 95 percent confidence intervals.

MULTIVARIABLE LOGISTIC REGRESSION MODELING STRATEGY

A bivariate logistic regression analysis approach modeled each predictor of interest against the logit probability of intending to exclusively breastfeed and unadjusted odds ratios and 95 percent confidence intervals were reported. To facilitate analysis, categories were collapsed to ensure sufficient counts where necessary. Predictors found to be significant in this analysis were cross checked with those found to be significant in the descriptive analysis and any additional variables found were noted for possible inclusion into a multivariate logistic regression model.

A p-value driven approach of backwards selection (at the=0.05 level) was used to determine a final model. Backward selection was chosen as this method of elimination allows for simultaneous adjustment of all other interaction terms. Two variables, sub-district and the knowledge index were forced into the analysis process for the final model. First all predictors identified to be significantly associated with intention to exclusively breastfeed from previous analyses, were entered into the model and a backwards selection elimination was done. Following this, all possible interactions were introduced into the model. Possible presence of significant interaction was assessed using the chunk test and a second backwards selection elimination was carried out to reduce the model of all insignificant terms. An assessment of confounding was carried out at the final stage of model selection, based on calculations which considered both precision and validity. Adjusted odds ratios and corresponding 95 percent confidence intervals were reported.

After the final model was determined to include all necessary variables and that it was hierarchically well formulated, the model was assessed to determine how effectively it describes the outcome variable. The Hosmer-Lemeshow (H-L) test is a commonly used assessment of the goodness-of-fit (GOF) of a model. This test calculates a statistic ($\hat{C}$) from a grouping method based on percentiles of estimated probabilities with the number of groups commonly equal to 10, referred to as "deciles of risk".[77] The H-L test will be used as it provides a single, easily interpretable value that can be assumed to assess fit through a comparison of the observed and expected frequencies across deciles of risk.

Further analysis was conducted examining various combinations of the retained predictors on intention to exclusively breastfeed. The H-L GOF statistic was calculated for each of the models. This was done in order to examine changes in significance and magnitude of association between each predictor and the outcome as well as how well each model fit the data.

RESULTS

DESCRIPTIVE ANALYSIS

The majority of women in this study were literate[19]. The average maternal age as 25 years and only about 6 percent of the sample was 36 years or older. The majority of the head of households had no education (65 percent) and the average total number of household members was 5 with 35 percent of households reporting 6-10 members. Twenty-six

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[19] Following the standard DHS method of assessing literacy which is based on ability to read a full sentence

percent of women were nulliparous, with the majority of women reporting having had more than one child (51 percent) most women had not experienced the death of a child (77 percent). Approximately 33 percent of women reported having at least one antenatal care visit during this pregnancy. Half of the women (51 percent) scored 7-13 out of a total of 21 points on the wealth score indicating moderate levels of wealth relative to the others interviewed and almost all of the women were Muslim (Table 2).

Relationship between key demographic characteristics and intention to exclusively breastfeed

Table 3 summarizes these findings. Intention to exclusively breastfeed in this population was high with 82 percent reporting intention to exclusively breastfeed. There was a strong relationship between intention to exclusively breastfeed and when a mother decided that she would breastfeed, as opposed to other methods of feeding. The majority of women made their decision to breastfeed their baby during their first trimester of pregnancy of which 88 percent were intenders and 12 percent were not-intending to exclusively breastfed. Receipt of any antenatal counseling (ANC) or information about nutrition for pregnant women during current pregnancy was strongly associated with intention to exclusively breastfeed. The majority of women who did not have at least one ANC session during this pregnancy of which 80 percent were intenders and 20 percent were non-intenders.

Relationship between intention to exclusively breastfeed and indices of maternal attitudes, self-efficacy and knowledge

Table 4 shows that there was a difference between the two groups of intenders across levels of maternal self-efficacy and attitudes. The majority of women who scored high on the self-efficacy index (approximately 84 percent) reported intent to exclusively breastfeed whereas the majority of women who scored low (75 percent) reported not-intending to breastfeed. Out of all women who reported high levels of positive attitude, 91 percent reported intent to exclusively breastfeed whereas of those who indicated lower levels of positive attitude, approximately 25 percent (lowest: 25 percent and low: 24.6 percent) reported not intending to exclusively breastfeed. There was no evidence of a difference across the three levels of the knowledge score between intenders and non-intenders.

Mean score of the indices of maternal attitude, self-efficacy and knowledge, their principal components and intention to exclusively breastfeed

In order to further understand the relationship between attitudes and self-efficacy across the two intention groups in each of the sub-districts, the cumulative indices were factored into principal components, with each component reflecting a subtle dimension of the larger construct (results shown in Table 5). The PCA analysis of the cumulative attitude index factored into three separate components 1) time management, 2) difficulty with privacy and 3) positive view of exclusive breastfeeding. The results indicated that the mean score of only one of the three components specifically that of time management, in

addition to the mean score of the attitude index were statistically different between intenders and non-intenders of exclusive breastfeeding in this sample of women.

Two principal components were extracted from the self-efficacy index. The first reflected objective aspects relating to self-efficacy and the second factor reflected emotional aspects. The means score of the two separate components, in addition to the cumulative index of self-efficacy were statistically different between the two intention groups.

The mean score for any correct knowledge of breastfeeding was also found to be statistically different between intenders and non-intenders.

Correct exclusive breastfeeding knowledge and intention to exclusively breastfeed

An analysis of the association between key questions related to exclusive breastfeeding knowledge and the odds of intending to exclusively breastfeed highlight some of the gaps in basic knowledge. The five key questions analyzed in Table 6 are strongly associated with intention to exclusively breastfeed and all increase the likelihood that a woman will intend to exclusively breastfeed.

Approximately 39 percent of women in this study knew that they should start breastfeeding immediately after birth; Women who knew this were about 2 times more likely to intend to exclusively breastfeed compared to those who answered incorrectly. Only 61 percent of women knew at what age a baby should start receiving liquids (including water) and only 51 percent correctly answered the question relating to timing

of first foods. Knowledge regarding the nutritional benefits of breast milk for infant growth was low, with only 32 percent of women acknowledging that exclusive breastfeeding helps their baby grow.

MULTIVARIABLE LOGISTIC MODELS

All variables found to be significant predictors of intention to exclusively breastfeed in both the descriptive analysis as well as the bivariate logistic regression analysis were included in the initial model. The three maternal indices: knowledge (OR: 1.64, 95% CI 1.14, 2.36), attitudes (moderate positive levels- OR: 2.44, 95% CI 1.30, 4.59), self-efficacy (OR: 3.15 95% CI 1.70, 5.85) along with when the decision to breastfeed was made (before pregnancy or first trimester- OR: 12.93, 95% CI 7.51, 22.26 or second or third trimester- OR: 8.44, 95% CI 4.71, 15.12)   and at least one ANC session during current pregnancy (OR: 1.6, 95% CI 1.06, 2.42) were all found to be significantly associated with intention to exclusively breastfeed in the bivariate logistic regression analysis (Table 7). When considering the associations it is important to not only the measure of effect but the relative precision. For instance, timing of when the decision to breastfeed was made appears to be strongly associated to intent to exclusively breastfeed with large measures of effect. However, the associated confidence intervals indicate poor precision. The variable exclusively breastfed last child was found to be strongly

associated to intention to exclusively breastfeed in the descriptive analysis but due to large amounts of unjustified missing data this variable was not included in the model.[20]

The following discussion describes the results of the models presented in Table 8. By examining the relationship among various combinations of these predictors and intention to exclusively breastfeed the changes in the general association as well as the magnitude of this association may be seen. The principal components of attitudes and self-efficacy along with knowledge were entered alone first (Model 1) followed by the addition of timing of decision to breastfeed (Model 2). Next the individual components were replaced by the full attitudes and self-efficacy indices along with the knowledge index (Model 3) and finally, Model 5 the last model, is the final gold standard model including the full maternal attitudes, self-efficacy, knowledge indices along with timing of decision to breastfeed and sub-district (Model 4).

Model 1 was unadjusted for sub-district and examines the associations of the knowledge index and intention to exclusively breastfeed along with the principal components of each of the cumulative attitude and self-efficacy indices. This was done to further examine the possibility that specific components of the cumulative indices may be associated with intention to exclusively breastfeed in a different manner than when separated out. This model found that the component of maternal self-efficacy relating to emotional aspects was strongly related to exclusive breastfeeding (OR: 1.89, 95% CI 1.48, 2.40). The odds of intending to exclusively breastfeed for those women who felt emotionally able or more

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[20] A flowchart describing the information available for the variable 'Exclusively breastfed last child' may be found in the appendix

confident were about 1.9 times that of women who did not have this level of emotional self-efficacy. The three attitudinal components were found to be significant. Mother who had a more positive attitude towards challenges of time management were more likely to intend to exclusively breastfeed compared to those with a less positive view of time management (OR: 1.19, 95% CI 1.13, 1.24). However, in this model women who had positive attitudes towards privacy issues (OR: 0.90, 95% CI 0.84, 0.98) and held a positive view of exclusive breastfeeding (OR: 0.76, 95% CI 0.61, 0.95) were less likely to intend to exclusively breastfeed; a decrease in likelihood of 10 percent and 24 percent respectively. The narrow confidence intervals indicate that these measures of effect were good estimates of the true effect. This model had a very poor fit (H-L Pr>0.009).

Model 2 examined the unadjusted associations among all attitudinal and self-efficacy components, the knowledge index, as well as timing of decision to breastfeed and intention to exclusively breastfeed. This analysis found emotional aspects of self-efficacy to be significant (OR: 1.94, 95% CI 1.51, 2.48)- the association increasing slightly in magnitude from Model 1 to Model 2 (OR in Model 1: 1.89 and OR in Model 2: 1.94). Time management (OR: 1.16, 95% CI 1.10, 1.22), one of the three attitudinal components, remained strongly associated to intent to exclusively breastfeed. In addition, the timing of when the decision was made to breastfeed was also strongly associated with a 9.6 increase in odds of intending to exclusively breastfeed for those women who made the decision before or during the first trimester (OR: 9.6, 95% CI 5.35, 17.20) and 6.7 increase in odds for those who made the decision during the second or third trimester (OR: 6.7 95% CI 3.60, 12.54). The referent group for this variable was women who had not yet made a decision at the time of interview. However, these large measures of effect

must be interpreted with caution as the large width of the confidence intervals indicate poor precision and suggest less certainty about whether or not these findings were good estimates of the true effect of these variables. Knowledge on the other hand, remained moderately associated with intent to exclusively breastfeed. Overall this model had a poor fit (H-L Pr>0.071).

Model 3 was adjusted for sub-district and included all components of attitudes and self-efficacy, the knowledge index, as well as timing of decision the breastfeed. The main difference highlighted in this model compared to that of Model 2 was that the objective component of self-efficacy was strongly associated with intent. Women who expressed positive attitudes towards more objective or practical aspects of exclusive breastfeeding were 1.3 times more likely to intend to exclusively breastfeed compared to those who expressed lower levels of confidence related to practical aspects exclusive breastfeeding. The knowledge index remained moderately associated with intentions. This model had a poor fit (H-L Pr>0.133).

Model 4 was unadjusted for sub-district and included only the three composite indices of knowledge, maternal attitudes and self-efficacy. The odds of intending to exclusively breastfeed for those women at higher levels of positive maternal attitude were 2.1 times more than that of women with lower levels of positive attitudes and for women at a higher level of self-efficacy, the odds of intending to exclusively breastfeed were 2.4 times that of women at lower levels of self-efficacy. The relatively precise confidence intervals indicate that these two findings were good estimates of the true effect. The

association of knowledge and intention remained moderately associated in this model. This model had a poor fit (H-L Pr>0.135).

Model 5 was the final model, as well as the gold standard model obtained from the backwards elimination analysis. It examined the association of knowledge and maternal intention to exclusively breastfeed, while considering the cumulative association of self-efficacy and attitudes. This model also controlled for sub-district and timing of decision made to breastfeed. This model revealed that making a decision to breastfeed before or during pregnancy, having high or medium level of positive maternal attitudes towards exclusive breastfeeding and high levels of self-efficacy towards exclusive breastfeeding, improve a mother's likelihood to intend to exclusively breastfeed. In this final model, higher levels of knowledge, controlled for all other variables appears to increase the odds of intending to exclusively breastfeed by 1.1 times that of a mother with lower levels of knowledge. It was found to be moderately associated with intention to exclusively breastfeed (OR: 1.12, 95% CI 0.74, 1.71). This final model was assessed by the Hosmer-Lemeshow test which indicated that it was a very good fit (Pr>Chisq 0.927).

DISCUSSION

The primary goal of this analysis was to examine the associations among knowledge, attitudes, self-efficacy and exclusive breastfeeding intention. In a series of multiple logistic regression models higher levels of self-efficacy, medium to high levels of attitude (indicative of more positive attitudes), earlier decision on breastfeeding method, and sub-district were found to be significant predictors of maternal intention to exclusively

breastfeed. As breastfeeding intention has been found to be strongly associated with actual breastfeeding practice, identifying potentially modifiable factors of intent to exclusively breastfeed is crucial to improving exclusive breastfeeding practice.

This analysis shows that positive attitude towards exclusive breastfeeding is a strong predictor of intent to exclusively breastfeed. Particularly significant is the principal component of time management, which remained significant throughout all five models. In this analysis, a mother who positively viewed potential challenges to time management related to exclusive breastfeeding was more likely to intend to exclusively breastfeed. When analyzing the attitude index as a whole, it was found that a high level of positive attitude was significantly associated with intention to exclusively breastfeed. A high level of positive attitude remained significant in the presence of the other two indices, as seen in Model 4, demonstrating a 2.1 fold increase in the odds of intending to exclusively breastfeed. The same association was observed in the final model resulting in a 2.3 fold increase in the odds of intending to exclusively breastfeed. The finding that maternal attitude is a strong predictor of intention to exclusively breastfeed is consistent with literature. However, literature confirming the association related to a specific component of this index such as time management, in this analysis, is less clearly documented as the process of PCA extracts components specific to the set of questions used and the population being analyzed. The majority of literature assessing the relationship between attitudes and intention to exclusively breastfed has assessed attitudes as a larger construct. Nevertheless, the association between positive attitude and intention to

exclusively breastfeed has been highlighted in studies which have applied health behavior models to exclusive breastfeeding practice in diverse populations. Wambach et al. assessed breastfeeding intention and outcome based on a strict application of Theory of Planned Behavior and found that maternal attitude was a strong predictor of intentions among a sample of pregnant women, 6 weeks prior to delivery, in the United States.[9] Another prospective cohort study in the United States found that it was important to ensure positive attitude towards exclusive breastfeeding as a mother's attitude remained an influential construct for both intention and duration of exclusively breastfeeding.[78]

The models in this study show that self-efficacy is associated with intention to exclusively breastfeed in this sample of rural Bangladeshi women. When analyzing theprincipal components of self-efficacy, the component which captured emotional aspects of self-efficacy remained significant throughout all model combinations. A mother who felt more emotionally empowered regarding her ability to exclusively breastfeed her child was more likely to express intent to exclusively breastfeed. In the adjusted analysis presented in Model 3, women were 2.14 times more likely to intend to exclusively breastfeed given that they felt emotionally confident about the practice. Once individual components were replaced by their respective indices, high levels of self-efficacy were significantly associated with intention to exclusively breastfeed. When the self-efficacy index was analyzed in the presence of the other two indices alone (Model 4) high levels of self-efficacy were associated with a 2.4 fold increase in the odds of intending to exclusively breastfeed. In the fully adjusted model (Model 5), a high level of self-efficacy was associated with an even greater measure of association; a 3.9-fold increase in the odds of intending to exclusively breastfeed. The finding that a higher

level of self-efficacy is strongly associated is consistent with other studies. One prospective study on 300 women in their last trimester of pregnancy in Australia found that high breastfeeding self-efficacy was strongly related to breastfeeding initiation and exclusivity.[79] A Danish cohort study examining the influence of maternal psychosocial factors on duration and breastfeeding confirmed the positive relationship between self-efficacy and initiation as well as self-efficacy and duration of breastfeeding.

It was not surprising to find that most women reported high levels of positive attitudes and self-efficacy, despite residing in a rural area characterized by lower levels of education and literacy. One of the main reasons is that breastfeeding is a cultural norm in Bangladesh and an close to universal practice with 98 percent of women reporting ever breastfeeding their child and breastfeeding duration ranging between 28 and 32 months.[10] However whether or not a mother understands the concept of exclusive breastfeeding correctly and if she knows how it is different from *any* breastfeeding is less clear.

A noteworthy observation from this study was that a high level of knowledge was only modestly associated with intent to exclusively breastfeed throughout the models. When examining the bivariate association between knowledge and intention independent of other variables (Table 9), a higher level of knowledge was significant and did show to increase a women's likelihood of intending to exclusively breastfeed by 64 percent. However, after controlling for other variables, as seen was done in Models 1-5, this relationship was reversed and a less strong association was observed. This suggests that although knowledge may translate into practice in isolation of other factors, in real-life settings this process is complicated by other factors.

A qualitative study in Mozambique found that women had heard of the recommendation to exclusively breastfeed up to 6 months yet few mother-in-laws, fathers and other key family members knew this nor believed in this recommendation greatly affecting whether or not the women successfully practiced proper exclusive breastfeeding.[80] Similar challenges have been raised in breastfeeding literature on Bangladesh. A UNICEF Infant and Young Child Feeding Review Report focused on Bangladesh, found that pressure from extended family members such as domineering grandmothers was a factor that contributed to failure to exclusively breastfeed.[70] Other studies also found similar doubts among women who were unsure that breast milk alone would be sufficient for their child needs, an issue leading to premature weaning and failure to exclusively breastfeed.[80-82] In line with these studies, this analysis found that although approximately 95 percent of women agreed that exclusive breastfeeding was the most nutritious food for their baby; another 39 percent agreed that exclusive breastfeeding was challenging as you could never be sure that your baby was getting enough milk and an additional 15 percent neither agreed nor disagreed to this statement. This shows that a large proportion of women in this sample doubt the adequacy of feeding their child breast milk alone.

Women in this study did have some general knowledge about breastfeeding. The mean score for intenders (7.1 ± 2.4) was slightly higher than non-intenders (6.3± 2.4) on a scale of 0-14 points. However, it was concerning to find critical gaps in exclusive breastfeeding knowledge. For instance, 40-50 percent of women did not appear to know the appropriate time to begin introduction of complementary foods and liquids. Lack of knowledge Literature published on Bangladesh found that many women did not fully understand the definitions or specific terms used in breastfeeding recommendations

preventing them from effectively practicing a recommended infant feeding method.[83] For instance, Haider et al. found that although 97 percent of women reported having heard the term 'breast milk alone' (the direct translation of the term 'exclusive breastfeeding' in Bangla) 70 percent wrongly perceived it to mean giving the baby breast milk and water.[71]

STRENGTHS AND WEAKNESSES

One of the strengths of this study was the use of composite indicators of maternal self-efficacy and attitudes. Although many studies have used composite maternal dimensions to assess breastfeeding practices and beliefs, very few if any, have attempted to understand how these dimensions function relative to one another in a rural population in Bangladesh. Additionally, exclusive breastfeeding is a field more fully investigated abroad with research regarding intention to exclusively breastfeed considerably less developed in Bangladesh. This study contributes towards developing this area of breastfeeding literature in Bangladesh. Secondly, not only did this study attempt to understand the relationship among the larger constructs of maternal dimensions, it also deconstructed the larger indices to try and understand the more subtle components of maternal attitudes and self-efficacy and examined how these were related to exclusively breastfeeding intention in this particular population in rural Bangladesh. An additional strength related to the tool used. The questionnaire administered was greatly informed by several data collection tools that had been used in previous research.

Several limitations warrant further attention. Lack of data on specific variables limited their use in the analysis. For instance, the indicator relating to whether or not a mother exclusively breastfed her last child has been identified in literature to be associated with

future exclusive breastfeeding practice.[83] However it was not possible to include this indicator in the models due to a significant amount of incorrectly coded data.[21]

Secondly, the self-efficacy and attitudes indices were created through analysis of a set of questions which used a 3 point Likert scale to rate a mother's relative agreement or disagreement to each statement. It is possible that a more sensitive analysis could have resulted from use of a 7 or even 9 point Likert scale in order to capture more subtle differences in a mother's response. Future analysis of similar concepts may consider using a Likert scale with more gradations to see if greater variation in responses is detected.

Another limitation to this analysis relates to the p-value of the Hosmer-Lemeshow goodness-of-fit test which was used to assess the final model. The validity of this p-value may be compromised depending on the distribution of expected frequencies across the deciles of risk. More conservative views claim that all counts across these deciles, must be greater than 5, however Hosmer and Lemeshow assume a slightly more liberal view.[77] The final model for this analysis resulted in two cells with frequencies of less than 5.[22] However, following Hosmer and Lemeshow's more liberal view, it is believed that the calculation of the p-value for the final model in this study (Model 5) is in fact accurate enough to support the hypothesis that the model fits. However further analysis, under a

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[21] A flowchart describing the information available for the variable 'Exclusively breastfed last child' may be found in the appendix

[22] See Appendix for table presenting distribution of expected frequencies across deciles of risk for the final model (Model 5).

more conservative view, using alternate goodness-of-fit tests for sparse data may be useful to explore.

4. CONCLUSION, FINAL COMMENTS AND REFLECTIONS

The present study is a preliminary investigation into the relationships among knowledge, attitudes, self-efficacy and intention to exclusively breastfeed among pregnant women in rural Bangladesh. Higher levels of self-efficacy and positive attitudes were found to be strongly associated with intention to exclusively breastfeed whereas a higher level of knowledge was only moderately associated with intent to exclusively breastfeed. This underlines the complexity of the process of how knowledge impacts actual behavior and highlights a common challenge in health behavior research. The assumption that higher levels of correct breastfeeding knowledge will translate into stronger exclusive breastfeeding intention and improve actual practice may be an oversimplification of the reality in which knowledge is actually applied.

Unique to the Bangladeshi context is the finding that despite low levels of education and socio-economic status women are already highly empowered and hold very positive attitudes towards exclusive breastfeeding. This suggests that, in this population, it may be more fruitful to develop future interventions aimed at strengthening knowledge over empowerment and attitudes. Addressing prevalent cultural misconceptions such as doubts surrounding the adequacy of breast milk alone and working to dissipate potentially harmful traditional practices such as prelacteal or early complementary feeding which hinder proper exclusive breastfeeding practice may also positively impact exclusive breastfeeding practice. Additionally communicating and standardizing infant

feeding recommendations into locally understandable terms is critical to facilitating translation of knowledge into real-life practice.

As familial decisions implicate many more actors than the mother herself and family traditions are often imposed by more influential family members such as the head of the household or a mother-in-law. Maternal knowledge of best infant feeding practices such as proper exclusive breastfeeding is often overridden, therefore knowledge building and behavior change communication interventions should involve immediate and extended family members to counteract such pressure and reduce the risk of failure to successfully exclusively breastfeed.

The data for this thesis were from an observational study embedded within the Window of Opportunity project (Window), a longitudinal two-year cohort study funded by CARE-USA. The cohort study is part of the evaluation process of Window. As this was the first data collection point of the Window cohort it is inevitable that there will be aspects in need of improvement. This section discusses a few areas of improvement, reflects on the overall process and relates this research back to the Window project.

WINDOW COHORT: QUESTIONNAIRE DEVELOPMENT, DATA COLLECTION AND ANALYSIS

Although the questionnaire included previously utilized tools and scales, several aspects could be improved for future data collection points. Firstly, given the importance of the mother in this analysis, it is critical when collecting general household information to ensure that all information related to the mother is recorded in a manner that allows for

easy identification. For instance, at the point of data analysis, the variable maternal education, an important characteristic, was found to not be easily extractable from the data collected about other household members. In a country where polygamy is practiced, household members include many of the extended family members and daughters often bear similar names to their mothers. Given this, it was difficult to filter specific maternal information that was not clearly recorded. This is a questionnaire development challenge and one that should be clearly noted for all future data collection points.

Additionally, data collection must be regulated carefully in order to reduce unnecessary loss of useful information. For instance, in this analysis information on the opinions towards exclusive breastfeeding, held by people close to the mother could have been informative. Responses were to be recorded using a 3-point Likert scale (Agree, Neither agree or disagree, Disagree). If the person in question was no longer alive, the field workers were instructed to leave a blank and record a reason. However, given a large number of blank inputs with no reasons offered, it was not possible to include this information in the analysis. This highlights the importance of continued quality assurance with respect to data collection as well as inputting. In the case of the Window cohort, this means coordinating efforts of data quality and assurance throughout the data collection process. Data is collected simultaneously by several field workers in rural areas and then transported to the capital soon after for data inputting by a separate team. At each point the data is handled by a new person, highlighting the need for data quality checks at key intervals throughout this process.

Another aspect specific to the development of this thesis was the limited time available to carry out the analysis. The two week visit to Bangladesh took place in early January 2011, field work was completed by the 4 February 2011 and data management or inputting was only completed by early March 2011 in Bangladesh. As a result, analysis of the data and write up for this thesis only began in the middle of March 2011 leaving just about one month to complete before the thesis deadline. Although the timing in this case was unavoidable, more time would have allowed for a deeper, more intricate analysis.

PUBLIC HEALTH AND POLICY IMPLICATIONS

The results of this analysis will contribute to baseline knowledge of the population for the Window cohort study. One of the key findings in this analysis was of the importance of time management and privacy, two separate principal components of maternal attitude. Both of them were found to be strongly associated to intention to exclusively breastfeed. Previous formative research done by CARE, has found similar associations suggesting this to be an interesting relationship for further research and underlines potential implications for future program development in this specific population. In order to improve the prevalence and practice of exclusive breastfeeding in Bangladesh, it is necessary to understand the nuances specific to each separate population. Future analysis aimed at understand how much each determinant influences a woman's decision and ultimate practice to exclusively breastfeed are necessary as they inform program design by ensuring that interventions target appropriate determinants of behavior and ensures that limited funds available are invested in initiatives that will bring about the greatest improvement in health.

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LIST OF MANUSCRIPT FIGURES AND TABLES

FIGURES

Manuscript Figure 1: Study administration timeline, by child age

Recruitment, first consent, enrollment, and fieldwork (survey of feeding intentions)

Follow up visits

Cohort 1 only

Month (Child's Age)

-2
PREGNANCY

3

9

16

POST-NATAL

End-line survey: all children less than 24 months enrolled in the study
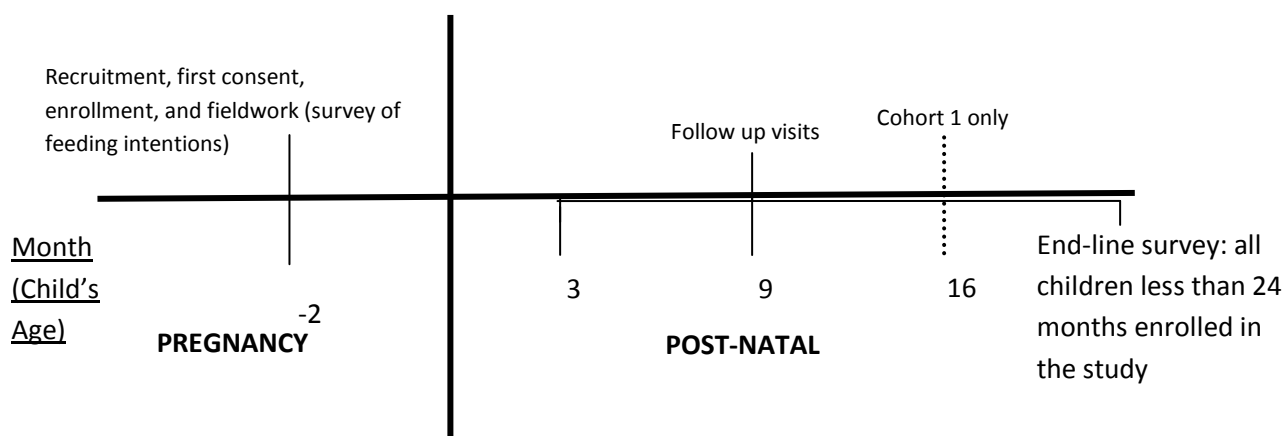
Manuscript Figure 2: Rolling participant recruitment timeline, by project month (eventual mother-infant dyads)

2-YEAR-MARK (child's age)

N_{C1}= 800 is 2 years

N_{C2}= 800 is 18 months

N_{C3}= 800 is 12 months

COHORT 1 (N=800)

COHORT 2 (N=800)

COHORT 3 (N=800)

Project Month

January 2011

June 2011

December 2011

TWO YEARS (End of March 2013)
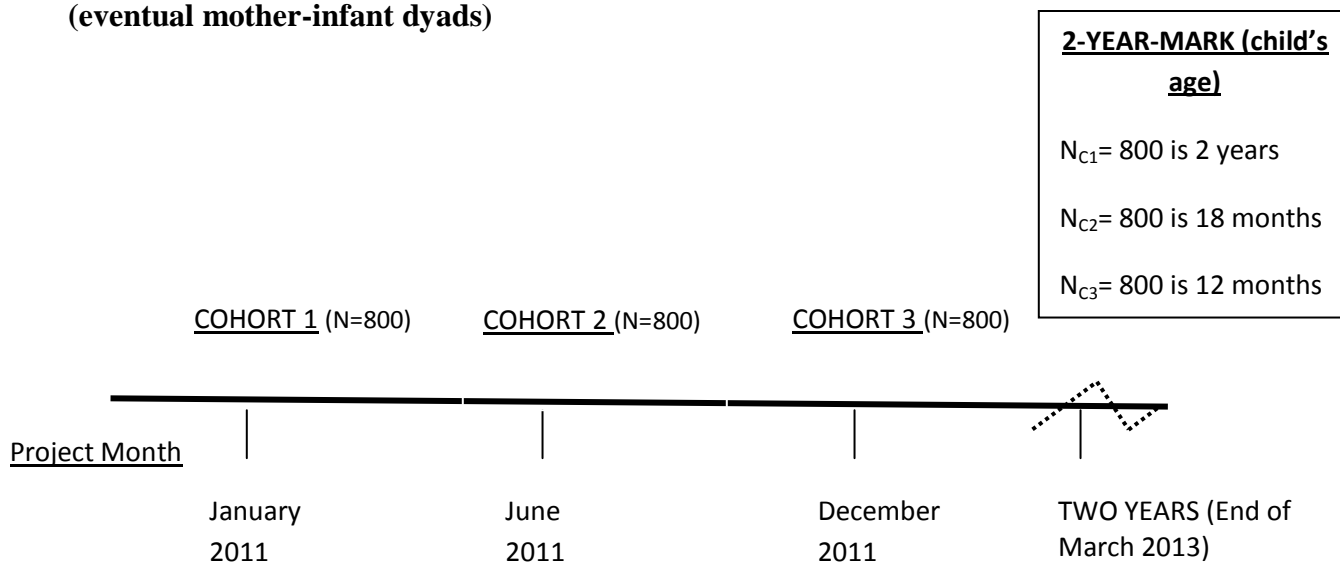
Manuscript Figure 3: Conceptual Model of Maternal Knowledge Attitudes, Self-efficacy and Intention to Exclusively Breastfeed (EBF)
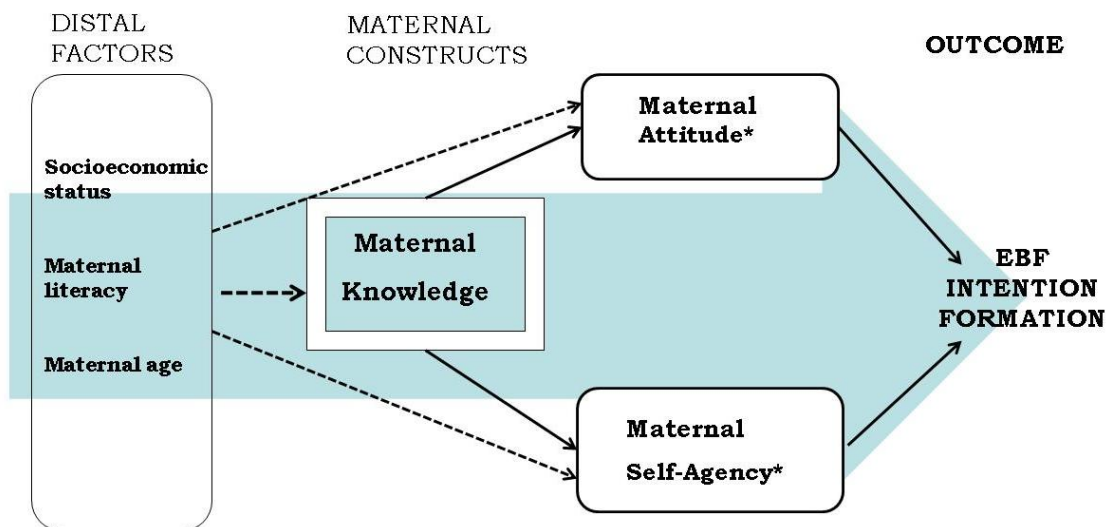
Cumulative maternal factors: maternal attitude and agency influence the relationship of knowledge on intention to exclusively breastfeed. The arrows indicate the direction of influence between one factor and the next. The dashed arrow suggests how background socio-economic and cultural aspects play into development of attitudes, agency and knowledge indirectly affecting intention formation. The two cumulative indices are marked by an asterisk referencing them to their source, Ajzen et al.,'s (1985) the theory of planned behavior (TPB). Maternal knowledge is an additional construct not typically seen in TPB analysis.

TABLES

Manuscript Table 1: Principal Component Variables and Total Variance Accounted

VARIABLE AND PERCENT VARIANCE ACCOUNTED FOR	THEME
ATTITUDES	
Principal Component 1: 23.2%	
EBF takes up too much time	Time Management
EBF will make it hard to go back to work	Time Management
Mothers who feed the baby other things get more rest than mothers who EBF	Time Management
Breastfeeding is messy	Time Management
Feeding the baby something other than breast milk is easier than only breastfeeding	Time Management
EBF is difficult as it limits the mother's freedom to do other things	Time Management
EBF is difficut because it means that no one else can help you feed	Time Management
Principal Component 2: 16.9%	
EBF is difficult because it is uncomfortable to feed the baby in public	Privacy
EBF is difficult because it is embarrassing to feed the baby in public	Privacy
EBF is difficult because it is messy to feed the baby in public	Privacy
Principal Component 3: 12.7%	
EBF is the most nutritious food for my baby	Positive View of EBF
EBF is the best way of providing food for my baby	Positive View of EBF
EBF is healthy for the baby	Positive View of EBF
EBF makes you closer to your baby	Positive View of EBF
EBF is better than feedign the baby other foods because breast milk is free	Positive View of EBF
TOTAL VARIANCE ACCOUNTED FOR: 52.8%	
SELF-EFFICACY	
Principal Component 1: 31.1%	
I am confident I can EBF	Emotional
I am physically able to EBF	Emotional
I am determined to EBF	Emotional
Principal Component 2: 16.9%	
I won't need help to EBF	Objective
I know how to EBF	Objective
I believe EBF is easy	Objective
TOTAL VARIANCE ACCOUNTED FOR: 48.0%	

EBF- Exclusive Breastfeeding

Manuscript Table 2: Demographic characteristics of a sample of pregnant mothers in Kishoreganj district, Bangladesh

Characteristic		All mothers (n=800)	
		n (%)	mean ± sd
SOCIO-ECONOMIC			
Level of education of head of household	None	519 (64.9)	--
	Primary	179 (22.4)	
	Secondary	92 (11.5)	
	Higher	7 (0.9)	
	Religious	3 (0.4)	
Religion	Muslim	787 (98.4)	--
	Hindu	13 (1.6)	
Wealth score	0-6	220 (27.5)	--
	7-13	409 (51.1)	
	14-21	171 (21.4)	
Maternal illiteracy*	Illiterate	329 (41.1)	--
	Literate	471 (58.9)	
ANTENATAL CARE AND BIRTH			
Prior births	No prior	208 (26.0)	--
	One prior	184 (23.0)	
	More than one prior	408 (51.0)	
Number of child deaths	0	619 (77.4)	0.3 ± 0.7
	1-2	167 (20.9)	
	3+	14 (1.8)	
Antenatal care during this pregnancy	Yes	261 (32.6)	--
Exclusively breatfeed last child**	Yes	120 (31.7)	--
Timing of decision to breastfeed	Before Pregnancy	58 (7.3)	--
	First Trimester	438 (54.8)	
	Second Trimester	109 (13.6)	
	Third Trimester	120 (15.0)	
	No Decision Made	75 (9.4)	
DEMOGRAPHIC			
Total number of household members	1-5	481 (60.1)	5.4 ± 2.5
	6-10	282 (35.3)	
	11-15	33 (4.1)	
	16+	4 (0.5)	
Mother's age	15-25	450 (56.3)	25.4 ± 5.9
	26-35	304 (38.0)	
	36-45	44 (5.5)	
	46+	2 (0.3)	

* Maternal illiteracy was defined as not being able to read at all

**denominator=379 See Appendix for flowchart

Manuscript Table 3: Relationship between key demographic characteristics and intention to exclusively breastfeed in a sample of pregnant women in Kishoreganj district, Bangladesh

Characteristic	All N=800	Intenders n=658	Non-Intenders n=142	p-value
SOCIO-ECONOMIC				
Level of Education of Head of Household				
None	519 (64.9)	422 (81.3)	97 (18.7)	
Primary	179 (22.4)	149 (83.2)	30 (16.8)	p=0.66†
Secondary	92 (11.5)	79 (85.9)	13 (14.1)	
Higher	7 (0.9)	6 (85.7)	1 (14.3)	
Religious	3 (0.4)	2 (66.7)	1 (33.3)	
Wealth score				
0-6	220 (27.5)	176 (80.0)	44 (20.0)	
7-13	409 (51.1)	336 (82.2)	73 (17.9)	p=0.09+
14-21	171 (21.4)	146 (85.4)	25 (14.6)	
Maternal Literacy				
None	329 (41.1)	267 (81.2)	62 (18.8)	χ_2=0.45
Some	471 (58.9)	391 (83.0)	80 (17.0)	p=0.50
ANTENATAL CARE AND BIRTH				
Prior Births				
No Prior Births	208 (26.0)	160 (76.9)	48 (23.1)	
One prior	184 (23.0)	161 (87.5)	23 (12.5)	χ_2=0.88 p=0.35
More than One	408 (51.0)	337 (82.6)	71 (17.4)	
Antenatal Clinic Visit during Current Pregnancy				
Yes	261 (32.6)	226 (86.6)	35 (13.4)	χ_2=5.0
No	539 (67.4)	432 (80.1)	107 (19.9)	p=0.03
Exclusively breatfeed last child**				
Yes	120 (31.7)	117 (97.5)	3 (2.5)	p<0.01†
No	259 (68.3)	202 (78.0)	58 (22.4)	
Timing of decision to breastfeed				
Before pregnancy	58 (7.3)	52 (89.7)	6 (10.3)	
First Trimester	438 (54.8)	387 (88.4)	51 (11.6)	
Second Trimester	109 (13.6)	93 (85.3)	16 (14.7)	χ_2=74.0 p<0.01
Third Trimester	120 (15.0)	98 (81.7)	22 (18.3)	
No decision made	75 (9.4)	28 (37.3)	47 (62.7)	
DEMOGRAPHIC				
Maternal Age	800 (100.0)	25.4 ± 5.8	25.2 ± 6.3	p=0.73 +

χ_2 Mantal Hentzel Chi-square   + Pooled p-value reported

**denominator=379 See Appendix for flc † Fisher's Exact Test

Manuscript Table 4: Relationship between intention to exclusively breastfeed and indices of maternal attitudes, self-efficacy and knowledge in a sample of pregnant women in Kishoreganj district, Bangladesh

Index	Intenders	Non-Intenders	
	n=658	n=142	p-value
Attitudes			
Lowest (19-25)	18 (75.0)	6 (25.0)	
Low (26-31)	101 (75.4)	331 (24.6)	χ_2= 19.3
Medium (32-38)	232 (76.6)	71 (23.4)	p<0.01
High (39-45)	307 (90.6)	32 (9.4)	
Self-efficacy			
Low (10-12)	2 (25.0)	61 (75.0)	
Medium (13-14)	27 (69.2)	12 (30.8)	p<0.01†
High (15-18)	629 (83.5)	124 (16.5)	
Knowledge			
Low (0-4)	80 (69,6)	35 (30.4)	χ_2=2.10
Medium (5-9)	452 (82.5)	96 (17.5)	p=0.15
High (10-14)	126 (92.0)	11 (8.0)	

† Fisher's Exact Test otherwise χ_2 Mantal Hentzel Chi-square

Manuscript Table 5: Mean score of the three maternal indices of Attitude, Self-Efficacy and Knowledge and its principal components stratified by intention to exclusively breastfeed in a sample of pregnant women in Kishoreganj district, Bangladesh

Index or Component	Intenders n=658	Non-intenders n=142	T-statistic	p-value
Maternal Attitude (scale 19-45)	36.8± 5.1	34.3 ± 4.6	5.27	<0.01
Time Management (scale 7-21)	17.5 ± 3.8	14.7 ± 4.0	7.76	<0.01
Privacy (scale 3-9)	4.6 ± 2.4	5.0 ± 2.6	-1.61	0.11
Positive View of Breast milk (scale 5-15)	14.7 ± 1.1	14.6 ± 1.0	0.59	0.56
Maternal Self-Efficacy (scale 10-18)	17.4 ± 1.3	16.6 ± 1.8	6.73	<0.01‡
Emotional (scale 3-9)	8.8 ± 0.6	8.4 ± 1.1	4.83	<0.01‡
Objective (scale 4-9)	8.6 ± 0.9	8.3 ± 1.1	3.91	<0.01‡
Maternal Knowledge (scale 0-56)	7.3 ± 2.4	6.3 ± 2.4	4.2	<0.01

‡ satterwaite p-value

Manuscript Table 6: Prevalence and odds of correct exclusive breastfeeding knowledge and intention to exclusively breastfeed in a sample of pregnant women in Kishoreganj district, Bangladesh

Key Exclusive Breastfeeding Knowledge Questions (paraphrased)	Desired Response	Correct Response (%)	Odds Ratio of EBF Intention given correct response[a]
How long after birth should a baby start breastfeeding?	Immediately	38.6	2.09 (1.39, 3.14)*
What should a mother do with the "first milk" or colostrum?	Give it to her baby by breatfeeding soon after birth	83.9	2.51 (1.63, 3.85)*
At what age should a baby first receive liquids (including water) other than breast milk?	6 or 7 months	61.8	1.74 (1.21, 2.51)*
At what age should a baby first receive foods in addition to breast milk?	6 or 7 months	51.4	1.51 (1.05, 2.18)*
Reasons why a young baby should be exlcusively breastfeed	Protects baby from illness Helps baby grow	65.5 32.4	2.06 (1.43, 2.98)* 2.45 (1.55, 3.85)*

*denotes significance at the 0.05 level

** reference group = incorrect answer

[a]Odds Ratio and 95 % Confidence Intervals for Intending to Exclusively Breastfeed of those who correctly responded versus those who incorrectly responded

Manuscript Table 7: Prevalence and unadjusted odds of intention to exclusively breastfeeding in a sample of pregnant women in Kishoreganj district, Bangladesh

Variable	n (%)	Odds ratio intending to EBF[a]	
Knowledge Index			
Reference= Low	*331 (41.4)*	*1.00*	--
High	469 (58.6)	1.64	(1.14, 2.36)*
Attitudes Index			
Reference= Low	*66 (8.3)*	*1.00*	--
Medium	259 (32.4)	2.44	(1.30, 4.59)*
High	475 (59.4)	0.85	(0.45, 1.58)
Self-efficacy Index			
Reference= Low	*47 (5.9)*	*1.00*	--
High	753 (94.1)	3.15	(1.70, 5.85)*
When decision to breastfeed was made			
Reference= no decision taken	*75 (9.4)*	*1.00*	--
Before/ first trimester	496 (62.0)	12.93	(7.51, 22.26)*
Second/ third trimester	229 (28.6)	8.44	(4.71, 15.12)*
Any ANC visit during current pregnancy			
Reference= No	*539 (67.4)*	*1.00*	--
Yes	261 (32.6)	1.60	(1.06, 2.42)*
Wealth score	--	1.05	(0.99, 1.11)
Maternal age	--	1.00	(0.98, 1.04)

*denotes significance at the 0.05 level

[a] Unadjusted Odds Ratio and 95 % Confidence Intervals of intending to exclusive breastfeed (EBF)

Manuscript Table 8: Multivariable analysis examining the relationship of maternal knowledge and intentions to exclusively breastfeed given exposure to the variables included in each model in a sample of pregnant women in Kishoreganj district, Bangladesh

	Model 1	Model 2	Model 3	Model 4	Model 5
	Unadjusted model with attitudinal components, self-efficacy components and knowledge index,	**Unadjusted** model with attitudinal components, self-efficacy components and knowledge index, **timing of decision to breastfeed**	**Adjusted** model with attitudinal components, self-efficacy components knowledge index, timing of decision to breastfeed and **sub-district**	**Unadjusted** model with three maternal indices- attitudes, self-efficacy and knowledge	**Adjusted** <u>final model</u> with three indices- attitude self-efficacy and knowledge and timing of decision to breastfeed and sub-district
	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)
Maternal Self-efficacy components					
Objective	1.21 (0.98, 1.49)	1.17 (0.94, 1.47)	1.32 (1.04, 1.67)*	--	--
Emotional	1.89 (1.48, 2.40)*	1.94 (1.51, 2.48)*	2.14 (1.66, 2.77)*	--	--
Maternal Attitudinal components					
Time management	1.19 (1.13, 1.24)*	1.16 (1.10, 1.22)*	1.12 (1.06, 1.19)*	--	--
Privacy	0.90 (0.84, 0.98)*	0.93 (0.85, 1.01)	0.94 (0.87, 1.03)	--	--
Superiority of Breast milk	0.76 (0.61, 0.95)*	0.80 (0.65, 1.00)	0.87 (0.70, 1.09)	--	--
Timing of decision to breastfeed					
Reference= no decision taken	--	*1.00* --	*1.00* --	--	*1.00* --
Before pregnancy/ first trimester	--	9.59 (5.35, 17.20)*	8.32 (4.57, 15.12)*	--	9.92 (5.54, 17.75)*
Second trimester/ third trimester	--	6.72 (3.60, 12.54)*	6.53 (3.44, 12.37)*	--	7.36 (3.97, 13.65)*
Maternal Attitude Index					
Reference= Low	--	--	--		*1.00* --
High	--	--	--	2.10 (1.10, 4.00)*	2.30 (1.14, 4.66)*
Medium	--			0.79 (0.42, 1.49)	1.48 (0.73, 3.02)
Maternal Self-Efficacy Index					
Reference= Low	--	--	--		*1.00* --
High	--	--	--	2.43 (1.28, 4.63)*	3.91 (1.91, 8.00)*
Maternal Knowledge Index					
Reference= Low					
High	1.43 (0.98, 2.09)	0.96 (0.62, 1.49)	0.96 (0.62, 1.51)	1.43 (0.98, 2.09)	1.12 (0.74, 1.71)
Model Goodness-of-fit Test (Hosmer-Lemeshow)	*Pr> Chisq 0.009*	*Pr> Chisq 0.071*	*Pr> Chisq 0.133*	*Pr> Chisq 0.135*	*Pr> Chisq 0.927*

* denotes significance at 0.05 level
Models 3 and 5 were adjusted for sub-district

APPENDIX 1

FLOWCHART OF VARIABLE: EXCLUSIVELY BREASTFED LAST CHILD

(in reference to footnotes 19 and 20)

KARIMGANJ

```
          ┌─────────────────────────────────────────┐
          │   Exclusively breastfed last child       │
          └─────────────────────────────────────────┘
          │                    │                    │
  ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
  │  Yes = 92    │    │  No= 103     │    │  N/A= 205    │
  └──────────────┘    └──────────────┘    └──────────────┘
                                                  │
                              ┌───────────────────────────────┐
                              │  No previous births= 95       │
                              └───────────────────────────────┘
                                            │
                              ┌───────────────────────────────┐
                              │  Last child died= 18          │
                              └───────────────────────────────┘
                                            │
                                  ┌───────────────────┐
                                  │  N/A = 92*        │
                                  └───────────────────┘
```

KATIADI

```
          ┌─────────────────────────────────────────┐
          │   Exclusively breastfed last child       │
          └─────────────────────────────────────────┘
          │                    │                    │
  ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
  │  Yes = 28    │    │  No= 156     │    │  N/A= 216    │
  └──────────────┘    └──────────────┘    └──────────────┘
                                                  │
                              ┌───────────────────────────────┐
                              │  No previous births= 113      │
                              └───────────────────────────────┘
                                            │
                              ┌───────────────────────────────┐
                              │  Last child died= 17          │
                              └───────────────────────────────┘
                                            │
                                  ┌───────────────────┐
                                  │  N/A = 86*        │
                                  └───────────────────┘
```
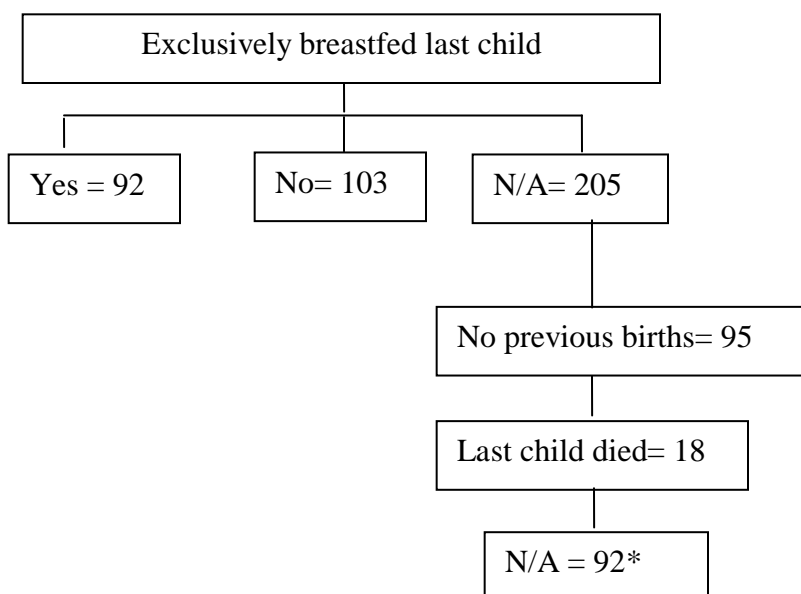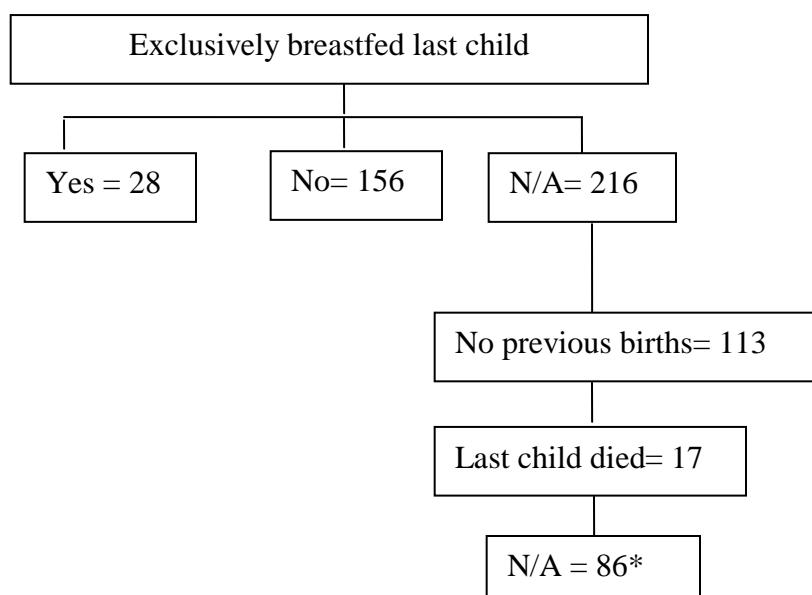
*Respondents were provided with a definition of exclusive breastfeeding for this study. The category of non-applicable was meant to capture only those women who had no previous child (Karimganj =95 and Katiadi=113) as well as those who did not exclusively breastfeed their last child because of death of child. All others (Karimganj=92 and Katiadi=86) should have been recorded as 'No' indicating that they did not exclusively breastfeed their last child as per the definition given and should have then skipped the following questions in Section 5 and moved to Section 6 of the questionnaire. Total N/A in both sub-districts 205+216= 421 missing from the denominator for variable exclusively breastfed last child resulting in the denominator of 379 (800-421).

APPENDIX 2

FINAL DECILES OF RISK FOR HOSMER-LEMESHOW GOODNESS-OF-FIT TEST FOR THE FINAL MODEL

(in reference to footnote 21)

Partition for the Hosmer and Lemeshow Test					
Group	Total	EBF_YN1 = 1		EBF_YN1 = 0	
		Observed	Expected	Observed	Expected
1	80	29	28.79	51	51.21
2	93	67	67.66	26	25.34
3	95	75	76.20	20	18.80
4	61	51	50.21	10	10.79
5	49	43	41.90	6	7.10
6	79	66	68.67	13	10.33
7	78	72	71.81	6	6.19
8	69	64	65.10	5	3.90
9	58	57	55.34	1	2.66
10	138	134	132.33	4	5.67

Hosmer and Lemeshow Goodness-of-Fit Test		
Chi-Square	DF	Pr > ChiSq
3.1132	8	0.9271

APPENDIX 3

STRATIFIED ANALYSIS BY SUB-DISTRICT

CARE's intervention site: Karimganj Non-intervention site: Katiadi

Appendix Table 1: Key demographic characteristics stratified by sub-district, Bangladesh

Characteristic		Karimganj All mothers (n=400)		Katiadi All mothers (n=400)	
		n (%)	mean ± sd	n (%)	mean ± sd
Total number of household members	1-5	216 (54.0)	5.7 ± 2.8	265 (66.3)	5.0 ± 2.1
	6-10	156 (39.0)		126 (31.5)	
	11-15	24 (6.0)		9 (2.3)	
	16+	4 (1.0)		0 (0.0)	
Level of education of head of household	None	258 (64.5)		261 (65.3)	
	Primary	93 (23.3)		86 (21.5)	
	Secondary	45 (11.3)	--	47 (11.8)	--
	Higher	3 (0.8)		4 (1.0)	
	Religious	1 (0.3)		2 (0.5)	
Mother's age	15-25	212 (53.0)	25.9 ± 5.7	238 (59.5)	24.8 ± 6.0
	26-35	165 (41.3)		139 (34.8)	
	36-45	22 (5.5)		22 (5.5)	
	46+	1 (0.3)		1 (0.3)	
Prior births	No prior	95 (23.8)	--	113 (28.3)	--
	One prior	101 (25.3)		83 (20.8)	
	More than one prior	204 (51.0)		204 (51.0)	
Number of child deaths	0	310 (77.5)		309 (77.3)	
	1-2	86 (21.5)	0.3 ± 0.6	81 (20.3)	0.4 ± 0.8
	3+	4 (1.0)		10 (2.5)	
Antenatal care during this pregnancy	Yes	153 (38.3)		108 (27.0)	--
Religion	Muslim	396 (99.0)	--	391 (97.8)	--
	Hindu	4 (1.0)	--	9 (2.25)	--
Maternal illiteracy*	Illiterate	173 (43.3)	--	156 (39.0)	--
	Literate	227 (56.8)	--	244 (61.0)	--
Exclusively breastfeed last child**	Yes	92 (47.2)		28 (15.2)	
Timing of decision to breastfeed	Before Pregnancy	41 (10.3)		17 (4.3)	
	First Trimester	230 (57.5)		208 (52.0)	
	Second Trimester	59 (14.8)		50 (12.5)	
	Third Trimester	49 (12.3)		71 (17.8)	
	No Decision Made	21 (5.3)		54 (13.5)	
Wealth score	0-6	103 (25.8)		117 (29.5)	
	7-13	204 (51.0)		205 (51.3)	
	14-21	93 (23.3)		78 (19.5)	

* Maternal illiteracy was defined as not being able to read at all

**denominator=379 See Appendix for flowchart

Appendix Table 2: Relationship between key demographic characteristics and intention to exclusively breastfeed of pregnant women stratified by sub-district, Bangladesh

Characteristic	Karimganj All N=400	Intenders n=365	Non-Intenders n=35	p-value	Katiadi All N=400	Intenders n=293	Non-Intenders n=107	p-value
Level of Education of Head of Household								
None	258 (64.5)	236 (91.5)	22 (8.5)		261 (65.3)	186 (71.3)	75 (28.7)	
Primary	93 (23.3)	84 (90.3)	9 (9.7)	p=0.47	86 (21.5)	65 (75.6)	21 (24.4)	p=0.47
Secondary	45 (11.3)	42 (26.7)	3 (6.7)		47 (11.8)	37 (78.7)	10 (21.3)	
Higher	3 (0.8)	2 (66.7)	1 (33.3)		4 (1.0)	4 (100)	0 (0)	
Religious	1 (0.3)	1 (100)	0 (0)		2 (0.5)	1 (0.5)	1 (0.5)	
Prior Births								
No Prior Births	95 (23.8)	81 (85.3)	14 (14.7)	χ_2=0.18	113 (28.3)	79 (27.0)	34 (30.1)	χ_2=0.44
One prior	101 (25.3)	96 (95.0)	5 (5.0)	p=0.67	83 (20.8)	65 (78.3)	18 (21.7)	p=0.51
More than One	204 (51.0)	188 (92.2)	16 (7.8)		204 (51.0)	149 (73.0)	55 (27.0)	
Maternal Age	400	25.9 ± 5.7	25.9 ± 6.0	p=0.99	400	24.8 ± 5.9	25.0 ± 6.4	p=0.77
Maternal Literacy								
None	173 (43.3)	158 (91.3)	15 (8.7)	χ_2=0.00 p= 0.96	156 (39.0)	109 (69.9)	47 (30.1)	χ_2=1.49 p= 0.22
Some	227 (56.8)	207 (91.2)	20 (8.8)		244 (61.0)	184 (75.4)	60 (24.6)	
Antenatal Clinic Visit during Current Pregnancy								
Yes	153 (38.3)	136 (88.9)	17 (11.1)	χ_2=1.72 p= 0.19	108 (27.0)	90 (83.3)	18 (16.7)	χ_2=7.66 p= 0.01
No	247 (61.8)	229 (92.7)	18 (7.3)		292 (73.0)	203 (69.5)	89 (30.5)	
Timing of decision to breastfeed								
Before pregnancy	41 (10.3)	39 (95.1)	2 (4.9)		17 (4.3)	13 (76.5)	4 (23.5)	
First Trimester	230 (57.5)	219 (95.2)	11 (4.8)		208 (52.0)	168 (80.8)	40 (19.2)	
Second Trimester	59 (14.8)	56 (94.9)	3 (5.1)	p<0.00†	50 (12.5)	37 (74.0)	13 (26.0)	p<0.00†
Third Trimester	49 (12.3)	40 (81.6)	9 (18.4)		71 (17.8)	58 (81.7)	13 (18.3)	
No decision made	21 (5.3)	11 (52.4)	10 (47.6)		54 (13.5)	17 (31.5)	37 (68.5)	
Exclusively breatfeed last child**								
Yes	92 (47.2)	91 (98.9)	1 (1.1)		28 (15.2)	26 (92.9)	2 (7.1)	
No	103 (52.8)	90 (86.4)	14 (13.6)	p<0.00†	156 (84.8)	112 (71.8)	44 (28.2)	p<0.02†
Wealth score								
0-6	103 (25.8)	92 (89.3)	11 (10.7)	χ_2=0.36	117 (29.3)	84 (71.8)	33 (28.2)	χ_2=0.01
7-13	204 (51.0)	187 (91.7)	17 (8.3)	p=0.55	205 (25.6)	149 (72.7)	56 (27.3)	p=0.94
14-21	93 (23.3)	86 (92.5)	7 (7.5)		78 (19.5)	60 (76.9)	18 (23.1)	

χ_2 Mantal Hentzel Chi-square

**denominator=379 See Appendix for flowchart   † Fisher's Exact Test

Appendix Table 3: Relationship between intention to exclusively breastfeed and indices of maternal attitudes, self-efficacy and knowledge, stratified by sub-district in Bangladesh

Index	Karimganj			Katiadi		
	Intenders	Non-Intenders		Intenders	Non-Intenders	
	n =365	n=35	p-value	n=293	n=107	p-value
Attitudes						
Lowest (19-25)	13 (92.9)	1 (7.1)		5 (50)	5 (50)	
Low (26-31)	57 (89.1)	7 (11.0)	p=0.03†	44 (62.9)	26 (37.1)	p=0.02 †
Medium (32-38)	228 (94.2)	14 (5.8)		79 (81.4)	18 (18.6)	
High (39-45)	67 (83.8)	13 (16.3)		165 (74.0)	58 (26.0)	
Self-efficacy						
Low (10-12)	2 (33.3)	4 (66.7)		0 (0.0)	2 (100.0)	
Medium (13-14)	20 (76.9)	6 (23.1)	p<0.00†	7 (53.9)	6 (46.2)	p=0.02†
High (15-18)	343 (93.2)	25 (6.8)		286 (74.3)	99 (25.7)	
Knowledge						
Low (0-4)	46 (79.3)	12 (20.7)		34 (59.7)	33 (40.4)	
Medium (5-9)	259 (92.5)	21 (7.5)	p<0.00†	193 (72.0)	75 (28.0)	p=0.04 +
High (10-14)	60 (96.8)	2 (3.2)		66 (88.0)	9 (12.0)	

† Fisher's Exact Test otherwise χ_2 Mantal Hentzel Chi-square

+ MH Chi-square

Appendix Table 4: Mean score of the maternal attitude index and principal components stratified by intention to exclusively breastfeed stratified by sub-district, Bangladesh

KARIMGANJ	MATERNAL ATTITUDE INDEX			
	Time Management Scale range 7-21	**Difficulty with Privacy** Scale range 3-9	**Positive View of Breast milk** Scale range 5-15	**Attitude Index** Scale range 19-45
	M ± SD	M ± SD	M ± SD	M ± SD
Intenders n=365	18.3 ± 4.0	4.6 ± 2.4	14.6 ± 1.2	37.4 ± 5.6
Non-Intenders n=35	16.9 ± 4.3	3.9 ± 1.9	14.7 ± 0.8	35.5 ± 5.2
T-statistic p-value	1.77 0.064	1.48 0.141	-0.49 0.623‡	1.9 0.0584
KATIADI	M ± SD	M ± SD	M ± SD	M ± SD
Intenders n=293	16.6 ± 3.3	4.6 ± 2.5	14.8 ± 0.9	36.0 ± 4.3
Non-Intenders n=107	14.0 ± 3.6	5.3 ± 2.7	14.6 ± 1.0	33.9 ± 4.4
T-statistic p-value	6.61 <0.01	-2.35 0.019	1.83 0.069‡	4.24 <0.01

‡ Satterwaite p-value

Appendix Table 5: Mean score of the maternal self-efficacy index and principal components stratified by intention to exclusively breastfeed stratified by sub-district, Bangladesh

KARIMGANJ	MATERNAL SELF-EFFICACY INDEX		
	Emotional **Scale Range 3-9**	**Objective** **Scale Range 4-9**	**Agency** **Scale Range 10-18**
	M ± SD	**M ± SD**	**M ± SD**
Intenders n=365	8.8 ± 0.7	8.5 ± 1.0	17.2 ± 1.3
Non-Intenders n=35	7.7 ± 1.6	7.9 ± 1.0	15.6 ± 2.1
T-statistic p-value	3.81 <0.01‡	3.46 <0.01	4.61 <0.01‡
KATIADI	**M ± SD**	**M ± SD**	**M ± SD**
Intenders n=293	8.9± 0.4	8.7 ± 0.7	17.6 ± 0.9
Non-Intenders n=107	8.6 ± 0.8	8.4 ± 1.1	16.9 ± 1.6
T-statistic p-value	3.89 <0.01‡	3.17 <0.01‡	4.17 <0.01‡

‡ satterwaite p-value

Appendix Table 6: Mean score of maternal knowledge index stratified by intention to exclusively breastfeed stratified by sub-district, Bangladesh

KARIMGANJ	MATERNAL KNOWLEDGE INDEX
	Scale range 0-14
	M ± SD
Intenders n=365	7.2 ± 2.4
Non- Intenders n=35	5.8 ± 2.5
T-statistic p-value	3.41 <0.01
KATIADI	**M ± SD**
Intenders	7.3 ± 2.5
Non- Intenders n=107	6.5 ± 2.4
T-statistic p-value	2.95 <0.01