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BREASTFEEDING SUPPORT PROGRAMS: SYSTEMATIC REVIEW OF
SOCIOECONOMIC LITERATURE

by

Chinelo Ibekwe

A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of
the requirements of the Sally McDonnell Barksdale Honors College

Oxford

May 2018

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Abstract

This thesis describes a systematic review and analysis of literature concerning breastfeeding and programs focused on improving breastfeeding participation. It examines breastfeeding programs with respect to intervention evaluation and the economic impact of breastfeeding programs, and scrutinizes social factors such as race, ethnicity, cultural identity, income, and age which potentially influence the outcomes of these breastfeeding programs. It explores how breastfeeding programs have reduced rehospitalization of low birth weight and preterm infants through the implementation of one or a combination of the following services to mothers and babies: breast pump supplies, education, and training on breastfeeding, transportation to and from the neonatal intensive care unit (NICU), and in-home visits with social workers, community health workers, and lactation specialists. A systematic literature review was conducted, and 150 articles were found, but 89 were reviewed based on their attention to one or a combination of the following: cost benefits analysis of breastfeeding programs, intervention evaluation of breastfeeding programs, economic impact of breastfeeding programs, methods implemented to reduce rehospitalization of low birth weight and preterm infants, social factors influencing the outcome of breastfeeding programs, health benefits of breastfeeding to the mother and infant, and breastfeeding trends in the United States and federal policies on breastfeeding. The findings from these articles showed that to maximize the cost savings and economic impact of breastfeeding, programs should take into account the cultural, individual, and economic background of the mother while simultaneously initiating improvement techniques such as: better training of healthcare professionals, longer durations of paid maternity and paternity leaves, and increased provision of education and support to nursing mothers.

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LIST OF ABBREVIATIONS

BDNF	Brain-derived Neurotrophic Factor
BFHI	Baby Friendly Hospital Initiative
BSSL	Bile Salt-stimulating Lipase
EBF	Exclusive Breastfeeding
EGF	Epidermal Growth Factor
GAGs	Glycosaminoglycans
GDNF	Glial cell-line Derived Neurotrophic Factor
GDP	Gross Domestic Product
HIV	Human Immunodeficiency Virus
LGBTQI	Lesbian, Gay, Bisexual, Transgender, Queer, Intersex
NHS	National Health Service
NICU	Neonatal Intensive Care Unit
RFTS	Right! from the Start
SAR	Suspected Allergic Rhinitis
SARS	Suspected Allergic Respiratory Symptoms
SIDS	Sudden Infant Death Syndrome
sIgA	Secretory Immunoglobulin A
VEGF	Vascular Endothelial Growth Factor
WHO	World Health Organization
XO	Xanthine Oxidase
UNICEF	United Nations Children's Fund

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CHAPTER ONE: INTRODUCTION

I am a chemical engineering final-year student at the University of Mississippi. My long-term goal is to become a health policy maker and eventually serve as the Minister of Health in my country, Nigeria. I am starting early to identify under-explored health problems such as poor breastfeeding outcomes, affecting Nigeria. Knowing that Nigeria's exclusive breastfeeding rate is only at 17%, I became interested in the Right! From the Start Initiative to explore the field of breastfeeding and its effect on populations and economies. During one of my winter breaks, I shadowed a neonatologist at Batson Children's Hospital in Jackson, Mississippi, and took interest in the hospital's lactation program. I observed a lactation nurse (who could not speak Spanish) struggle to teach a Hispanic mother (who could not speak English) how to use a breast pump. The nurse eventually had to set up a phone call with a Spanish interpreter to help with relaying information to the mother. I was disappointed by the ineffective communication between the healthcare provider and the patient. This personal experience made me more passionate about understanding social factors similar to language barriers, which influence breastfeeding outcomes.

Among newborns, preterm and low birth weight infants are the most susceptible to certain childhood diseases (The Urban Child Institute, 2012). Evidence from research studies suggests that breastfeeding helps to protect infants from some of these diseases (World Health Organization, n.d.b). This thesis presents a systematic literature review on the success of breastfeeding programs in increasing breastfeeding rates and decreasing rates of rehospitalization of preterm and low birth weight infants. It also introduces a breastfeeding program called Right! from the Start Initiative, designed to provide continuous quality support to nursing mothers as

they transition from the neonatal intensive care unit (NICU) to community health centers. The program will eventually be evaluated based on its cost-effectiveness in reducing rehospitalization of low birth weight infants in specific counties across the Mississippi Delta. It will also help inform the Right! From the Start Program development and future evaluation by suggesting a rate of rehospitalization reduction to target, based on the range of rates that have resulted from previous, similar, and successful breastfeeding programs. Throughout this research study, low birth weight has been defined as the birth weight of an infant of less than 2500 grams regardless of gestational age, while preterm or premature infant represents an infant born before 37 completed weeks of gestation. The term “low birth weight” and “preterm” are used interchangeably by many research studies because both categories of infants undergo similar health challenges.

CHAPTER TWO: BENEFITS OF BREASTFEEDING

Health and Developmental Benefits of Breastfeeding

This chapter introduces and summarizes the literature on the benefits of breastfeeding to help inform the later systematic review of factors influencing breastfeeding. First, it addresses why breastmilk is especially important to preterm and low birthweight infants, and then discusses how the components of human milk influence physiological and immunological processes in newborn infants. This chapter also addresses the health benefits of breastmilk to the mother.

Breastfeeding is a traditional way of providing young infants with the nutrients they need for healthy growth and development (World Health Organization, n.d.b). Major benefits of breastfeeding to the child include reduced risks of gastrointestinal disorders, obesity, respiratory infections, asthma, and other diseases highlighted in this chapter. Major benefits of breastfeeding to the mother include reduced risks of cancers, type 2 diabetes, cardiovascular diseases, arthritis and osteoporosis. The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of a child's life, with continued breastfeeding until the age of two years or more (World Health Organization, n.d.a).

Human breastmilk generally contains about 87% water, 3.8% fat, 1.0% protein, and 7% lactose. During nursing, breastmilk composition varies over time based on the changing needs of the infants. There has also been an observation that a mother's milk usually contains nutrients adequate for the baby, regardless of whether the mother's nutrition is adequate or not (Martin, Ling, & Blackburn, 2016). Among these nutrients, special attention is usually given to certain bioactive and immunomodulatory factors such as gastrointestinal hormones, immunoglobulins, lactoferrin, lysozyme, oligosaccharides, nucleotides, growth factors, enzymes, antioxidants, and

cellular components. These nutrients are important because they not only ensure defense against infections, but also actively regulate the immune response and alter the bacterial flora in the intestine (Bertino et al., 2012).

In the first 2 to 4 weeks after delivery, the mother of a preterm infant naturally produces milk which is slightly different in composition, compared to that produced by a mother of a full-term infant. The preterm milk contains more proteins and minerals, and various kinds of fatty acids. Preterm infants typically have smaller and less developed gastrointestinal tracts compared to full-term infants (healthychildren.org, n.d.). Owing to the vulnerability of preterm infants, the nutritional content of breastmilk is crucial to the gastrointestinal maturation and brain development of these infants (Nascimento & Issler, 2004). Specific components of milk including: epidermal growth factor, nerve growth factor, somatomedin-C, insulin, thyroxine, cortisol, taurine, glutamine, and amino acids may be responsible for gastrointestinal maturation (Callen & Pinelli, 2005). Bertino et al. (2012) highlight that based on a study, extremely preterm infants who were breastfed in the NICU showed higher scores for mental, motor, and behavioral ratings at ages 18 months and 30 months, compared to non-breastfed preterm infants (Bertino et al., 2012).

In preterm milk, oligosaccharides are in higher concentrations compared to term milk (Bertino et al., 2012). Ochert (2009) highlights human milk to contain 90 different oligosaccharides which form over 900 different chemical structures. Each chemical structure blocks infection by preventing specific bacteria strain from attaching to the gut wall and mucosal surfaces of an infant. Formula has not been proven to contain this specific composition of oligosaccharides and their unique chemical structures (Ochert, 2009). Oligosaccharides also enhance the growth of probiotic organisms (Ballard & Morrow, 2013), hinder bacteria from

attaching to the host mucosa, and help to prevent systemic infection and necrotizing enterocolitis in low birth weight infants (Callen & Pinelli, 2005).

The protein composition of breastmilk is necessary for low birth weight/preterm infants because it contains 30% casein and 70% whey, while formula contains 82% casein and 18% whey. Breastmilk whey contains α -lactalbumin which is more suitable for preterm infants because it is easily digested, and thus promotes faster gastric emptying. Whereas, bovine milk whey contains α -lactoglobulin, a protein which most likely causes bovine milk protein allergy and colic. Breastmilk whey proteins also contain lactoferrin, lysozyme, and secretory immunoglobulin A (sIgA) which reduce infections in preterm infants, especially those susceptible to nosocomial infections. On the other hand, these whey proteins are found in only minute quantities in bovine milk (Callen & Pinelli, 2005).

Aside lactoferrin, lysozyme, and sIgA, breastmilk also contains other proteins such as lactadherin, mucins, and κ -casein, and enzymes such as bile salt-stimulating lipase (BSSL). These components of human milk provide defense against infections (Liu & Newburg, 2013). A mother's milk contains antibodies to pathogens which she has been exposed to, and usually, her baby would also be exposed to these same pathogens. Most milk antibodies contain a protein called secretory immunoglobulin A (sIgA), which is resistant to digestion. Human milk contains greater amounts of sIgA compared to bovine milk used in formula. sIgA antibodies protect the baby by sticking to microbes and obstructing them from attaching to, and infecting gut cells. Their presence in the nose and mouth defend the baby against airborne diseases (Ochert, 2009). Lactoferrin kills bacteria, viruses, and fungi directly, and uses its anti-inflammatory influence to lessen the pain, swelling, and high temperature that come with an infection. Lactoferrin being resistant to digestion helps to prevent urinary tract infections in babies when it is passed into

their urine, and also nurtures the growth of friendly bacteria in the infants' intestine. Human lactoferrin is different from that found in the milk of other species contained in formula, and it is present in uniquely higher levels in human milk (Ochert, 2009). Lactoferrin's antimicrobial feature is based on its ability to isolate iron which is needed for bacterial growth, thus exerting a bacteriostatic effect. Utilizing its cationic feature, it merges with the lipopolysaccharide of the Gram negative bacterial surface, destroying the bacteria cell membrane (Turin & Ochoa, 2014).

Lactadherin prevents rotaviral infection which may cause gastroenteritis in infants. It also enables healing of the intestine during inflammation. BSSL protects infants from viral infections such as Norwalk and human immunodeficiency virus (HIV). BSSL merges with dendritic cells, inhibiting HIV trans-infection of CD4+ T cells. Mucins block certain infections such as HIV, rotavirus, salmonella enterica serovar typhimurium, and Norwalk virus (Ballard & Morrow, 2013). K-casein forms new molecules, para-k-casein, and caseinomacropptide, in the gut's lumen to increase microbiota growth. It also prevents pathogens from attaching to the epithelial cell surface in the gastrointestinal and respiratory tract (Turin & Ochoa, 2014).

Breastmilk also contains lipids and carbohydrates. The carbohydrates include lactose and oligosaccharides. Low birthweight infants absorb over 90% of the lactose in human milk. The trace quantities of unabsorbed lactose from breastmilk softens an infant's stool, enhances the absorption of minerals, and boosts the presence of favorable intestinal flora (Callen & Pinelli, 2005). Stooling helps to lower bilirubin levels, and lower bilirubin levels reduce the risk of jaundice developing in infants (Paediatrics & Child Health, 2007). The lipids in human milk provide 50% of the calories in the milk. The derivatives of linoleic and linoleic acids (fatty acids), arachidonic acid and docosahexanoic acid, enhance visual function/retinal development in infants (Patel & Bhatia, 2016). Also, the arrangement of fatty acids on the triglyceride molecule,

coupled with the action of BSSL, enhances greater fat absorption in low birthweight infants (Callen & Pinelli, 2005). Glycolipids in the mother's milk help to inhibit infection by obstructing microbes from being attached to the cells of the gut (Ochert, 2009). Human milk contains glycosaminoglycans (GAGs), a complex group of carbohydrate polyanions. Due to their capacity to interact with numerous macromolecules, GAGs are able to control many cellular and physiological processes such as cell-cell and cell-matrix interaction, cell growth and differentiation, anti-infective and anti-inflammatory processes, etc. The proteoglycans present in GAGs are responsible for its regulatory functions. Human milk GAGs are capable of obstructing the HIV envelop glycoprotein gp120 from binding to the cellular CD4 receptor in the infant. Breastmilk GAGS contain chondroitin sulfate, dermatan sulfate, and heparan sulfate which are in higher amounts, and show distinct compositions and structures compared to bovine milk GAGs. The composition and structural diversity of these GAGS possibly influence their different metabolic fates such that more human milk GAGs are utilized in an infant's body, compared to GAGs in formula milk (Maccari et al., 2016).

Human milk contains bioactive nutrients that are not present in formula milk. The growth factors in human milk influence the functioning of the intestinal tract, vasculature, nervous system, and endocrine system of an infant. Vascular endothelial growth factor (VEGF) regulates angiogenesis which is the development of new blood cells. There is less VEGF in preterm milk than term milk to mitigate the burden of retinopathy of prematurity (ROP), an eye disease common in preterm babies (Ballard & Morrow, 2013).

The epidermal growth factor (EGF) which is more present in preterm milk than in full term milk, enables the healing and maturation of the intestinal mucosa. Being resistant to low pH and digestive enzymes, EGF is able to navigate through the stomach to the intestine to trigger the

enterocyte to intensify DNA synthesis, cell division, water and glucose absorbance, and protein synthesis. EGF is most abundant in early breastmilk but decreases throughout lactation. (Ballard & Morrow, 2013). Brain-derived neurotrophic factor (BDNF) and glial cell-line derived neurotrophic factor (GDNF) ensure the development of the infant's central nervous system which is an extension of the newborn's immature intestine. GDNF promotes neuron survival and outgrowth, while BDNF increases peristalsis, a function which is usually disabled in the gut of a preterm infant (Ballard & Morrow, 2013).

Between four and ten months of age, the thymus, a central organ of the immune system, is usually bigger in breastfed babies than in formula-fed babies. IL-7, a cytokine, and leptin, a hormone, both found in higher quantities in human milk, influence the size difference. The thymus is vitally responsible for recognizing the body's own tissues to prevent the immune system from attacking them. Ochert (2009) concludes that children who never underwent optimal breastfeeding will have deficient immune systems for the rest of their lives.

Erythropoietin (Epo), a hormone produced by the kidney, ensures intestinal development and prevention of anemia of prematurity by increasing red blood cells. It may also help to hinder mother-to-child transmission of HIV, reduce incidences of necrotizing enterocolitis, and increase hemoglobin and hematocrit levels (Ballard & Morrow, 2013). Adiponectin controls metabolism and reduces inflammation, while leptin and ghrelin protect against obesity by controlling satiety and energy balance in infants (Savino, Liguori, Fissore, & Oggero, 2009).

In addition to breastmilk containing protective enzymes, hormones, and other macromolecules, Al-Shehri et al. (2015) explain that during breastfeeding, the infant's saliva reacts with the xanthine oxidase (XO) in breastmilk to regulate neonatal oral microbiome. The

reaction forms hydrogen peroxide which obstructs the growth of certain bacteria such as oral streptococcus, *S. aureus*, *Salmonella* spp., and *Lactobacillus* spp. (Al-Shehri et al., 2015).

The immunological functions of breastmilk enhance its protective effects against specific health problems such as infant cancer in the form of leukemia (Amitay & Keinan-Boker, 2015; Kwan, Buffler, Abrams, & Kiley, 2004), neuroblastoma (Daniels, Olshan, Pollock, Shah, & Stram, 2002), and testicular cancer (Coupland, Forman, Davey, Pike, & Oliver, 2004). It also protects against enteroviruses (Wall, n.d.), Crohn's disease (Jantchou, Turck, Balde, & Gower-Rousseau, 2005), *Helicobacter Pylori* (Monajemzadeh et al., 2010), respiratory tract infections (Tromp et al., 2017), and otitis media (Wall, n.d.).

Cryptorchidism is a disease common in neonatal males, causing the lack of one or both testes from the scrotum. The predominance of cryptorchidism ranges between 1% and 3% in full-term infants but has a 30% prevalence in premature infants (Chung & Brock, 2011). Barthold, Hossain, Oliver-Fisher, Reilly, Figueroa, BaniHani, and Manson (2013) highlight that a decrease in breastfeeding and an increase in soy milk feeding increase susceptibility to cryptorchidism (Barthold et al., 2013). Regarding breastmilk's effect on dental health, the American Dental Association emphasizes that breastfed infants are less likely to develop teeth alignment issues such as open bites, crossbites, and overbites, compared to artificially fed infants (American Dental Association, n.d.). Yildirim, Shea, and Pelton (2015) highlight that lack of breastfeeding increases an infant's susceptibility to pneumococcal disease which is an infection caused by *S. pneumoniae* bacterium. This disease potentially leads to sepsis, otitis media, or bacterial meningitis (Yildirim et al., 2015). Newborn infants are also prone to developing type 2 diabetes mellitus, however, Das (2007) proposes that compared to non-breastfed infants, breastfed infants are less prone to this condition because of the presence of higher

docosahexaenoic acid and polyunsaturated fatty acids in muscle phospholipids. Higher concentrations of polyunsaturated fatty acids in the skeletal muscle membrane lead to lower concentrations of plasma glucose, while lower concentrations of docosahexaenoic acid and polyunsaturated fatty acids enhance insulin resistance (Das, 2007).

Pisacane, De Luca, Impagliazzo, Russo, De Caprio, and Caracciolo (1995) address acute appendicitis as a health problem less common in children who have been breastfed for a prolonged period of time. The study suggests that extended breastfeeding reduces the risk of developing acute appendicitis because the immune elements of breastmilk release an antigen avoidance system which reduces the intensity of the infection and its inflammations. These reduced inflammations could influence the immune system of the infant to develop a more tolerant lymphoid tissue at the base of the appendix (Pisacane et al., 1995).

Gastroesophageal reflux is a disease common in newborn infants which causes stomach contents to flow backwards into the esophagus because of a faulty sphincter at the base of the esophagus, resulting in heartburn. Lightdale and Gremse (2013) point out that gastroesophageal reflux is less predominant in breastfed infants than in formula-fed infants. Salmonellosis is another disease common in formula-fed infants. Formula, during the course of preparation, is likely to be contaminated with salmonella, thus increasing the likelihood of infants developing salmonellosis. On the other hand, breastfed infants have lower chances of developing salmonellosis because of less exposure to the bacteria present through artificial feeding. These infants are also protected against infections through the antibodies present in breastmilk (Rowe et al., 2004). Breastfeeding also protects infants from some allergic diseases such as atopic dermatitis, suspected allergic rhinitis (SAR), and suspected allergic respiratory symptoms (SARS) (Kull, Wickman, Lilja, Nordvall, & Pershagen, 2002). *Giardia lamblia*, a parasitic

infection in infants, is also reduced through breastfeeding (Kutty, 2014). Sudden Infant Death Syndrome (SIDS), common among low birth weight and premature infants, is an unexplained death of an infant usually during sleep. It may be caused by a variety of factors such as metabolic disorders including hypothermia and hyperthermia. SIDS has been proven to be more prominent in formula-fed infants than in breastfed infants (Shamberger, 2014). Also, among very low birth-weight infants, meningitis is less common among the human milk-fed infants compared to the exclusively formula-fed infants (Wall, n.d.).

Studies have shown that breastfeeding provides potential benefits for an autistic child. Most autistic children have acute health problems such as allergies, digestive problems, and respiratory problems. They also struggle with neurological, cognitive, and developmental inhibitions. Human milk contains amino acid taurine, docosahexaenoic acid, and arachidonic acid needed for brain development. In infants, breastmilk strengthens the immune system, and secures the gastrointestinal system. Hence, breastfeeding has been proven to promote cognitive, visual, and sensory development in autistic children. It is also likely to provide emotional development to these infants because of the chance to bond through breastfeeding. Based on reports from some mothers, breastfed autistic infants become more responsive, affectionate, and social, compared to formula-fed autistic infants (Land, 2001).

Breastfeeding not only has its effects on the infant, but also on the mother. It reduces her likelihood of developing illnesses such as cancer, diabetic and metabolic diseases, rheumatoid arthritis, osteoporosis, and osteoarthritis. It also influences her cardiovascular health.

Breastfeeding, which reduces a mother's life span number of menstrual cycles, also reduces her vulnerability to endogenous hormones, thus decreasing her likelihood of developing breast cancer. Breastfeeding causes breast cells to differentiate to produce more milk, and thus,

these differentiated cells are more resistant to developing into cancer cells, compared to cells which have not undergone differentiation (National Cancer Institute., n.d.). Wang, Li, and Shi (2015) suggest that breastfeeding also reduces a mother's susceptibility to endometrial cancer which is caused by the excessive thickening of the uterus lining leading to the growth of cancer cells. The excessive thickening of the uterus lining is caused by a hormone imbalance during which estrogen is overproduced compared to progesterone (Wang et al., 2015). Also, according to Lagergren and Jansson (2005), breastfeeding reduces a mother's risk of developing esophageal cancer, while Su, Pasalich, Lee, and Binns (2013), based on a case-control study in southern China, highlight the protective effect of breastfeeding on the risk of ovarian cancer in nursing mothers. Yi, Zhu, Zhu, Liu, and Wu (2015) also highlight that the prevalence of breastfeeding in women reduces their risks of developing thyroid cancer (Yi et al., 2015).

Regarding diabetes in nursing mothers, Liu, Jorm, and Banks (2010) emphasize that mothers who do not breastfeed have a 50% increased risk of developing type 2 diabetes later in life. Breastfeeding essentially helps to reduce this risk. The mechanism behind this preventive role of breastfeeding for diabetes is still unclear, however, there is a possibility that breastfeeding provides nursing mothers with better insulin sensitivity which is retained after childbirth. (Liu et al., 2010). Concerning the risk of cardiovascular diseases in nursing mothers, Schwarz (2015) measured cardiometabolic risk with respect to visceral adiposity, based on the fact that an increase in visceral adiposity promotes the risk of cardiovascular disorders. The study shows that mothers who breastfed for 7-12 months following their first birth had a 28% lower chance of developing cardiovascular disease compared to mothers who never breastfed. Also, there was a 23% lower risk of developing coronary heart disease in mothers who lactated for two or more years. With respect to hypertension, lactation hormones (i.e., oxytocin, prolactin, and cortisol)

influence blood pressure. Schwarz (2015) shows that mothers who did not breastfeed had over 20% likelihood of developing hypertension (Schwarz, 2015).

The Surgeon General’s Call to Action to Support Breastfeeding highlights the excess infantile and maternal health risks associated with not breastfeeding as shown in Table 1.

Table 1. Excess Health Risks Associated with Not Breastfeeding

Source: U.S. Department of Health and Human Services (2011)

Outcome	Excess Risk (%)
<i>Among full-term infants</i>	
Acute ear infection (otitis media)	100
Eczema (atopic dermatitis)	47
Diarrhea and vomiting (gastrointestinal infection)	178
Hospitalization for lower respiratory tract diseases in the first year	257
Asthma, with family history	67
Asthma, no family history	35
Childhood obesity	32
Type 2 diabetes mellitus	64
Acute lymphocytic leukemia	23
Acute myelogenous leukemia	18
Sudden infant death syndrome	56
<i>Among preterm infants</i>	
Necrotizing enterocolitis	138
<i>Among mothers</i>	
Breast cancer	4
Ovarian cancer	27

The Surgeon General’s Call to Action to Support Breastfeeding not only highlights the health benefits of breastfeeding, but also introduces the environmental and psychosocial benefits.

However, this thesis will focus primarily on the health benefits.

CHAPTER THREE: BREASTFEEDING TRENDS IN THE U.S. AND FEDERAL POLICIES ON BREASTFEEDING

Federal Policies on Breastfeeding and the Development of Baby Friendly Hospitals

Within the last 25 years, the Surgeons General of the United States have redesigned breastfeeding policies to foster better breastfeeding outcomes. In 1990, the United States signed onto the *Innocenti Declaration on the Protection, Promotion, and Support of Breastfeeding*, a declaration which implored all governments to nationally conduct breastfeeding engagements, provide optimal breastfeeding support through maternal health services, implement the *International Code of Marketing of Breast-milk Substitutes*, and enact laws to secure breastfeeding among working mothers. This declaration was adopted by the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF). In 2000, the *HHS Blueprint for Action on Breastfeeding* was released to declare breastfeeding as an important public health issue in the United States (U.S. Department of Health and Human Services, 2011).

The U.S. national objectives for the Healthy People 2010 called for 75% of mothers to initiate breastfeeding, 50% to continue breastfeeding for six months, 25% to continue breastfeeding for one year, 40% to breastfeed exclusively for three months, and 17% to breastfeed exclusively for six months (U.S. Department of Health and Human Services, 2011). Table 2 shows the breastfeeding objectives for the *Healthy People 2010*, while Table 3 shows the breastfeeding objectives for the *Healthy People 2020*.

Table 2. Healthy People 2010 Targets

Source: United States Breastfeeding Committee (n.d.). Adapted by author.

Increase in proportion of mothers who breastfeed	1998 Baseline (unless noted) % of Mothers	2010 Target % of Mothers
In early postpartum period	64	75
At 6 months	29	50
At 1 year	16	25
Exclusively through 3 months	43 (2002)	40
Exclusively through 6 months	13 (2002)	17

Table 3. Healthy People 2020 Targets

Source: United States Breastfeeding Committee (n.d.). Adapted by author.

Objective	Baseline (year measured) %	2020 Target %
Infants who are breastfed ever	74.0 (2006 births)	81.9
Infants who are breastfed at 6 months	43.5 (2006 births)	60.6
Infants who are breastfed at 1 year	22.7 (2006 births)	34.1
Infants who are breastfed exclusively through 3 months	33.6 (2006 births)	46.2
Infants who are breastfed exclusively through 6 months	14.1 (2006 births)	25.5
Proportion of employers that have worksite lactation support programs	25.0 (2009)	38.0
Proportion of breastfed newborns who receive formula supplementation within the first 2 days of life	24.2 (2006 births)	14.2
Proportion of live births that occur in facilities that provide recommended care for lactating mothers and their babies	2.9 (2009)	8.1

To foster better breastfeeding outcomes, WHO and UNICEF, in 1991, established the Baby-Friendly Hospital Initiative which enumerates maternity practices known as the Ten Steps to Successful Breastfeeding. The Ten Steps to Successful Breastfeeding are highlighted below:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.

2. Train all health care staff in skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding
4. Help mother initiate breastfeeding within one hour of birth.
5. Show mothers how to breastfeed and how to maintain lactation, even if they are separated from their infants.
6. Give newborn infants no food or drink other than breastmilk, unless *medically* indicated.
7. Practice “rooming in”—allow mothers and infants to remain together 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no pacifiers or artificial nipples to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic (U.S. Department of Health and Human Services, 2011).

In California, researchers insisted that disparities in in-hospital rates of exclusive breastfeeding were less common in baby-friendly hospitals compared to non-baby friendly hospitals within the same geographic region (U.S. Department of Health and Human Services, 2011). According to Philipp, Malone, Cimo, and Merewood (2003), in 1999, Boston Medical Center (BMC) became the 22nd U.S. baby-friendly hospital. Within this hospital, breastfeeding initiation rates increased from 58% in 1995 to 86.5% in 1999, and constantly remained at high levels in the later years (Philipp et al., 2003). There are currently 512 U.S. baby-friendly hospitals and birthing centers across all 50 states, the District of Columbia, and the Commonwealth of Puerto Rico. Each baby-friendly hospital aims to increase the proportion of live births that occur in health facilities which provide recommended lactation care to nursing

mothers and their babies. Presently, 24.64% of yearly births take place at the baby-friendly birthing centers (Baby-Friendly USA, n.d.).

Disparities in Breastfeeding Rates and the Need for More Effective Breastfeeding Programs

Despite the numerous benefits of breastfeeding to mothers and infants, breastfeeding rates remain low within some countries, and particular regions within countries, and fall short of WHO recommendations. The U.S. 2014 breastfeeding report card showed that in Mississippi, 61.5% infants were ever breastfed, 28.9% were breastfed at six months, 10.0% were breastfed at 12 months, 28.8% were exclusively breastfed at three months, and 10.1% were exclusively breastfed at six months (Centers for Disease Control and Prevention, 2014).

According to the 2014 National Nutrition and Health Survey, approximately 7 million children are born in Nigeria every year, but only 25% are exclusively breastfed within 0 to 6 months of age (UNICEF Nigeria (n.d.)). In some western countries, breastfeeding rates also remain below 80% (Bernard, Cohen, & Kramer, 2016). Across many countries, various factors cause a decline in breastfeeding rates. Some common factors are religion, race, and culture. Table 4 shows the disparities in breastfeeding rates with respect to race/ethnicity and maternal education.

Thus, the next questions are: How do social, economic, and political factors inhibit breastfeeding rates (for the remainder of this thesis, I will use the term “social” or “socioeconomic” to refer to social, economic, and political factors)? What is being done to improve breastfeeding rates, and what can we learn from these efforts?

Table 4. Breastfeeding Rates with Respect to Race/ethnicity and Maternal Education

Source: U.S. Department of Health and Human Services (2011). Adapted by author.

Sociodemographic factor	Ever breastfed (%)	Breastfeeding at 6 months (%)	Breastfeeding at 12 months (%)
Race/ethnicity			
American Indian or Alaska Native	73.8	42.4	20.7
Asian or Pacific Islander	83.0	56.4	32.8
Hispanic or Latino	80.6	46.0	24.7
Non-Hispanic Black or African American	58.1	27.5	12.5
Non-Hispanic White	76.2	44.7	23.3
Maternal education			
Not a high school graduate	67.0	37.0	21.9
High school graduate	66.1	31.4	15.1
Some college	76.5	41.0	20.5
College graduate	88.3	59.9	31.1

The effectiveness analyses of breastfeeding programs have begun to focus on diverse factors influencing these rates such as race, ethnicity, income, age, and degree of awareness. Breastfeeding rates vary with different regions because of differences across cultural factors (Bonet, Blondel & Khoshnood, 2010). To address breastfeeding rates, research studies have assessed intervention evaluation and economic impact in relation to the effectiveness and usefulness of breastfeeding programs. Some of these programs have been hospital-based, community-based, and/or may have involved home visits or peer-group support. The development of breastfeeding programs has been an important on-going research especially as more policies are being developed with regards to gender inequality and women's performance and success in the workplace.

Intervention evaluation involves a well-rounded examination of the implementation of a change to a breastfeeding program. It accounts for external factors such as income, ethnicity,

culture, and religion, to promote breastfeeding rates. Policy makers require a thorough examination of these areas because they largely determine the feasibility of a breastfeeding program. Economic impact focuses on how breastfeeding programs affect the individual (nursing mother), family, broader society, government, and businesses. A major aspect of economic impact is cost benefit analysis which is a method used to compare the gains and costs of breastfeeding programs. These costs vary between time costs, monetary costs, and many others. Economic impact analysis is a prerequisite for potential investments. A program with a higher return-on-investment may receive greater attention.

The following systematic review provides an analysis of breastfeeding programs with respect to intervention evaluation and economic impact of breastfeeding programs, and scrutinizes social factors such as ethnicity, cultural identity, income, age etc. which potentially influence the outcomes of these breastfeeding programs. It also explores how breastfeeding programs have reduced rehospitalization of low birth weight and preterm infants through the implementation of one or a combination of the following services to mothers of low birth weight or preterm babies: breast pump supplies, education and training on breastfeeding, transportation to and from the NICU, and in-home visits with social workers, community health workers, and lactation specialists. By referencing other research studies, it provides recommendations to enhance the impact of breastfeeding programs.

CHAPTER FOUR: METHODS

Systematic Review of Literature

A systematic review of literature is a methodical collection, reading, and analysis of research studies that answer a specific research question. This literature review addresses the major research question: Based on the outcomes of previous breastfeeding research projects that provide services similar to those of Right! From the Start, what is a reasonable percentage of reduced rehospitalization of low birth weight and preterm infants that Right! From the Start should aim for? It also examines social factors influencing disparities in breastfeeding rates, and analyzes breastfeeding programs with respect to intervention evaluation and economic impact.

The articles used for this systematic review were selected and organized sequentially such that each selection stage raises questions that will be answered in the subsequent section. The first set of articles selected addresses why breastfeeding rates vary, by reviewing social factors influencing breastfeeding rates across different social groups. The second set of articles explain how breastfeeding intervention programs are taking social factors into account to foster better breastfeeding outcomes. The third set of articles address why there is a need for better intervention programs by highlighting the cost efficiency and economic impact of breastfeeding. The fourth set of articles focus on the rates of rehospitalization of low birthweight and preterm babies in the U.S., how breastfeeding programs have helped to reduce these rehospitalization rates, and the cost savings associated with the reduction.

Some of the references cited are from the following sources: University of Mississippi Library database, JSTOR, EBSCOhost, and MEDLINE. Others are from free online journals and organization websites. They are peer reviewed, and were published between 1995 and 2017. One

hundred and fifty articles were found, but 89 were reviewed based on whether they effectively analyzed one or a combination of the following: health benefits of breastfeeding to mother and infant, breastfeeding trends and federal policies on breastfeeding, intervention evaluation of breastfeeding programs, economic impact of breastfeeding programs, methods implemented to reduce rehospitalization of low birth weight and preterm infants, and social factors influencing the outcome of breastfeeding programs. To be included in this analysis, their methods of research were described adequately to enable the reader to link the results from these studies with a systematic procedure, thus creating more understandable and useful data. Both simple and advanced search methods were used to retrieve the articles. The articles' research methods were also scrutinized to ensure that the final pool of articles had a mix of both quantitative and qualitative research methods to ensure a well-rounded approach to examining breastfeeding programs. A quantitative method uses demographic, vital records, and sample surveys for statistical analyses, while a qualitative approach relies on interviews, observation, focus groups, and review of literature to understand social phenomena.

The search terms used in chapter four include:

- Low-income mothers and breastfeeding programs
- Intervention evaluation for breastfeeding program
- Return-on-investment for breastfeeding programs
- Economic impact for breastfeeding programs
- Cost effectiveness of breastfeeding programs
- Cost benefit analysis for breastfeeding programs
- Ethnicity and breastfeeding
- Transition of infants from hospital to home life

- Visitation program to reduce rehospitalization of low birth weight and preterm infants
- Providing pumps to nursing mothers to reduce rehospitalization of low birth weight and preterm infants
- Education and training for nursing mothers to reduce rehospitalization of low birth weight and preterm infants
- Transportation to NICU for nursing mothers to reduce rehospitalization of low birth weight and preterm infants
- Social workers, community health assistants, and lactation specialists to assist nursing mothers; reduced rehospitalization of low birth weight and preterm infants
- How does formula advertisement reduce breastfeeding rates?
- Why do breastfeeding rates decrease after cesarean operations?

From the 89 articles, 9 (10%) articles addressed breastfeeding trends and federal policies on breastfeeding, 37 (42%) addressed the health and development benefits of breastfeeding; 15 (17%) addressed social factors influencing breastfeeding rates; 9 (10%) addressed intervention evaluation; 12 (13%) addressed economic impact; and 7 (8%) addressed reduced rehospitalization and its cost savings.

CHAPTER FIVE: FINDINGS FROM SYSTEMATIC REVIEW

This chapter examines: the most significant social factors that influence breastfeeding rates; efforts of breastfeeding intervention programs in improving breastfeeding practices; economic impact of breastfeeding on nursing mothers, businesses and governments; and the cost savings associated with reduced rehospitalization as a result of breastfeeding.

Social Factors and Identity: Factors that Inhibit and Promote Breastfeeding Rates

From the 89 articles reviewed, 15 (17%) addressed social factors influencing breastfeeding rates. These factors include culture, religion, ethnicity, race, age, language barriers, family dynamics, and degree of awareness.

Degree of awareness is a prime factor influencing breastfeeding rates. The U.S. Department of Health and Human Services (2011) indicates that although most women are aware that breastfeeding provides the best nutrition to their infants, these mothers are often unaware about the specific benefits of breastmilk, and the risks associated with not breastfeeding. Through qualitative research, studies have shown that obstetricians, during prenatal visits, sometimes educate mothers on breastfeeding and the use of infant formula, thus creating uncertainty in mothers. Thus, these mothers often resort to ineffective sources such as books, leaflets, and other written materials, to gain information on breastfeeding. In addition to poor education of mothers on breastfeeding during prenatal visits, other inadequate maternal services provided by hospitals also hinder breastfeeding. For example, separating mothers from their babies during hospital admission negatively affects the initiation and duration of breastfeeding. Also, poor training of clinicians on evidence-based knowledge of breastfeeding may result in the transfer of false information to nursing mothers. A healthcare provider who is ambivalent about

breastfeeding may educate the mother based on personal experiences instead of peer-reviewed breastfeeding facts (U.S. Department of Health and Human Services, 2011).

Cultural identity also influences the effectiveness of breastfeeding programs. A study was conducted in The Netherlands to compare breastfeeding patterns of ethnic minority groups with those of native mothers. The study focused on two major natural ethnic groups: Mediterranean and Caribbean. These groups were compared to the native Dutch population. The higher percentage of people from ethnic minorities who started breastfeeding seemed to have a cultural basis: the *Koran* recommends 2 years of breastfeeding. This cultural basis most likely influenced the high starting rates of Mediterranean women. However, these women experienced barriers to continuing breastfeeding. A major barrier was inadequate breastfeeding counselling caused by factors such as language difficulties (Rossem, Vogel, Steegers, Moll, Jaddoe, Hofman, & Raat, 2010). Another study was conducted to observe the predominance of exclusive breastfeeding among Chinese, Malay, and Indian mothers. The results showed that Chinese mothers had higher breastfeeding rates at 6 months. There is a possibility that these high rates of breastfeeding may be linked with higher maternal age common to Chinese mothers (Pang et al., 2015).

Another study among low-income women in the United States showed that Hispanic mothers recorded longer breastfeeding duration compared to African American or White mothers. In a separate study, there were no significant differences in the duration and exclusivity of breastfeeding between Whites and Mexican-Americans; however, the proportions of Black children who were fed breast milk exclusively at 4 months were consistently lower than those of White children across sociodemographic and health-related data (Pang et al., 2015). To reinforce the link between ethnicity and breastfeeding, Chapman and Perez-Escamilla (2012) point out that

based on the U.S. 2007 National Immunization Survey data by racial/ethnic group, breastfeeding rates were lower among Black women (60%) when compared with other ethnic groups. Hispanic and Asian women were meeting the Health People 2020 goal of 81.9% breastfeeding initiation, while Native American and White women were close to attaining the goal. However, after 6 months post-partum, no groups were meeting the Healthy People 2020 goals. To understand why breastfeeding initiation rates are low among Black women, Anstey, Chen, Elam-Evans, and Perrine (2017) explain that African American women experience barriers such as inadequate receipt of breastfeeding information from providers, and lack of access to professional breastfeeding support. These barriers may be present because facilities located in zip codes with a high concentration of African American residents are less inclined to exercise supportive breastfeeding practices: early initiation of breastfeeding, limited use of breastfeeding supplements, rooming-in, limited use of pacifiers, and post-discharge support, compared to areas with lower percentages of African Americans (Anstey et al., 2017).

Inadequate lactation support at the workplace also hinders breastfeeding. Small businesses with less than 100 employees are the least likely to provide lactation support. Also, regardless of firm size, most businesses discourage bringing infants to the workplace (U.S. Department of Health and Human Services, 2011). In 2009, the Society for Human Resource Management showed that only 25% of companies surveyed provided lactation assistance to employees. Nursing mothers often struggle with inflexibility of their work hours, inaccessibility to childcare facilities near the workplace, and lack of privacy to breastfeed or express milk. They may also have inadequate facilities to store milk at an optimum temperature. When mothers lack access to privacy at work, they may use the restroom to breastfeed or express milk. This approach is unhygienic and often results in early weaning. Lack of maternity leave also hinders

breastfeeding. The longer the maternity leave, the higher the likelihood of a woman combining employment and breastfeeding. In a survey of 712 mothers, the duration of breastfeeding increased by one-half week with each week of maternity leave. Unfortunately, mothers who earn hourly wages are still less likely to breastfeed compared to those who earn salaries because the former possess less control over their schedules, and may lose a portion of their pay if they take multiple breaks to express milk (U.S. Department of Health and Human Services, 2011).

The U.S. Department of Health and Human Services (2011) insist that as of 2001, only 43% of U.S. adults believed that women should have the right to breastfeed in public. The stigma and embarrassment associated with breastfeeding in public is a significant barrier to breastfeeding in the United States. Some women shy away from breastfeeding in public because of the notion that female breasts are sexual objects. Women are also less likely to breastfeed because of lactation problems such as swollen breasts, sore nipples, mastitis, pain, leaking milk, and failure to latch on by infant. Until they get professional assistance, they may discontinue breastfeeding. A mother's lack of confidence in breastfeeding may also hinder her from breastfeeding because of factors such as the perception that milk supply is insufficient (U.S. Department of Health and Human Services, 2011).

Based on family dynamics, Anderson, Damio, Chapman, and Perez-Escamilla (2007) indicated that non-Puerto Ricans were typically found to respond better than their Puerto Rican counterparts to the exclusive breastfeeding peer counselling intervention. The study found a negative correlation between exclusive breastfeeding and U.S. residence of the infant's Puerto Rican maternal grandmother. The authors argued that Puerto Rican grandmothers generally are not supportive of breastfeeding. Thus, family dynamics may have influenced why non-Puerto Ricans in the intervention group were six times more likely to breastfeed exclusively at two

months post-partum compared to their Puerto Rican counterparts who also received peer counseling support (Anderson et al., 2007). Family dynamics could also influence breastfeeding rates with respect to paternal influence. A father may become a negative influence when he is concerned about how a mother would perform household responsibilities if she breastfeeds. However, studies have shown a 20% increase in breastfeeding rates among African American families in which breastfeeding education was directed at the father. In a trial, 25% women whose partners engaged in training on how to address frequent lactation-related problems such as pain or fear of insufficient milk, were still breastfeeding at six months, compared with 15% of women whose partners were only educated on the benefits of breastfeeding. A mother's social network (e.g. friends) also influences her breastfeeding practices. If she is surrounded by female friends who breastfeed, then she will be more likely to breastfeed (U.S. Department of Health and Human Services, 2011).

According to Wanjohi et al. (2016), research was conducted to understand the cultural beliefs that hindered breastfeeding in low-income communities in Kenya. Results showed that some nursing mothers regarded feeding colostrum (the most nutritious part of breastmilk) to a baby as a cultural taboo. These mothers described colostrum as a dirty portion of milk, and would often throw it away. Their reluctance to breastfeed in the first few days would often result in prelacteal feeding, a practice which is discouraged by the World Health Organization (WHO). Some mothers also believed that breastmilk alone was insufficient for either too small or too big babies, and would result in feeding these infants inappropriate foods such as porridge, which are not easily digested by newborns. Other mothers believed that breastfeeding in public exposed them to malicious neighbors who could “cast evil spells” on them or their children. Some of these women also had

ideas that women became unattractive after breastfeeding because constant breastfeeding caused saggy breasts. They also believed that boys needed a shorter duration of breastfeeding compared to girls because boys required excessive quantities of milk, and would thus weaken the mother. On the other hand, in some communities such as Muslim communities, exclusive breastfeeding was prevalent because the women regarded it as a religious recommendation (the *Koran* recommends two years of breastfeeding) (Wanjohi et al., 2016). Through this study, the different traditional views on breastfeeding were shown to vary with different communities. To improve breastfeeding practices, there is a need to tailor specific interventions to specific communities and groups. A possible intervention could be to promote initiatives that educate nursing mothers on modern and beneficial views of breastfeeding, through partnering with community and religious leaders, and the husbands of nursing mothers.

Some analysts have argued that the benefits of breastfeeding are being oversold, and women are harmed when they are being pressured to breastfeed especially when they are unable to or are uninterested. Rippeyoung and Noonan (2012) explore how to reconcile potential conflicts between women's biological and socioeconomic realities. The results from this research appeal to policymakers aimed at gender equity in the workplace and those interested in increasing overall rates of breastfeeding. To better understand the obstacles to breastfeeding, a large body of research has shown that poor, less educated, and non-professional working women are less likely to breastfeed compared to non-poor, more educated, professional women. Rippeyoung and Noonan (2012) focused on changes in earnings after child-birth as a function of infant feeding type. The nursing mothers were divided into three categories: i) exclusive formula-feeders, ii) short-duration breastfeeders, and iii) long-duration breastfeeders. Women who breastfed for long periods recorded greater decrease in income within the first five years of

their infants' lives. There is a possibility that breastfeeding makes a woman more attracted to family than work. To address the economic and social consequences of breastfeeding on nursing mothers, alternative solutions have been highlighted, such as a federal law protecting women's right to breastfeed at work, increase in paid parental leave, and presence of onsite day-cares (Rippeyoung & Noonan, 2012).

In Western countries, breastfeeding initiation and duration differs between native and non-native mothers. However, results are controversial as some studies find that more non-native mothers start breastfeeding and continue it, as others find that less non-native mothers start breastfeeding and continue it. To explain the inconsistencies in research studies, there is a need to understand that results may be confounded by socio-demographic factors (Rossem et al., 2010).

In addition to cultural identity, some specific biomedical complications are starting to have major impacts on breastfeeding inequities. These include increasing rates of cesarean section, and high prevalence of preterm delivery and low birth weight births. In Latin America and the Caribbean, there are very high rates of cesarean section deliveries, thus increasing the risk of introducing milk-based prelacteal feeds among low-income women (Perez-Escamilla & Sellen, 2015). Hobbs, Mannion, McDonald, Brockway, and Tough (2016) hypothesize that the early termination of breastfeeding after cesarean section may be caused by maternal and stress response. The damage of abdominal surgery in both planned and emergency cesarean sections may affect lactogenesis. To reduce the incidence of breastfeeding cessation after cesarean sections, healthcare providers are encouraged to provide breastfeeding counselling to pregnant mothers considering cesarean section. In the case of emergency cesarean sections, additional

support should be provided to lactating women during the immediate to early postpartum period (Hobbs et al., 2016).

Another pressing issue regarding breastfeeding programs is the ineffectiveness of these programs in developing countries. Exclusive breastfeeding (EBF) for six months might be difficult, particularly where maternal malnutrition is common. Breastfeeding rates decrease with inadequate assistance to nursing mothers. Hence, education and support remain the foundation for lactation and breastfeeding. Culturally appropriate and exhaustive breastfeeding education is necessary to encourage breastfeeding among low-income mothers. This stage of education is crucial during the prenatal period, in the hospital during first week postpartum, and repeated, continual support in the mother's home (Imdad, Yakood, & Bhutta, 2011).

Access to breastfeeding protection and support has been framed as a human right with issues of social injustice and equity becoming paramount (Perez-Escamilla & Sellen, 2015). Unfortunately, there are still inequities that restrict access to breastfeeding support. Breastfeeding equity requires addressing the needs of underrepresented communities through an in-depth understanding of power structures. There is now extensive knowledge on key obstacles preventing low-income women from practicing optimal breastfeeding behaviors. This knowledge extends to breastfeeding challenges faced by indigenous communities in diverse geographical locations, for example, African-American communities, women in military, HIV positive women, primiparous women, and the LGBTQI community. Regarding the LGBTQI community, there is little awareness about the process of induced lactation among lesbian mothers feeding adopted children. Induced lactation needs to be understood not only from the milk volume perspective but also through a better characterization of the composition of milk produced (Perez-Escamilla & Sellen, 2015).

Although support for breastfeeding is widely recognized as one of the most cost-effective interventions, it still remains one of the most underfunded. In Australia, infant milk formula is exempt from the national goods and services tax, yet lactation aids such as breast pumps are taxed at 10% (Smith, 2015). About 60% of maternity services globally are not Baby Friendly Hospital Initiative (BFHI) designated. Hospitals provide mothers with free formula for their infants but then require the mothers to purchase their own breast pump to provide milk for their hospitalized infants (Smith, 2015). Breast-milk substitute companies usually distribute the free formula to these hospitals as incentives, and directly market the product to consumers via mass media and print advertisements. Marketing of formula to nursing mothers is significant in hindering the initiation and continuation of exclusive breastfeeding post-partum (Piwoz & Huffman, 2015). Hence, government policies should be implemented to limit the sales of breast-milk substitutes, and health professionals should be well-trained on the adverse effects of formula before they are certified to provide health advice to nursing mothers.

These articles have highlighted breastfeeding rates to be influenced by language barriers, religion, culture, family dynamics, cesarean deliveries, and varying levels of support and education for nursing mothers. Given how much knowledge is available about breastfeeding inequities, the next questions to ask are: Why is this knowledge that can effectively address breastfeeding inequities in vulnerable subgroups not being put into widespread practice? Is there further work being implemented to understand the cultural differences in mode of feeding and its implications on maternal and infant health? How are intervention programs working with nursing mothers in indigenous communities to increase exclusive breastfeeding? If language is a barrier to providing better health support, are health programs willing to invest in training local healthcare workers how to speak languages of targeted local groups?

Intervention Evaluation: Practices that Increase the Effectiveness of Breastfeeding Support Programs

From the 89 articles reviewed, 9 (10%) addressed intervention evaluation. Intervention evaluation summarizes a case of increasing breastfeeding rates through combined individual and group counselling, facility and community-based counselling, peer support, improved breastfeeding self-efficacy, and improved training of healthcare professionals.

Nursing mothers, because of limited knowledge and confidence, and perception of insufficient milk, may often fail to breastfeed exclusively. Pediatricians, nurses, midwives, and lay counselors are therefore encouraged to provide education to these mothers through interventions such as mother-to-mother support, telephone-based support, peer counselling, or trained personnel via home visits (Haroon, Das, Salam, Imdad, & Bhutta, 2013). In the research study by Haroon et al. (2013), the following interventions were employed: individual counseling, group counseling, community-based interventions, and facility-based interventions. Analyzing their influence on exclusive breastfeeding rates, combined individual and group counseling turned out to be more effective than individual or group counseling alone. Facility and combined facility-and-community-based interventions also increased breastfeeding rates (Haroon et al., 2013).

Community-based intervention was also reinforced through the research study by Shakya et al. (2017), which introduced one-on-one and group peer support for mothers, peer nutrition counseling, shared decision making, and grandmothers/elders-to-mother nutrition counseling. Community-based peer support significantly increased exclusive breastfeeding rates among mothers in low and middle-income countries, and high-income countries. In low and middle-income countries, mothers who received peer support usually exclusively breastfed their babies

for longer periods compared to mothers in high-income countries. The reason may be because in high-income countries, there are higher social preferences for instant formula feeding, whereas in low and middle-income countries, negative social attitudes to formula develop as a result of high cost and low commercial marketing. Hence, peer support could be effective in increasing exclusive breastfeeding in low and middle-income countries, however, in high-income countries, peer support should be accompanied with more support from professional health workers (Shakya et al., 2017). Also, in low and middle-income countries, mothers who received peer support were more likely to initiate breastfeeding compared to those without support. This idea could be applied to low-income mothers in high-income countries such that providing peer support to these mothers would help to increase breastfeeding initiation. The conclusion is that optimal breastfeeding support is defined differently in low and middle-income countries versus high-income countries (Shakya et al., 2017).

Maternal breastfeeding self-efficacy represents an important psychometric factor for improving breastfeeding outcomes. It is defined as a mother's confidence in her ability to breastfeed her new infant (Otsuka et al., 2013). Otsuka et al. (2013) analyze the effectiveness of a breastfeeding self-efficacy intervention in baby friendly and non-baby friendly hospitals. In the study, a breastfeeding self-efficacy workbook was provided to women in their third trimester, requiring them to complete the workbook before delivery. The intervention improved breastfeeding self-efficacy, and increased the exclusive breastfeeding rates at 4 weeks after childbirth in baby friendly hospitals. There were no significant improvements seen in non-baby friendly hospitals at any point post-partum. This outcome in non-baby friendly hospitals demonstrates how a hospital's institutional routine could hinder the enhancement of

breastfeeding self-efficacy because of factors such as: separation of mother and infant, no lodging for the day and night, and the use of artificial teats to breastfeed infants. The study shows that through impacting maternal psychometric factors, interventions promote exclusive breastfeeding. It also highlights the need to reform hospital practices before breastfeeding self-efficacy interventions are implemented (Otsuka et al., 2013).

In a study by Chapman and Perez-Escamilla (2012) to determine the effect of interventions on breastfeeding rates among minority women, the following were implemented:

- Peer counseling involving home visits, hospital visits, telephone support, and provision of breast pumps;
- Professional support involving registered nurse support (sometimes bilingual) through home and hospital visits, lactation consultant support through home visits, telephone support, and provision of nursing bra and breast pumps;
- Breastfeeding team comprising a peer counselor and a professional such as a registered nurse; and
- Breastfeeding-specific clinic appointment involving support from pediatric residents with additional breastfeeding training, prenatal appointments to discuss breastfeeding at pediatric clinics, support from peer counselors with international board-certified lactation consultant supervision, and appointments to attend breastfeeding clinic at 3 to 7 days post-partum.

Most of the interventions resulted in increased breastfeeding rates, however, breastfeeding interventions provided by nurses working alone were generally less effective than the other types of interventions. This result points out the need for a more diverse healthcare team to ensure better rapport with minority women (Chapman & Perez-Escamilla, 2012).

The individual, cultural, and economic background of a mother should be considered in the implementation of breastfeeding support interventions. Breastfeeding adolescent mothers need support in one or more of the following domains: emotional, self-esteem, instrumental, informational, and network (Feldman-Winter & Shaikh, 2007). Adolescents represent one of the least likely populations to breastfeed because of challenges such as: how to cope with the stigma related to being a teen mother, lack of parenting preparedness, reliance on social support systems that may not encourage breastfeeding, low income, and poor educational opportunities. Hence, breastfeeding promotion for adolescents needs to be developmentally appropriate, patient-centered, and linked to multidimensional support (Smith, Coley, Labbok, Cupito, & Nwokah, 2012). Breastfeeding rates increase among adolescents when counseling becomes culturally sensitive and individually modified to address challenges influencing these adolescents' infant feeding decisions (Feldman-Winter & Shaikh, 2007).

The effectiveness of a breastfeeding program could be influenced by a change in health professionals' patterns of operations or health routines directly impacting nursing mothers. Hospital practices and government health policies may have a great effect on the breastfeeding success of mothers. A study by Kang, Song, Hyun, and Kim (2005) shows that breastfeeding rates decreased because healthcare professionals did not provide practical help to mothers encountering difficulties during breastfeeding. A healthcare professional's lack of knowledge results in inaccurate or inconsistent advice. An effective intervention proposed was to increase training and education for healthcare professionals and peer support helpers, and to establish a systematic education program at the community level which would offer easier access to different classes of the public (Kang et al., 2005).

To raise breastfeeding rates, policy makers and healthcare leaders should reinforce interventions such as: improving maternity care policies, providing workplace lactation accommodations, increasing the capacity of peer counseling programs, establishing marketing campaigns that reach out to a mother's main support networks such as fathers and grandmothers, and educating mother to shy away from deceptive advertisements of breast milk substitutes. State and local partnerships should also be established to provide infrastructure for breastfeeding support (Ma et al., 2012). However, the success of an intervention program is not only measured with regards to its effect on increasing breastfeeding rates, but also based on its cost savings.

Economic Impact: Cost-Benefit Analysis of Breastfeeding, and Direct and Indirect Monetary Effects on the Individual, Family, Businesses and Government

From the 89 articles reviewed, 12 (13%) addressed the economic impact of breastfeeding. An increase in human milk feeding comes with high economic value. The economic impact of breastfeeding could be evaluated based on its financial effects on the individual (nursing mother), family, broader society, businesses, and government. In a cost-benefit or return on investment analysis, the cost or investment represents how much is being spent in running a breastfeeding program or providing breastfeeding support while the benefit or return focuses on the cost savings from reduced costs of hospital admissions and other financial gains.

An increase in breastfeeding rates decreases the financial burden on health insurance providers through increased cost savings. Zeretske (2005) proposes that the total annual cost of not breastfeeding is between \$1.186 to \$1.301 billion. Breastfeeding reduces the medical costs of an infant by approximately \$200 for the first 12 months of life, while a total of \$ 1 billion could be saved per annum if lactation consultant support is provided to nursing mothers, with a cost to

benefit ratio of 0.7. Table 5 shows a breakdown of costs savings for a reduction in diseases in breastfed infants:

Table 5. Costs Savings for Reduced Cases of Common Newborn as a Result of Breastfeeding
Source: Zeretske (2005). Table created by author.

	Year 1997 cost savings from reduced cases as a result of breastfeeding (\$ millions)
Childhood cancer	10
Childhood diarrhea	100
Ear infections	500
Trypanosoma	500
Juvenile onset diabetes	2600
Respiratory syncytial virus	225
Total Savings	\$ 4.18 billion

Zeretske (2005) also points out that premenopausal cancer which is reduced in mothers who breastfeed, saves \$202 million.

Ma, Brewer-Asling, and Magnus (2012) summarize the cost savings from reduced cases of lower respiratory tract infections, gastroenteritis, necrotizing enterocolitis, and sudden infant death in Louisiana. Table 6 shows these costs saving with respect to the percentage of mothers who breastfed exclusively:

Table 6. Cost Savings from Reduced Cases of Common Newborn Diseases in Breastfed Infants
Source: Ma, Brewer-Asling, and Magnus (2012). Table created by author.

	Cost savings if 80% of mothers breastfeed exclusively for 6 months in 2006 (in 2010 US\$)	Cost savings if 90% of mothers breastfeed exclusively for 6 months in 2006 (in 2010 US\$)
Lower respiratory tract infections	\$ 6,746,031	\$7,760,472
Gastroenteritis	\$2,745,172	\$3,111,195
Necrotizing enterocolitis	\$5,795,253	\$6,681,377
Sudden infant death syndrome	\$87,407,657	\$102,147,564
Total	\$102,694,113	\$119,700,608

The economic impact of breastfeeding also addresses the return on investment recorded by companies that provide lactation support to their female employees. This support includes: privacy to express milk in lactation rooms; flexible breaks to express milk; education through pamphlets, online resources, lunchtime prenatal classes; and access to lactation consultants. The cost savings associated with these companies are seen in the retention of experienced employees (nursing mothers) thus minimizing the need for employing replacement staff, and the costs incurred for training these new hires; the reduction in sick time taken by both moms and dads for children's illnesses; and lower health care and insurance costs (womenshealth.gov, n.d.). An illustration of these business savings is shown by the insurance company CIGNA which performed a 2-year study of 343 employees who participated in their lactation support program. The company found that the program produced an annual savings of \$240,000 in healthcare expenses, and \$60,000 savings in reduced absenteeism rates (womenshealth.gov, n.d.). The Minnesota Department of Health points out that businesses that implement lactation support programs often gain a return on investment of 3:1 (Minnesota Department of Health, n.d.).

To review the economic impact of breastfeeding on governments, Mahon, Claxton, and Wood (2016) insist that providing support to mothers, and encouraging them to breastfeed exclusively for the first four months could save the UK National Health Service (NHS) over £11 million per year by reducing the incidence and treatment costs for acute infections such as gastrointestinal and lower respiratory tract infections, and acute otitis media in infants. This study also estimates that the international impact of not breastfeeding is associated with economic losses of about \$302 billion annually, or 0.49% of world gross national income (Mahon et al., 2016). According to Zeretzke (2005), increasing breastfeeding in Australia could

increase the national food output by A\$3.4 billion which is equivalent to a 0.7% rise in GDP (Zeretzke, 2005).

UNICEF, World Health Organization, 1,000 days, and Alive and Thrive (2017) highlight breastfeeding to be a profitable investment in global health such that \$35 is generated for every \$1 invested in breastfeeding. It is an investment in human capital development which could benefit a country's economy. The World Bank's new Investment Framework for Nutrition notes that meeting the World Health Assembly's target of exclusive breastfeeding in the first 6 months of life would save 520,000 children's lives over the next 10 years. If the target were to be reached by 2025, it would result in better cognitive development and infant survival rates which would generate an additional \$300 billion economic return across lower and middle-income countries. The United States alone could record estimated \$13 billion cost savings per year if 90% of families meet the recommendation of exclusive breastfeeding in at least the first 6 months of life (UNICEF et al., 2017). However, in China where the exclusive breastfeeding rate is at approximately 21%, the total economic cost of not breastfeeding is determined to be about \$66 billion per year, or 0.61% of China's gross national income. This economic cost stems from a combination of losses in cognitive capacity, child deaths due to preventable diarrhea and pneumonia, and deaths in women from cancers and type II diabetes. In Nigeria where exclusive breastfeeding is only 17%, insufficient breastfeeding is likely to cost the country's economy \$21 billion per year, or 4.1% of its gross national income. Although India reports 55% exclusive breastfeeding rates in children under 6 months, the country's economy still suffers a loss of \$14 billion from inadequate breastfeeding. This loss represents 0.7% of India's gross national income. In Indonesia, the rate of exclusive breastfeeding is about 42%, however, the inadequate breastfeeding practices cost the economy approximately \$9 billion dollars which is 1.06 % of

Indonesia's gross national income. In Mexico, the rate of exclusive breastfeeding is about 31%, and inadequate breastfeeding costs the Mexican economy \$8 billion, which is 0.67 of its gross national income. Similar to China's economic cost breakdown, Nigeria, India, Indonesia, and Mexico are also affected by child and maternal deaths, as well as cognitive losses, as shown in Table 7 (UNICEF et al., 2017).

Table 7. Estimated Annual Economic Costs Attributable to not Breastfeeding, and Poor Breastfeeding Practices at Current Levels Compared to Near Universal Coverage

Source: UNICEF et al. (2017). Table created by author.

	Future economic cost of mortality (USD \$billion)	Future economic cost of cognitive losses (USD \$billion)	Total combined economic cost as percentage of GNI
China	6.13	59.60	0.61
India	7.10	7.25	0.70
Indonesia	2.32	6.94	1.06
Mexico	1.10	7.13	0.67
Nigeria	11.94	9.10	4.10

On an individual level, the economic impact of breastfeeding on nursing mothers should emphasize time costs and commodification of mothers' breast milk. According to Smith and Forrester (2013), the high time cost of feeding an infant is not commonly recognized. These time costs should be incorporated when addressing the costs of breastfeeding on nursing mothers. Exclusive breastfeeding is particularly time intensive for mothers who end up spending less time on personal needs such as sleeping and social activities. In order to gain the public health cost benefits of exclusive breastfeeding, there is a need for policies that give mothers more time for breastfeeding. Paternal assistance is also encouraged to reduce the unpaid domestic work expected of the mother. Policies that promote "breastfeeding friendly" child care arrangements are also critical to reducing maternal time trade-offs of infant care without detriment to breastfeeding among working mothers (Smith & Forrester, 2013).

Smith (2015) highlights that turning human milk into a commodity creates prospective breastfeeding benefits that could create profit for some of the world's poorest women. Regulators tend to focus on potential risks of feeding donated human milk rather than on the health risks associated with exposing infants to highly processed bovine milk. In the case of food safety, commodifying human milk and breastfeeding creates debatable policy concerns. With the help of technology, human milk is now collected, processed, and sold commercially, while employment in wet-nursing increases (Smith, 2015). This commodification of human milk potentially makes human milk available to more babies, and could also increase societal recognition of the economic value of breastfeeding thus reducing the purchase of bovine milk-based substitutes. Women, as sole producers of breastmilk are able to earn a living as wet-nurses, or by selling their breastmilk through human milk markets. On the other hand, markets for human milk could reduce women's ability and incentives to breastfeed their own infants (Smith, 2015).

The cost benefit analyses of breastfeeding programs are important, however, the inclusion of time costs, and the commodification of milk also play significant roles when examining the economic impact of breastfeeding on nursing mothers. A proper understanding of these rarely explored areas will lead to better policies which prioritize providing optimal support to these mothers. Governments are likely to become more supportive breastfeeding programs if greater awareness is made about how breastfeeding affects a country's economy on a macro level.

After analyzing the effectiveness and usefulness of programmatic interventions with respect to intervention evaluation and economic impact, the next question is: How have breastfeeding programs reduced rehospitalization of low birth weight and preterm infants through the implementation of one or a combination of the following services to mothers of low

birth weight or preterm babies: breast pump supplies, education and training on breastfeeding, transportation to and from the NICU, and in-home visits with social workers, community health workers, and lactation specialists?

Reduced Rehospitalization and Its Costs Savings

From the 89 articles reviewed, 7 (8%) addressed reduced rehospitalization as a result of breastfeeding, and its cost savings.

Aloy et al. (2016) describe how changes in homecare for preterm and low birth weight infants have reduced rehospitalization of these infants. The study defines homecare as “a service offering home medical and nursing care to the patient at home in equal quantity and quality as in the hospital.” It highlights communication, information, and support as the key elements of the model. This homecare program provides advantages such as breastfeeding support which promotes increased weight gain in the newborn, an improvement in developmental results which introduces lower risks of infections, personal health education for the caregiver, and better restructuring of healthcare resources. The results from this study showed a decrease in rehospitalization rates from 2.2% to 1.3% between 2002 and 2014 (Aloy et al., 2016). Under the U.S. Department of Health and Human Services, “Bridge to the Future” was designed as a nurse home visitation program to support low-income families of frail infants discharged from the neonatal intensive care unit. Specially trained nurses provide the caregivers of very low birth weight babies with in-depth training on home care to prevent rehospitalization of the infants. Results show that infants who receive postpartum care record a 2% reduction in rehospitalization (Agency for Healthcare Research and Quality, 2008).

Cost savings from reduced rehospitalization of low birth weight and preterm infants through breastfeeding is currently an underexplored area in maternal and child health. However, Brooten et al. (2001) used a model of prenatal care targeting women at high risks of delivering low birth weight babies between January 1, 1992 and January 1, 1996. Half of the prenatal care was delivered at the mothers' homes by well-trained nurse specialists. The result included fewer infant rehospitalizations with a saving of over 750 total hospital days and \$2,880,000 (Brooten et al., 2001). According to Underwood, Danielsen, and Gilbert (2007), based on the California maternal and newborn/infant hospital discharge records from 1992 to 2000, 15% of preterm infants were rehospitalized at least once within their first year of life, with an average annual cost per admission of \$8,468 (Underwood et al., 2007). Based on the California Medicaid program between 1984 and 1987, Rogowski and Harrison (1995) also present an annual readmission cost of \$13,000 for extremely low birth weight infants (< 1,000 g), and a range between \$9,100 and \$11,300 for very low birth weight infants (<1,500 g) (Rogowski & Harrison, 1995).

The link between the reduction in rehospitalization of babies and respective cost savings has undergone limited investigation at least in terms of what can be found in the published literature; hence, the Right! From the Start Program is an important project which will draw attention to the impact of this analysis.

CHAPTER 6: DISCUSSION AND CONCLUSION

The major barriers to breastfeeding stem from biological, social, demographic, economic, and psychological factors. They all play unique and significant roles in influencing breastfeeding outcomes; hence it is difficult to pinpoint what factors are the most important. However, across the research studies reviewed, women's need to return to work after giving birth, and poor access to professional breastfeeding support pose as the most popular factors increasing early termination of breastfeeding. Regarding the need to return earlier to work, an appropriate question to consider is: Are white-collar and non-white-collar businesses willing to provide and extend durations of paid maternity leaves? Breastfeeding equity is also an important factor which should not only focus on race or ethnicity but should also encompass the needs of women in military, HIV positive women, women in LGBTQI communities, and women in other underrepresented communities (Perez-Escamilla & Sellen, 2015).

A review of breastfeeding interventions shows that combined individual and group counselling is more effective than individual or group counselling alone (Haroon et al., 2013). Also, health care providers are encouraged to create more diverse teams of workers who are more likely to connect better with nursing mothers from different backgrounds (Chapman & Perez-Escamilla, 2012). Breastfeeding is recognized as a major economic investment for families, businesses, and governments as seen in increased cost savings and time gains. Although some research studies highlight actual return-on-investments for breastfeeding, the government might question whether they are willing to further publicize these benefits through more innovative approaches such as mandatory breastfeeding education in schools and work places, and door-to-door breastfeeding education in low-income neighborhoods.

Owing to the newness of the research on how better breastfeeding program services reduce rehospitalization of low birth weight and preterm infants, articles addressing this topic are scarce. Although other research studies have demonstrated that postpartum home visitation is linked with a reduction in rehospitalization of infants, there are still uncertainties about how providing mothers with breast pump supplies, education and training on breastfeeding, and transportation assistance to and from the NICU, significantly reduce rehospitalization. Hence, the Right! From the Start initiative is important because of the need to draw attention to these other unexplored areas which may potentially impact cost savings from reduced rehospitalization of low birth weight and preterm babies.

Application to Right! From the Start Neonatal Intensive Care Unit (NICU) Breastfeeding Initiative

In the provision of support to nursing mothers, there is discontinuity in the quality of services offered to these mothers in the hospital versus when they transition into community health centers. Right! From the Start is a collaborative project between Women and Children Health Initiatives, Inc., Community Foundation of Northwest Mississippi, University of Mississippi, and the University of Mississippi Medical Center to improve mother and baby health outcomes through providing community and hospital-based support for breastfeeding. It seeks to provide a more coordinated transition from the neonatal intensive care unit (NICU) to community health centers. The program will offer mothers better services such as access to hospital grade breast milk pumps, enhanced transportation services, and coordinated team-based care and social support. After the baby is discharged, the community staff will assume responsibility for coordination and social support of the mother and the baby, but will stay in

contact with hospital staff. Mothers that do participate in the program are expected to breastfeed their babies for at least 6 months.

This research study focuses solely on mothers whose low birth weight babies have been admitted to the Newborn Center at the University of Mississippi Medical Center. Participating mothers are selected from the following counties: Bolivar, Coahoma, Leflore, Sunflower, Quitman, Washington, Holmes, Humphreys, Panola, Sharkey, Tallahatchie, and Tunica. The purpose of this study is to determine the outcomes from providing continuous support to mothers of low birthweight babies, and their babies, who live in the Mississippi Delta. This support will be provided throughout the first two years of the baby's life.

The Right! From the Start initiative is expected to reduce rehospitalization of low birth weight infants through an increase in breastfeeding rates. The program proposes a reduction in the rehospitalization of low birth weight infants by a specific percentage; however, given the newness of Right! From the Start, the initial percentage of rehospitalization, and cost per rehospitalization will be retrieved from other peer-reviewed research studies. To analyze the cost-effectiveness of the program, there will be a comparison between the cost savings of reducing rehospitalization of infants through running Right! From the Start versus the cost of delivering the program (e.g. cost of staff, cost of equipment used etc.). Demonstration of cost-effectiveness of Right! From the Start will encourage policy makers to invest in the expansion of the program to other parts of Mississippi.

Based on the research by Vohr et al. (2012), I assume that Right! From the Start's services will lead to a reduction in the rehospitalization of infants. To measure cost-effectiveness, I deduce that an increase in breastfeeding rates will most likely reduce rehospitalization (Radouani et al., 2016; Willows, n.d.). Research studies have demonstrated that

gastroenteritis, respiratory infections, and hyperbilirubinemia (jaundice) are common causes of rehospitalization of NICU infants (Kavehmanesh et al., 2008; Perme, Cerkenvenik, & Grosek, 2016; Radouani et al., 2016). The American Academy of Family Physicians (n.d.) suggests that preterm infants who are breastfed in the NICU have lower rates of rehospitalization. The Florida Breastfeeding Coalition, Inc. (n.d.) also shows that following the initiation of a lactation program, rehospitalization rates were reduced by 90%. This reduction was influenced by lessened dehydration and hyperbilirubinemia. Hence, the next question is: What is the cost of Right! From the Start providing coordinated breastfeeding support via hospitals and community health centers compared to doing nothing to help mothers and their families?

Recommendations

There are many programs that help to reduce rehospitalization of low birth weight and preterm babies. Although most of these programs do not perform all the functions of Right! From the Start, they have reduced rehospitalization by rates between 0.9% and 2% based on the provision of the home nursing care to nursing mothers. Hence, a rate within this range will be a reasonable goal for Right! From the Start. Also, future research could build on this thesis to understand the unique challenges of breastfeeding and the rates of rehospitalization of preterm and low birth weight infants at state levels, especially Mississippi.

Existing literature have addressed ethnicity, age, socioeconomic status etc. as factors which influence the success of breastfeeding programs, but two additional factors could be: poor electricity supply in certain areas which may affect the storage of breastmilk or the use of electric pumps, and the presence of a large number of non-English speakers (e.g. in the Gulf Coast of Mississippi), which may require the use of interpreters.

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