BREASTFEEDING PRACTICES AMONG NORTH CAROLINA WIC CLIENTS FROM 1996 THROUGH 2002: PATTERNS, CORRELATES, AND THE EFFECTS OF IN-HOME POSTPARTUM SUPPORT

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ABSTRACT

DEBORAH L. DEE: Breastfeeding Practices among North Carolina WIC Clients from 1996 through 2002: Patterns, Correlates, and the Effects of In-Home Support
(Under the direction of Carolyn T. Halpern)

Human milk is the optimal nutrition for infants for the first six months of life. Healthy People 2010 includes national breastfeeding goals including 75% of women initiating breastfeeding, 50% continuing for at least six months, and 25% continuing for at least one year. The American Academy of Pediatrics recommends exclusive breastfeeding for six months, with continued breastfeeding for at least one year or as long as mutually desired by mother and child. In the United States, those who least likely to breastfeed are women who are African American, residents of the southeast, and WIC participants. This dissertation examines patterns and correlates of breastfeeding practices among North Carolina WIC clients from 1996 through 2002. Because both macro- and micro-level factors can influence breastfeeding, the social ecological model is used as a theoretical framework to guide both papers. Beginning with an assessment of breastfeeding initiation and early introduction of human milk substitute (HMS) in the first paper, and following with an intent-to-treat evaluation of an in-home postpartum breastfeeding support program, this dissertation attempts to identify individual and community factors associated with breastfeeding. Results indicate that breastfeeding initiation has increased over time, but so has introduction of HMS within the first week postpartum among WIC clients who initiated breastfeeding. There are several practice and public health implications of the findings, including recommendations

related to hospital policies, WIC breastfeeding support, breastfeeding interventions, and evaluation methodologies.

To my mother, Donna Dee, who I wish was here to share this with me.

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CDC	Centers for Disease Control and Prevention
CI	Confidence interval
HPDS	Health Professions Data System
HMS	Human Milk Substitute (also known as “infant formula”)
HR	Hazard Ratio
IHBSP	In-Home Breastfeeding Support Program
LINC	Log Into North Carolina online data retrieval system
NC	North Carolina
OR	Odds ratio
PedNSS	Pediatric Nutrition Surveillance System
PNSS	Pregnancy Nutrition Surveillance System
SET	Social Ecological Theory
UNICEF	United Nations Children’s Fund
U.S.	United States
WHO	World Health Organization
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

CHAPTER 1

INTRODUCTION

Exclusive breastfeeding is optimal nutrition for infants for the first six months of life because it reduces the risk for many illnesses and chronic diseases in both mother and child.[1-6] The United States Public Health Service National Health Objectives for Disease Prevention and Health Promotion for 2010 (*Healthy People 2010*) aim to: (1) increase to 75% the proportion of women who initiate breastfeeding; (2) increase to 50% the proportion of women who continue breastfeeding their babies until six months of age; and (3) increase to 25% the proportion of women who breastfeed their babies until one year of age.[7]

Despite the documented benefits of human milk, public knowledge of these benefits, and recommendations from numerous health and professional organizations such as the American Academy of Pediatrics,[2] the American Public Health Association,[8] the American Academy of Family Physicians,[9] the American Dietetic Association,[10] the American College of Obstetricians and Gynecologists,[11] the World Health Organization (WHO)[12] and others, breastfeeding incidence, exclusivity, and duration in the United States are well below national goals. In addition, disparities exist in breastfeeding practices. According to national data, the primary demographic factors associated with a decision not to breastfeed or to breastfeed for a short duration include: being African American, being poor, living in the southeastern United States, completing 12 or fewer years of education, being unmarried, and being younger than 30 years old.[13-17]

While many studies have examined breastfeeding practices, few have identified existing models of breastfeeding assistance and support that are effective, and which could be replicated on a national level. In addition, previous studies assessing the effects of breastfeeding support have tended to focus on lay health advisors or peer counselors, who are typically volunteers or temporary employees, rather than on paraprofessionals (paid, benefited employees). The North Carolina In-Home Breastfeeding Support Program (IHBSP) is a unique intervention designed to provide comprehensive breastfeeding assistance to low income women in North Carolina, including in-home support offered by trained paraprofessionals. The program focuses on helping women who have initiated breastfeeding to extend the duration they breastfeed.

The current study includes two papers that focus on different aspects of the infant feeding practices of WIC participants in North Carolina from 1996-2002. Paper 1 is an assessment of patterns and correlates of breastfeeding initiation as well as early introduction of human milk substitute (HMS) into infants' diets. The second paper investigates trends in breastfeeding duration among North Carolina WIC participants from 1996 through 2002, with a particular focus on evaluation of the effects of postpartum support on the duration of breastfeeding among women living in program counties. This study expands previous research by taking an ecological approach and investigating multilevel, contextual effects on breastfeeding.

Defining Breastfeeding

Breastfeeding behaviors are neither clearly defined nor consistently operationalized in much of the literature.[18] Some studies explore whether mothers exclusively breastfeed (typically defined as infants receiving only human milk, with no other liquids or solids, not

even water), partially or mix feed (giving combinations of human and HMS, as well as prematurely introducing other liquids or solids), or never breastfeed. Other studies define feeding terms differently, such as definitions of exclusive breastfeeding that include human milk and water.[13] Moreover, some studies define successful initiation of breastfeeding as having 'ever breastfed,' even just once, for any length of time, while others require that breastfeeding lasts at least one or two weeks to meet the criteria for successful initiation. Further complicating matters, some studies fail altogether to define how "breastfeeding" is measured.

Discrepancies in the definition of breastfeeding practices make it difficult to compare study findings, and have implications for the interpretation of study results. For example, if breastfeeding is not clearly defined, a woman who was breastfeeding only once a day could be grouped into the same category as a woman exclusively breastfeeding, despite the very different amounts of human milk received by their respective infants. If the outcome under study was truly influenced by a high level of exposure to (or intake of) human milk, this kind of non-specific description of breastfeeding practices could potentially bias results toward the null.

The way breastfeeding is defined also affects analyses of breastfeeding duration. For researchers tracking the duration of breastfeeding, for example, it is important to distinguish between exclusive breastfeeding and "any" breastfeeding. While some US women exclusively breastfeed for six months as recommended, many other women in the US introduce HMS or other liquids or foods into their babies' diets before that time.[13, 14, 19-26] By carefully measuring the timing of discontinuation of exclusive breastfeeding, researchers may be able to identify specific times postpartum when interventions could be implemented

to help women continue giving only breast milk to their children. Careful tracking might also allow researchers to identify the relevant kinds of lactation support or other intervention women need, since reasons for terminating breastfeeding may vary according to time postpartum. For example, women who quit exclusive breastfeeding in the first week postpartum may have experienced latch difficulties resulting in pain when nursing, whereas women who stop exclusive breastfeeding at the six week or three month mark may do so because they plan to return to work or school and are afraid they will not be able to produce sufficient milk when away from their babies. These very different reasons for discontinuing exclusive breastfeeding require alternative strategies for women to overcome the challenges they face. These same rationales are also relevant to tracking cessation of "any" breastfeeding. It is crucial, therefore, that all breastfeeding-related studies include a specific definition of feeding-related terms.[18] The datasets used in this dissertation, however, define breastfeeding as "ever put to breast," and there is no way to further refine the definition.

Maternal and Child Health Risks of Not Breastfeeding

Breastfeeding is widely recognized as the ideal method of feeding and nurturing infants for the first six months of life for optimal growth and development. Mothers and children who do not breastfeed lose the physiological, immunological, and psychological benefits breastfeeding confers, and face increased risk for a number of acute and chronic diseases.[1, 5, 6, 27-29] Women who do not breastfeed may experience more postpartum bleeding, increased risk of breast[30] and ovarian cancers,[31] as well as increased risk of osteoporosis[32] and rheumatoid arthritis,[33] shorter intervals between births due to lack of lactational amenorrhea,[1] and longer time to return to prepregnancy weight[34] than women who

breastfeed. Child health risks associated with not breastfeeding or receiving human milk include, but are not limited to, increased morbidity from gastrointestinal,[35, 36] respiratory,[36, 37] and middle-ear infections,[35] and more atopic illness and allergic disease.[3, 36, 38, 39] Non-breastfeeding women and their infants also display fewer attachment behaviors than breastfeeding dyads.[24, 40]

Economic Benefits of Breastfeeding

In addition to its health benefits, breastfeeding confers economic benefits as well. Riordan estimated that HMS provided by WIC costs over $2.6 million annually,[41] and families are estimated to spend as much as $1500 on HMS during the first year of their infants' lives.[42] Apart from savings resulting solely from lower HMS expenditures, breastfed infants have been shown to have reduced healthcare costs compared to infants who are not breastfed.[1, 43] In a small study in a health maintenance organization in North Carolina, Hoey and Ware estimated that, for the first 12 months of life, medical care costs for infants who were not breastfed was $200 higher than for breastfed infants.[44]

Some of the savings associated with healthcare could be due to a reduction in otitis media (ear infection) occurrence among breastfed versus HMS-fed infants. Duffy et al. found that the incidence of otitis media at six months was 25% for exclusively breastfed infants, compared to 53% for HMS-fed infants.[45] Using this information and applying data from 2000, Weimer estimated that, simply by increasing breastfeeding to the *Healthy People* goal of 50% breastfeeding at six months, savings of over $3.6 billion would be realized.[46] In his analysis, Weimer considered cost savings related to hospital care, parents' time and wages, and premature deaths that would result from reductions in incidence of otitis media

($3.6 million), gastroenteritis ($9.9 million), and necrotizing enterocolitis ($3.2 billion). Moreover, since he only considered costs related to three childhood illnesses, and since he did not include costs related to purchases of over-the-counter medications, Weimer suggests that his estimate of $3.6 billion is likely an underestimate of potential savings that would be realized if the prevalence of exclusive breastfeeding increased from 1998 rates (64% initiated; 29% continued to six months) to those recommended by the Surgeon General (i.e., 75% initiate, 50% continue to six months).[46]

Infant and Young Child Feeding Recommendations

The *Healthy People 2010* national breastfeeding objectives call for 75% of women to initiate breastfeeding, 50% of women to continue breastfeeding until 6 months postpartum, and 25% continue breastfeeding for at least one year.[47] In 1998, the Surgeon General issued *A Blueprint for Action on Breastfeeding*, which promotes efforts to increase initiation and duration of breastfeeding in the US, particularly among those subpopulations of women who are least likely to breastfeed.[48] Within *Healthy People 2010* and the *Blueprint*, however, "breastfeeding" is not defined in terms of exclusivity (i.e., exclusive, partial, or mixed breastfeeding), thus making the goals and objectives related to breastfeeding ambiguous.

In their 2005 policy statement on breastfeeding and the use of human milk, the American Academy of Pediatrics (AAP) acknowledges the advances in scientific knowledge about the benefits of breastfeeding.[2] The AAP also issues guidelines for pediatricians that include recommending human milk for all infants (when not contraindicated) and providing clinical assistance to families to promote, protect, and support breastfeeding. The AAP also states that, in addition to the recommendation that women initiate breastfeeding, pediatricians

and parents should be aware that exclusive breastfeeding provides sufficient and optimal nutrition for the first six months of life, and that breastfeeding should be continued for at least one year or as long thereafter as mutually desired by mother and child.[2]

In addition to national recommendations on breastfeeding, international organizations such as the WHO and the United Nations Children's Fund (UNICEF) have put forth guidelines related to infant and young child feeding. In its jointly-endorsed document, *Global Strategy on Infant and Young Child Feeding,* the WHO and UNICEF advise that, aside from HIV-positive and AIDS-infected mothers for whom special considerations are required, all mothers have access to skilled support to initiate breastfeeding and to continue with exclusive breastfeeding for the first six months of their infants' lives, and that babies continue to breastfeed for up to two years and beyond, with the timely introduction of appropriate and safe complementary foods.[49] To prevent women from being given the false impression that HMS is equal to or better than breastfeeding, the WHO also developed the International Code of Marketing of Breast-milk Substitutes, which places restrictions on how HMS and related equipment are advertised.[50] In all of their documents and publications, the WHO and UNICEF clearly define all infant feeding related terms. For example, exclusive breastfeeding is defined as an infant receiving only breast milk without any additional food or drink, not even water.

The WHO and UNICEF also suggest that multiple levels of assistance and involvement be in place to help women feed their babies and young children optimally. In addition to recommendations about feeding, the WHO and UNICEF call for healthcare providers to be adequately trained so they can properly advise and assist women with initiating breastfeeding after childbirth, and for trained lay or peer counselors to be available

in the community to help women maintain breastfeeding. They also urge governments to play a role in promoting and supporting breastfeeding by investigating the status of their respective country's implementation of the International Code, and by protecting the breastfeeding rights of working women through legislation.[51]

Breastfeeding Data Sources

Ross Laboratories Mothers Survey[1] and the National Immunization Survey

For many years, data on national and state level breastfeeding practices were obtained from the Ross Laboratories Mothers Survey (RLMS), a national mail survey conducted annually in the United States since 1954 by Ross Products Division of Abbott Laboratories, a pharmaceutical company that manufactures HMS. Amid concerns about potential conflicts of interest in relying on breastfeeding data collected by a "formula" company and out of a desire to implement nation-wide governmental surveillance of breastfeeding, the Centers for Disease Control and Prevention (CDC) added infant feeding questions to the annual National Immunization Survey (NIS) in 1999.[52] State-level NIS data became available in 2003.

[1] Some researchers and breastfeeding advocates have questioned whether the Ross Laboratories Mothers Survey data can be trusted and whether it is ethical to rely upon breastfeeding data collected by a "formula" manufacturer. The RLMS and NIS show similar findings in general with regard to breastfeeding initiation, exclusivity, and duration among women in the United States, which suggests that concerns relating to the accuracy of data obtained by a manufacturer of human milk substitutes may be unwarranted. Nevertheless, phasing out reliance on RLMS data remains an important goal because of the conflict of interest inherent in using “formula” company data when discussing breastfeeding, and the need to be clear when sending public messages about the superiority of human milk compared to substitutes.

National Survey of Family Growth, the National Health and Nutrition Examination Survey, and the Pregnancy Risk Assessment Monitoring System

In addition to the RLMS and NIS data, other sources of breastfeeding data exist, but have features that make them less than ideal. Breastfeeding information can be obtained from the National Surveys of Family Growth (NSFG) and the National Health and Nutrition Examination Surveys (NHANES), for instance, but not on an annual basis. The Pregnancy Risk Assessment Monitoring System (PRAMS) also collects breastfeeding data, but these data are not routinely analyzed, nor are the surveys implemented by each state, thus precluding national-level analysis.

Pregnancy Nutrition Surveillance System

For information on breastfeeding initiation and introduction of HMS within the first six weeks postpartum among low-income women, one can use the Pregnancy Nutrition Surveillance System (PNSS). Data included in PNSS come from the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and Title V Maternal and Child Health (MCH) programs, and, like PRAMS, state participation in PNSS is voluntary. During the prenatal clinic visit, demographic and maternal health and behavioral data are collected. At the postpartum clinic visit, which usually occurs at approximately six weeks postpartum, breastfeeding initiation data are obtained, as are infant health data describing the birth outcome. Each woman contributes one record representing one pregnancy. The PNSS record that includes both prenatal and postpartum data is collected in the clinic, aggregated at the state level, and then submitted to the CDC on a quarterly basis. The CDC uses the state

data to generate an annual report that includes data related to births for each calendar year (January 1 through December 31).

Pediatric Nutrition Surveillance System

The PedNSS is a child-based public health surveillance system that describes the nutritional status of low-income US children (birth to age 20 years) who attend federally-funded MCH and nutrition programs. The PedNSS provides data on the prevalence and trends of nutrition-related indicators. Breastfeeding questions are asked of WIC-enrolled mothers with children under 24 months of age at the time of the WIC or other public health clinic visit.

Data in PedNSS are composed of information provided by WIC, Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) service, and Title V MCH programs. Data are collected at the clinic level, then aggregated at the state level and submitted annually to the CDC for analysis. When multiple records are submitted for a child during the reporting period, the CDC creates one unique record for that child by following specific selection criteria that may contain some data from all available records. The CDC then calculates the nutrition-related indices and sends each state a series of annual tables that summarizes the nutritional status and infant feeding practices by age of child and child's race/ethnicity.

Breastfeeding Initiation

Data from the RLMS indicate that the proportion of women who initiate breastfeeding in the United States has increased steadily, from a low of 24.7% in 1971 to 70.1% in 2002.[25] Recent data from the 2003 NIS indicate similar findings of 70.3% of US

women initiating breastfeeding.[13] The percentage of low-income or WIC-enrolled women who initiate breastfeeding is substantially lower than that of the general population. The RLMS began tracking WIC participants' breastfeeding behaviors in 1978, when 34.5% of WIC clients initiated breastfeeding, compared to 48.1% of non-WIC mothers.[53] Since then, disparities in breastfeeding initiation have continued and gaps in initiation between WIC and non-WIC mothers have actually increased. In 2002, only 58.8% of WIC mothers initiated breastfeeding compared to 79.2% of non-WIC mothers.[53] Since breastfeeding promotion is mandated as part of the services WIC clinics provide to women and families, it is unclear why the prevalence of breastfeeding has not increased more rapidly among WIC participants. Some researchers suggest that part of the problem may be that WIC sends mixed messages to pregnant women and mothers by providing vouchers for HMS, unless the mother is exclusively breastfeeding and receiving extra food vouchers for herself, thereby appearing to endorse it as an acceptable form of nutrition.[54, 55] (The food package for breastfeeding mothers extends for the first year of the child's life if the mother is not using any HMS.)

The present study will add to the literature by focusing specifically on women who are least likely to breastfeed: WIC-enrolled women living in the southeast. By exploring patterns of breastfeeding initiation and early HMS introduction among NC WIC clients from 1996 through 2002, it will be possible to determine some of the variables associated with low prevalence of breastfeeding initiation and high prevalence of early HMS introduction, thereby helping to identify more precisely those WIC clients who should be targeted for breastfeeding intervention and assistance.

Breastfeeding Exclusivity and Duration at 6 Months Postpartum

Though the goal of *Healthy People 2010* is to increase to 50% the proportion of women breastfeeding (any amount) at six months postpartum, only 33.2% of US women responding to the 2002 RLMS reported they were still breastfeeding any amount six months after childbirth.[53] Findings from the 2002 NIS are similar, indicating that 35% of women continued giving some breast milk at six months postpartum. The 2002 NIS revealed that only 13.3% of women were "exclusively breastfeeding" at six months. The NIS definition of exclusive breastfeeding includes provision of human milk and of water, however, so this is probably an overestimate of the percent of women who are giving nothing but human milk for the first six months postpartum. Among WIC participants, 2002 NIS data show that only 26.4% were giving any breast milk at six months postpartum, and only 9.7% of WIC recipients were exclusively breastfeeding at six months (again, using the NIS definition).[13]

Breastfeeding Duration at 12 Months Postpartum

The 2002 RLMS data show 19.7% of all US women report continuing to breastfeed for one year (12.8% of WIC mothers and 25.2% of non-WIC mothers).[53] Data from the 2002 NIS show a slightly lower percentage (16.1) of all US women continuing to breastfeed for at least one year.

Sociodemographic Characteristics and National Breastfeeding Practices

In addition to providing information on specific breastfeeding practices such as those mentioned above, the RLMS and the NIS data show that the prevalence of breastfeeding initiation, exclusivity, and duration varies by race/ethnicity, income and education level,

geographic residence, marital status, and age. For example, the RLMS and NIS data indicate that sociodemographic factors associated with a decision not to breastfeed include being non-white, poor, unmarried, younger than age 25, having fewer than 12 years of education, and living in the southeast.[26] The present study will add to the literature by providing further insight into reasons breastfeeding rates among low-income women from the southeastern US lag behind those of other populations.

North Carolina Breastfeeding Practices

Associations between certain demographic characteristics and breastfeeding are also evident in North Carolina, though prevalence of initiation and duration are lower compared with national levels. The 1994 North Carolina Birth Cohort (NCBC) study indicates that approximately 50% of North Carolina mothers attempted to breastfeed their infants for at least one day.[56] The NCBC also showed that white mothers were far more likely than black mothers to breastfeed (57% v. 31%, respectively). In addition, the NCBC study found that, while 71% of women who completed more than 12 years of education breastfed their infants, only 21% of women with lower levels of education breastfed. Among low income women in North Carolina, 30% of white women breastfed versus only 18% of African American women of similar economic status.[56]

More recently, the 2001 RLMS showed that almost 64% of women in North Carolina initiated breastfeeding, with about 26% continuing to breastfeed at six months postpartum.[25] When examining breastfeeding practices specific to NC WIC participants in 2000,

prevalence remains low: approximately 51% of WIC mothers initiated breastfeeding, and about 11% were still breastfeeding at six months.

In an assessment of NC breastfeeding trends from 1997 through 2001, Smith and colleagues used PRAMS data and found that 64% of women in North Carolina reported initiating breastfeeding, and that prevalence increased from 58.8% in 1997 to 67.5% in 2001.[57] The PRAMS data also showed that those least likely to breastfeed were women who were non-Hispanic black, unmarried, smokers, under age 20, had less than a high school education, and were WIC participants.[57] While informative, the study by Smith et al. is limited in that data on breastfeeding duration are restricted to a maximum of eight weeks postpartum, and there is no information on exclusive breastfeeding. This study will add to the knowledge gained from the study by Smith et al. by examining breastfeeding trends through 2002, by considering additional variables that could influence breastfeeding, and by looking at full breastfeeding duration.

Multiple Levels of Influence on Infant and Young Child Feeding Practices

Individual-Level Influences: Maternal and Infant Characteristics and Behaviors

As described previously, across various surveys and surveillance system data, common factors are found to be associated with suboptimal infant feeding practices (defined by WHO and UNICEF as choosing not to initiate breastfeeding, practicing non-exclusive breastfeeding during the first six months of an infant's life, and breastfeeding less than two years). In addition to women previously described as being as least likely to breastfeed, women who are overweight or obese prior to pregnancy[58-61] or who smoke[62] during

pregnancy or postpartum also are less likely than their counterparts to initiate breastfeeding or to continue breastfeeding for long periods of time.[62]

While some studies have examined the role of prenatal interventions on breastfeeding, no studies were found that have examined how the timing of entry to prenatal care influences breastfeeding, which will be something this study will add to the literature. In addition to examining prenatal care timing, I will also be able to examine whether maternal alcohol use during pregnancy influences breastfeeding, which is something few studies have been able to address.

In addition to maternal characteristics, infant characteristics such as low birth weight (that is, babies born weighing ≤2500 grams)[63, 64] and being born preterm (before 37 completed weeks gestation)[65] have been associated with reduced odds of optimal feeding behaviors. Studies suggest that babies born before 37 full weeks gestation and low birth weight may have physiological challenges with suckling which can lead to a mother's frustration, worry, and inability to establish lactation and breastfeed her child.

Delivery Characteristics

Characteristics of a mother's childbirth experience also have been shown to be potentially detrimental to breastfeeding. Some studies have found that women who have given birth by Cesarean section are less likely to successfully initiate and continue breastfeeding compared with women who have vaginal births.[66] Explanations for lower rates of breastfeeding among mothers who had Cesarean births include surgery-related delays in the time between birth and mother/child skin-to-skin contact as well as delays in breastfeeding initiation. In contrast, Patel et al. examined associations between operative

delivery and breastfeeding success and found no difference in breastfeeding initiation rates among mothers with and without surgical intervention.[67] The authors did find, however, that mothers who had Cesarean births also had longer hospital stays and higher rates of exclusive breastfeeding (77%) at hospital discharge compared to mothers with shorter hospital stays (66%). The authors theorized that staying longer in the hospital may have allowed mothers with Cesarean births to obtain more help with breastfeeding than was available to mothers with vaginal births who left the hospital after a shorter time. In a study evaluating the effects of motivational videotapes and/or peer counseling on breastfeeding duration among African American WIC clients, Caulfield et al. also found a positive association between Cesarean section delivery and breastfeeding initiation, but no association with breastfeeding duration.[68]

Health Care Providers and Birth Attendants

Interactions with healthcare providers have been identified as an important influence on women's infant feeding decisions and practices.[69] In one study, women who spoke with a physician about breastfeeding demonstrated more knowledge, were more likely to decide to breastfeed, and were more likely to participate in a community-based breastfeeding support group than women who did not.[70] Freed et al. found that prenatal and postpartum support by physicians had a positive effect on women's intentions to breastfeed and on breastfeeding duration. Women whose physicians promoted the benefits of breastfeeding during prenatal care visits, and who affirmed a woman's decision to breastfeed after delivery breastfed longer than women whose physicians failed to do so or who claimed that feeding HMS was as beneficial to infants as breastfeeding. While physicians' advice appears to have the greatest value and influence with mothers in general, economically-disadvantaged women may more

often seek information from nurses, nutritionists, and clerks in public clinics. Potential effects of these other information sources are not known.

Few studies have examined whether the type of healthcare provider attending the birth, such as a physician compared to a midwife, has an influence on infant feeding outcomes. Since typical medical school curricula do not include extensive training related to breastfeeding, medical doctors such as obstetricians and pediatricians may be less able to provide sufficient support for women who have questions about breastfeeding or who experience problems with breastfeeding after childbirth. In contrast, midwives are often extensively trained in providing support for breastfeeding and may therefore be better able to assist mothers who need help. This study will allow an exploration of whether type of birth attendant influences breastfeeding practices among NC WIC clients.

Hospital Policies

Hospital policies and procedures developed around a "formula-" or bottle-feeding paradigm also can be detrimental to breastfeeding duration.[51, 71, 72] For example, routine or Cesarean-related early separation of mother and newborn (preventing “rooming in”), "test-feeding" with sterile or glucose water, and imposing a feeding schedule on the newborn (vs. feeding on cue) are just some of the traditional hospital policies that serve to thwart mothers' efforts to initiate and to exclusively breastfeed. Lack of training of nursing staff may lead to misinformation to parents as well as poor breastfeeding support. In addition, distribution of free HMS samples, as well as physicians' and hospitals' use of note pads, pens, and educational materials with HMS manufacturers’ logos and messages may act as a silent yet

powerful endorsement of the brand as well as the product, thereby giving mixed messages to parents.[49-51, 71, 73]

County Characteristics and Breastfeeding

The social ecological model posits that there are influences on infant feeding that go beyond individual-level variables, and that these variables interact with other variables to influence decisions and behavior among individuals. County-level variables such as residents' access to community primary care providers (reflected by measures such as the ratio of primary care physicians/nurse practitioners/physicians' assistants/certified nurse midwives per 10,000 population) and metropolitan status of the county may have an impact on women's decisions and practices related to infant feeding. In addition, the "wealth" of a county, or its capacity to devote fiscal resources toward breastfeeding support programs could have a direct effect on women's infant feeding behaviors. Counties with high percentages of persons living below the poverty level may be less able to allocate financial resources to such efforts compared with counties with lower percentages of persons below poverty. I will explore these associations in my subsequent two papers.

Postpartum Support of Breastfeeding Mothers by Peer Counselors

Because of the many short and long-term health risks associated with not breastfeeding and not giving infants and young children human milk (e.g., donor human milk or by pumping and giving human milk by cup or bottle), studies have been conducted to try to identify effective ways to improve suboptimal breastfeeding practices. Sikorski et al. conducted a systematic Cochrane review of 20 randomized or quasi-randomized trials

(n=23,712 mother-infant pairs) involving provision of support for breastfeeding. Results of the study indicated a beneficial effect of postpartum support on breastfeeding duration. Specifically, postpartum support was shown to protect against the risk of breastfeeding cessation prior to two months postpartum.[74] They also found that postpartum breastfeeding support appeared to have a greater effect on extending duration of exclusive breastfeeding compared with "any" breastfeeding.

The review found a wide variety of personnel were responsible for providing breastfeeding support, including medical personnel, nursing staff, allied professionals, and lay advisors (community-based volunteers and peers of those to whom they provide support). They also found that the mode of support was an important determinant of success. Studies reporting predominantly face-to-face intervention showed a stronger effect in improving exclusivity and duration of breastfeeding compared to those using mainly telephone contact. Including a prenatal component in a breastfeeding support program did not seem to have an effect on breastfeeding duration.

Results of a study by Chapman and colleagues,[75] however, were in contrast to the meta-analysis finding that "lay support" had no effect on "any breastfeeding."[74] In a prospective randomized controlled trial examining the effectiveness of breastfeeding peer counseling for a low-income, predominantly Puerto Rican sample of 165 women in Connecticut, peer counselors working under the supervision of a certified lactation consultant (IBCLC) had a significant impact on breastfeeding initiation rates and duration rates at one and three months postpartum. The intervention included one prenatal home visit by the peer counselor, daily perinatal visits in the hospital, three postpartum home visits, and telephone consultation as needed by the woman. Chapman et al. found that women who participated in

the intervention were more likely to initiate breastfeeding and to breastfeed longer compared with women in the control group.

In an evaluation of breastfeeding promotion conducted by peer counseling programs in Mississippi WIC clinics, Grummer-Strawn and colleagues used data from the state's Pediatric Nutrition Surveillance System (PedNSS) from 1989 through1993 to compare breastfeeding rates in clinics with and without peer counselors.[76] Success of the program was assessed through increased prevalence of breastfeeding initiation, using the WIC definition of breastfeeding ("ever breastfed"). Breastfeeding initiation increased in both groups, but was higher in clinics that had peer counseling programs compared with those that did not. Having a breastfeeding specialist/lactation consultant (IBCLC) was significantly associated with improved breastfeeding practices, while having a peer counselor was not, unless the peer counselor spent at least 45 minutes with each client. Race of the provider or counselor was not a factor, nor was length of work experience as a peer counselor. As might be expected, the longer a program had been in place, the better the initiation rates among its clients.[76] Although there were many strengths of the study, over one-third of breastfeeding data were missing, which likely resulted in bias.[76]

To evaluate a peer counselor program that provided postpartum telephone-based peer support to women, Dennis et al. conducted a randomized controlled trial using 256 first-time breastfeeding mothers recruited from two semi-urban community hospitals in Toronto.[77] Peer counselors were volunteer women with breastfeeding experience who attended a 2.5 hour training session. The intervention included a telephone contact within 48 hours of hospital discharge, and follow up contacts as often as the mother deemed necessary. Women in the control group received standard care, including the ability to participate in hospital-

and community-based postpartum support that was provided by nurses, physicians, and IBCLCs. Women in the intervention group were significantly more likely to be breastfeeding at 4, 8, and 12 weeks postpartum than women in the control group.[77]

In sum, certain kinds of postpartum breastfeeding support appear effective in increasing breastfeeding initiation, exclusivity, and duration. Previous studies have examined specific aspects of support for breastfeeding mothers, such as the type of person providing support and the setting and method(s) in which the support is given. An evaluation of the North Carolina In-Home Breastfeeding Support Program builds on previous work by using multiple years of large datasets to examine whether an intensive, multi-modal support program is effective in increasing breastfeeding duration in women who are unlikely to breastfeed.

The North Carolina In-Home Breastfeeding Support Program

The IHBSP, as part of the North Carolina Expanded Food and Nutrition Education Program (EFNEP), involved collaboration between the Cooperative Extension Service, North Carolina State University, the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and local hospitals serving the majority of women in the relevant region (usually the county) throughout North Carolina. The IHBSP began as a pilot breastfeeding support program in Wake County in early 1991 in response to high rates of breastfeeding cessation in the first two weeks postpartum among WIC participants. The program capitalized on the strengths of WIC, health departments, and county hospitals, each with its resource of healthcare professionals and access to low-income women, and EFNEP, with its adult education model in which paraprofessionals are extensively trained to teach women

about various topics one-on-one in their homes. The primary objective of the IHBSP was to provide comprehensive breastfeeding education and support to food stamp eligible mothers to help them establish lactation and prolong breastfeeding duration. The program was implemented in counties that requested it if each program partner (county WIC clinic, local hospital, county health department, county Cooperative Extension Service) agreed to provide financial and/or in-kind support.

An important component of the IHBSP model was that it went beyond the traditional approach of using lay health advisors, volunteers, or underpaid, minimally-trained peer counselors as the providers of support. Instead, the IHBSP hired paraprofessionals to be the support providers, and called them Program Assistants, or PAs. To become a PA, a woman had to have personal breastfeeding experience, a high school degree or GED, and to complete an extensive and intensive breastfeeding support training program beyond the routine EFNEP adult education training. The program required PAs to attend quarterly breastfeeding training sessions, and to participate in routine performance reviews and service audits and observations by IHBSP lactation consultants (IBCLCs). The PAs were fairly compensated and received health insurance and vacation benefits like other university employees. The IHBSP administrators believed these factors helped the program retain high quality PAs and conferred legitimacy to the program and to the job of PA. In addition, PAs were provided with program-funded cell phones and/or pagers, and clients were given the cell phone numbers in order to be able to contact the PA anytime during business hours for assistance with breastfeeding.

County WIC clinics, health departments, and local hospitals facilitated the pairing of PAs and low-income women who wanted to breastfeed. Ideally, PAs met with potential

clients prenatally, when PAs conducted infant feeding classes at the health department. During the classes, PAs explained the importance of breastfeeding and described the free services available through the IHBSP. Program Assistants also made daily visits to partner hospitals to meet with prenatally-enrolled clients who had recently given birth, or to meet with other eligible new mothers who desired postpartum breastfeeding support. Within 72 hours of hospital discharge, PAs visited clients in their homes to assist with potential difficulties of engorgement and latch that may occur when a mother's milk comes in. In addition to the hospital and post-discharge visits, clients were routinely contacted, either in-home or by telephone (depending on client preference or PA assessment of need) at 2, 4, and 6 weeks, and at 2, 3, 6, 9, and 12 months after delivery, or until breastfeeding ceased, whichever occurred first.

Previous Evaluation of the NC In-Home Breastfeeding Support Program

To assess whether the pilot project was a success, a small evaluation was conducted by IHBSP administrators in 1991 after the program had been in place several months in Wake county. Duration data were compared between WIC clients who participated in the intervention in Wake and WIC clients in Guilford (control site) county who received no intervention. Wake and Guilford counties were chosen for comparison because they were closely matched in terms of county sociodemographics. Results of the evaluation indicated that the IHBSP increased the percentage of women who continued breastfeeding at two and eight weeks postpartum. (Table 1) As a result, the program expanded to several other counties across the state, as well as to other states.

Table 1. Comparison of mean duration of breastfeeding (weeks), and percentage of women reporting any breastfeeding at 2 and 8 weeks postpartum among WIC clients in Wake and Guilford counties, North Carolina, 1991.

County	Mean Breastfeeding Duration (Weeks)	Percent still breastfeeding at 2 weeks	Percent still breastfeeding at 8 weeks
Wake (intervention site) n=268	14.2	87	52
Guilford (comparison site) n=115	5.5	56	15
Percentage Point Difference	8.7	21	37

This descriptive evaluation of the pilot breastfeeding support program was limited in scope and the findings are over 15 years old, but at the time it was conducted, it was sufficient to justify expansion of the IHBSP. In 1991, the IHBSP operated in one county (Wake), but it expanded over time, ultimately offering support to women in 42 counties across North Carolina. In addition, the IHBSP breastfeeding support model was implemented in several other states. As the program began to expand, an administrative infrastructure housed within North Carolina State University was established to train and manage the program, and to solicit grant funding. In 2003, the IHBSP's primary source of funding, the Food and Nutrition Service, notified the program that it would no longer provide financial support. As a result, most counties were forced to end their programs. Some counties, however, identified alternative funding, and have maintained some form of in-home support for low-income women. The former IHBSP infrastructure and extensive training components no longer exist, and counties must maintain and manage program data and assessments individually.

Theoretical Framework

In designing the study, a review of the literature was conducted to investigate theoretical explanations of the influences on infant feeding practices and decision making. Many breastfeeding studies contain little or no mention of theory, but it is important to use theory to understand how people behave and make decisions. Thus, this study will draw from social ecological theory,[78] which has been used to help understand the multiple levels of influence on health promotion and health-related behaviors (in this case, breastfeeding initiation, exclusivity, and duration).

An ecological framework recognizes that health behaviors are embedded in a specific environmental and sociocultural context, with influences from the micro (individual) through macro (environmental) levels.[79] These levels can act alone, or can interact with each other to influence individual knowledge, beliefs, skills, and behaviors. Macro-level factors include such influences as the media, legislation, and policy, while micro-level factors include factors such as the woman's or her family's beliefs, a woman's social networks, and the community in which she lives. Both macro- and micro-level factors can have a direct or an indirect influence on women's infant feeding decisions and practices, and though it may not always be possible to include all levels in studies of breastfeeding, at the least they should both be acknowledged as influential.

In a study of breastfeeding practices among African American women, Bentley et al. delineated how the social ecological model serves as a useful tool for understanding the various levels of influence that operate simultaneously to affect women's decision-making. They describe the potent power of the media, for example, including television and print, and their ability to sway cultural norms about breastfeeding. The study goes on to describe

specific ways in which policy, organizations, community environments, interpersonal interactions, and individual factors can influence breastfeeding.[79]

Legislation is another powerful means through which norms and individual beliefs can be influenced. In a study examining the effects of welfare reform on breastfeeding, Haider et al. found it to have detrimental associations with breastfeeding duration at six months postpartum.[80] Laws to protect breastfeeding may ensure women's right to breastfeed in public, which could affect social norms, though changes in norms are likely to take some time to be changed. Legislation designed to ensure women's ability to take breaks to pump milk could be of particular relevance to low-income women who may not have the types of jobs that usually provide routine breaks or places to pump their milk.

Organizations, such as the World Health Organization, the American Academy of Pediatrics, and La Leche League International, also can have powerful influences on breastfeeding practices. The WHO International Code on Marketing of Breast-Milk Substitutes was established in 1981 to protect and promote breastfeeding and infant health.[50] One aspect of the Code is the restriction on provision of free HMS, something with which hospitals desiring designation as "Baby-Friendly" must comply, and which serves as an example of one way in which different levels (the organization of WHO and the community-level hospital) interact to influence breastfeeding.

Other aspects of the community environment can also influence breastfeeding. Communities that offer breastfeeding information and support programs may influence social norms about what constitutes acceptable forms of infant feeding, which may have an effect on a woman's feeding choice. Local WIC programs can influence low-income families through their promotion of breastfeeding and by referring women to community mother-to-

mother breastfeeding support groups. Even shopping malls can be influential, such as when they provide breastfeeding rooms. Space that is specially set aside for women and families to breastfeed helps convey to the community the importance and value placed on breastfeeding.

Intraindividual influences on breastfeeding, such as interactions between women and their family, friends, and health care providers, has been studied extensively in previous research.[16, 70, 75, 79, 81-85] Women who have supportive social networks are more likely to initiate and continue breastfeeding,[16, 86] as are women whose health care providers encourage and support breastfeeding.[70, 87]

Individual-level factors are associated with breastfeeding, and include things such as demographics, beliefs, knowledge, and skills. A woman's breastfeeding knowledge and skills, however, are likely to be shaped by influences such as media, WIC, access to lactation consultants postpartum, and hospital policies. Thus, research that focuses solely on individual-level factors may be missing opportunities to explore areas that, if targeted for intervention, could have large public health impacts compared to interventions focusing on individual women. In addition, research focusing on characteristics of individual women may be construed as placing responsibility for feeding practices entirely on women, when, as the social ecological model shows, is not the case.

In sum, infant feeding decision-making and behaviors often occur within households and are undertaken in isolation by an individual, but patterns of feeding behavior (such as breastfeeding) are influenced by multiple, overlapping factors operating at various levels (e.g., individual, interpersonal, community or environment, organizational, and policy levels). Influential factors may include social and peer pressure, family beliefs and motivations, healthcare provider or hospital policy influence, work or school constraints,

availability or lack of role models, access to primary care physicians or other healthcare providers, community support, local government's ability to devote effort and money toward supporting breastfeeding families, portrayals of child feeding in the media, and so forth. Ecological models posit that changes in any one component of the model can affect other components.[78, 79]

This study is novel in that it takes an ecological approach to studying the issue of breastfeeding. Specifically, this study will assess not only micro (individual) level factors, but will include macro (county) level factors as well. If the IHBSP is found to be effective, and if more information is gleaned about the breastfeeding support needs and desires of low-income women, limited financial resources can be put to efficient use to replicate the IHBSP model throughout the state of North Carolina and nationally, increasing breastfeeding initiation, duration, and exclusivity, and thus improving the health of infants, mothers, and families nationally.

Public Health Significance and Policy Implications

Although the numerous maternal and child health risks of not breastfeeding are well known, many women in the United States do not breastfeed or provide their children with human milk. Moreover, women with low incomes, especially those who participate in WIC and live in the southeastern United States, are among those least likely to initiate and continue breastfeeding. In light of the maternal and child health advantages of breastfeeding compared with artificial feeding, including dose-response effects, the Surgeon General has included in *Healthy People 2010* specific objectives that call for efforts to increase both initiation and duration of breastfeeding. Previous research has suggested that providing postpartum support to women increases the likelihood of successful breastfeeding initiation

and extends the duration a woman breastfeeds her child. The NC In-Home Breastfeeding Support Program uses a paraprofessional peer-support model aimed at helping women achieve their personal breastfeeding goals.

The present study first describes patterns and correlates of breastfeeding among WIC participants in North Carolina from 1996 through 2002 (paper 1). The second part of the study involves an evaluation to assess whether the IHBSP model of support extends duration of breastfeeding among women living in program (intervention) counties compared with women living in non-program (comparison) counties (paper 2). If the program is deemed to be successful in achieving its goals, it may warrant being reinstated in former program counties in North Carolina as well as being implemented state-wide. Study findings also could be used by administrators of breastfeeding support programs to tailor them to ensure current and future clients' breastfeeding support needs are being met, thereby enhancing program efficacy. If effective, the IHBSP model of breastfeeding support should be considered for implementation at the national level.

Expansion of an effective breastfeeding support program could aid in achievement of national breastfeeding objectives. In addition, increasing the incidence and prevalence of breastfeeding in the United States will lead to subsequent reductions in morbidity and mortality for women and children. Such improvements should result not only in substantial decreases in healthcare costs at the individual, community, and societal levels, but also in improved health status and quality of life for families.

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CHAPTER 2

PATTERNS AND CORRELATES OF BREASTFEEDING INITIATION AND EARLY INTRODUCTION OF HUMAN MILK SUBSTITUTE AMONG WIC PARTICIPANTS IN NORTH CAROLINA

Breastfeeding is widely recognized as the ideal method of feeding and nurturing infants for the first six months of life for optimal growth and development. Mothers and children who do not breastfeed lose the physiological, immunological, and psychological benefits breastfeeding confers, and face increased risk for a number of acute and chronic diseases.[1-6] Many organizations, such as the American Academy of Pediatrics (AAP) and the World Health Organization (WHO) have issued statements and recommendations encouraging women to breastfeed.[7, 8] The *Healthy People 2010* national breastfeeding objectives call for 75% of women to initiate breastfeeding (defined as "ever breastfeeding" while in the hospital), 50% of women to continue breastfeeding until 6 months postpartum, and 25% to continue breastfeeding for at least one year.[9] Women in the US still fall short of the *Healthy People 2010* breastfeeding goals, however, with WIC participants living in the southeastern US cited as being among those least likely to breastfeed.

Data from the Ross Laboratories Mothers Survey (RLMS), a mail- and phone-based survey conducted by Ross Laboratories, a division of Abbott Laboratories and a major manufacturer of formula in the US, indicate that the proportion of women who initiate breastfeeding in the US increased steadily, from a low of 24.7% in 1971 to 70.1% in 2002.[10]

Data from the 2003 National Immunization Survey (NIS), a phone-based survey conducted by the Centers for Disease Control and Prevention (CDC), similarly found 70.3% of US women initiating breastfeeding.[11] The RLMS data show also that the percentage of women enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) who initiate breastfeeding is substantially lower than that of the general population. Since the RLMS began tracking WIC participants' breastfeeding behaviors in 1978, when 34.5% of WIC clients initiated breastfeeding compared with 48.1% of non-WIC mothers,[10] disparities in breastfeeding initiation between WIC and non-WIC mothers have persisted. In 2002, only 58.8% of WIC mothers initiated breastfeeding compared with 79.2% of non-WIC mothers.[10] Additionally, data from the 2003 RLMS indicate that breastfeeding initiation has begun to decrease, especially among WIC mothers.[12]

Healthy People 2010 calls for 50% of women to breastfeed (exclusivity not specified) at six months postpartum,[9] but in 2002, only 33.2% of US women responding to the RLMS and 35% of NIS participants reported they were still breastfeeding any amount six months after childbirth.[10] The 2002 NIS, which allows water in its definition of exclusive breastfeeding, found that only 13.3% of women were exclusively breastfeeding at six months. Among WIC participants, 2002 NIS data show that only 26.4% were giving some breast milk at six months postpartum, and only 9.7% were exclusively breastfeeding at six months.[11]

North Carolina breastfeeding initiation and duration rates are lower than national rates, both for women overall and among WIC participants. The 2002 RLMS showed that almost 67% of all women in North Carolina initiated breastfeeding, with about 29% continuing to breastfeed at six months postpartum.[10] The prevalence of breastfeeding among

NC WIC participants in 2002 was lower: approximately 53% of WIC mothers initiated breastfeeding, and about 21% were still exclusively breastfeeding at six months. Studies have shown that maternal demographic characteristics (race/ethnicity, age, education), and behavioral characteristics (smoking, alcohol use, timing of prenatal care entry) are associated with infant and young child feeding practices. In addition, infant characteristics (birth weight, gestational age, sex) and delivery characteristics (mode of childbirth, birth attendant) have been associated with mode and duration of infant and young child feeding.[11, 13-17]

Many studies have confirmed the associations of many individual-level variables and breastfeeding, and innumerable interventions have been implemented that target these variables. Nevertheless, *Healthy People 2010* goals are not being met in most of the US, especially in southern states such as North Carolina, and among WIC participants. Guided by social ecological theory, we sought to examine the influence of multiple levels of variables on breastfeeding. As applied to this study, social ecological theory posits that there are multiple levels of influence on women's infant and young child feeding decisions and practices. These individual, intrapersonal, community, organizational, and contextual variables act directly and interact to influence women's feeding decisions and behaviors.[18] Thus, it is important to explore influences beyond those at the individual level in order to better understand the determinants of breastfeeding.

The goal of this study is to examine patterns and micro- and macro-level correlates of breastfeeding initiation and early introduction of HMS among a population of southeastern WIC clients from 1996 through 2002. The research questions addressed in this study are: (1) What is the percentage of NC WIC clients who initiated breastfeeding annually from 1996 through 2002? (2) From 1996 to 2002, do initiation rates vary according to maternal, infant,

delivery, or county characteristics? (3) Of those NC WIC clients who initiate breastfeeding, what percentage also introduce HMS within the first week postpartum? (4) From 1996 to 2002, does early introduction of HMS vary according to maternal, infant, delivery, or county characteristics?

Methods

Data Sources

To obtain individual, delivery, and feeding practices information, we used data from the 1996 through 2002 North Carolina Pregnancy Nutrition Surveillance System (PNSS) datasets. Data included in PNSS come from WIC and Title V Maternal and Child Health programs, and state participation in PNSS is voluntary. During the prenatal WIC clinic visit, demographic and maternal health and behavioral data are collected. At the postpartum WIC clinic visit, which usually occurs at approximately six weeks postpartum, breastfeeding initiation data are obtained, as are infant health data describing the birth outcome. Each woman contributes one record representing one pregnancy. The PNSS record includes the prenatal and postpartum data collected in the clinics, which is aggregated at the state level and submitted to the Centers for Disease Control and Prevention (CDC) on a quarterly basis. The CDC uses state data to generate an annual report based on births for each calendar year (January 1 through December 31).

County data were obtained from a combination of sources, including the North Carolina Health Professions Data System (HPDS) and the Log Into North Carolina (LINC) website. The HPDS contains information about types and numbers of healthcare providers located throughout North Carolina and was designed by the Cecil B. Sheps Center for Health

Services Research at the University of North Carolina at Chapel Hill. The LINC website (http://linc.state.nc.us/) provides an interactive data retrieval system where one can obtain historical information at the state, county, or municipality level on over 900 health, demographic, economic, and other items of interest. Both the HPDS and LINC have compiled data from many different sources, such as the US Census, the US Department of Commerce, the NC Department of Health and Human Services, and other agencies.

Data were available for 44,438 mothers in 1996, 46,550 mothers in 1999, and 49,208 mothers in 2002. Data on breastfeeding initiation were missing on 261 (1996), 253 (1999), and 414 (2002) mothers, leaving effective sample sizes of 44,177 in 1996, 46,297 in 1999, and 48,784 in 2002. The project was approved by the University of North Carolina School of Public Health Institutional Review Board.

Variable Construction

Outcome Variables. The first outcome of interest for this study was *breastfeeding initiation*. Initiation of breastfeeding was based on women's self-report of whether they gave their infant any amount of breast milk after birth and is a dichotomous variable (0=did not breastfeed; 1=breastfed). The second outcome variable of interest is *early introduction of human milk substitute* among women who initiated breastfeeding, which is based on mothers' self report of providing their infant with HMS in the first week postpartum. This measure is scored 0 if no HMS was given in the first week and 1 if the child received HMS in the first week postpartum. The PNSS does not contain information about introduction of other liquids or solids except HMS.

Explanatory Variables. Time is included in all analyses, as described below. Additional variables are classified as being individual-level (maternal, infant, and delivery characteristics) or county-level (primary care providers per capita, percent of county population below poverty, metropolitan status).

Time. *Year* reflects the calendar year (January 1 through December 31) in which the child was born and in which data were collected. To determine annual percentages of breastfeeding initiation and the introduction of HMS within one week postpartum, each year of data (1996 through 2002) as evaluated separately. For all other analyses, the datasets from 1996, 1999, and 2002 were combined and *year* was used as a categorical variable (1996, 1999, 2002).

Maternal Variables. *Maternal race/ethnicity* is a constructed variable combining mother's race and ethnicity. Dummy variables were created for non-Hispanic white (referent), non-Hispanic black, Hispanic, and Other race/ethnicity. *Maternal nativity* is a dichotomous variable indicating whether a mother was born in (referent) or outside the US *Maternal age* reflects mother's age in years at the time her child was born. To compare our findings with those of other national studies, we used a dichotomous variable with women age 30 or older as the referent. *Maternal education* is also a dichotomous variable, with women who had at least some college education compared with women who had a high school diploma or less education as the reference group. *Maternal tobacco use* is a dichotomous variable reflecting whether a woman smoked during pregnancy, with mothers who did not smoke during pregnancy as the referent. *Maternal alcohol use* is a dichotomous variable representing whether a woman did or did not (referent) consume alcohol during pregnancy. *Entry into prenatal care* is a dichotomous variable comparing women who began

prenatal care within the first trimester to a reference group of those who began prenatal care later in pregnancy or had no care. The dichotomous variable *short pregnancy interval* compares women who had less than one year between their last live birth and conception of the current child to a referent group including primiparas and women with longer interpregnancy intervals. *Primiparity* compares women having their first child to those with previous children (referent).

Infant Variables. *Preterm* is a dichotomous variable reflecting whether a baby was born before or after (referent) 37 completed weeks gestation. *Low birth weight* is a dichotomous variable indicating whether the child's weight at birth was <2500 grams (low birth weight) or ≥2500 grams (normal birth weight, referent). *Infant sex* is a dichotomous variable, with males as the reference group. *Multiple birth* is a dichotomous variable indicating whether the birth resulted in twins or higher order births or was a singleton birth (referent).

Delivery Characteristics. *Cesarean section* is a dichotomous variable indicating whether the birth was by Cesarean section or was by vaginal delivery (referent). *Midwife* is a dichotomous variable indicating whether a midwife or other attendant (physician or doctor of osteopathy, referent) attended the birth.

County Variables. *Number of primary care providers per 10,000 population* was made into a dichotomous variable indicating whether a county had a high (>75th percentile, or >9.32 primary care providers per 10,000 county population) number of primary care providers or not (referent). Primary care providers include physicians, physician assistants, nurse practitioners, and certified nurse midwives. This variable is being used as proxy measure of each county's ability to provide women with access to healthcare, particularly by

those providers most likely to be needed during prenatal and postpartum periods. *Percentage of persons below poverty* reflects the percentage of persons in each county whose incomes fall below the federal poverty level. Poverty data were available for each year except 1996, for which we used an average of the 1995 and 1997 poverty values. This variable is dichotomous and indicates whether a county had a high (>75th percentile, or >15.5%) percentage of its population living below the federal poverty level or not (referent). The poverty variable is being used as an indicator of the general financial state of a county and its residents, with the rationale that counties with a higher percentage of persons living below the federal poverty level have fewer economic resources available to devote toward breastfeeding support. *Metropolitan status* delineates whether each county is designated as being metropolitan or non-metropolitan (referent) as defined by the 1990 US Census.

Analysis Plan

Stata version 8.0 statistical software was used for all analyses.[19] Univariate analyses and bivariate analyses of each predictor variable and breastfeeding initiation or early HMS introduction were conducted to obtain details about the sample and women's feeding practices in 1996, 1999, and 2002. To determine predictors of breastfeeding initiation and early HMS introduction, multiple logistic regression was used, combining data from 1996, 1999, and 2002, and clustering on county of residence to account for potential intraclass correlation among women living in the same county. Variables significantly associated with breastfeeding initiation in bivariate analyses in any year (1996, 1999, or 2002) were included in the initial logistic regression model. To determine whether county level variables contributed to the prediction of each outcome above and beyond maternal, infant, and

delivery variables, a model omitting county level variables was fit. All significant variables were retained in a subsequent logistic regression to which county variables were added. A test was then conducted to assess whether the addition of county variables contributed significantly to the previous model. Chi-square tests were conducted to assess whether the proportions of women initiating breastfeeding or introducing HMS within the first week postpartum changed significantly from 1996 to 2002. A significance level criterion of 0.05 was used in all tests.

Sample Characteristics

Maternal, infant, delivery, and county characteristics of NC WIC clients with children born in calendar years 1996, 1999, and 2002 are shown in Table 1. Most characteristics remained fairly stable from 1996 through 2002, with the exceptions of the percentage of NC WIC participants who were Hispanic (7% in 1996, 18% in 2002) and the percentage of WIC clients born outside the US (9% in 1996, 20% in 2002).

The largest group of NC WIC clients were non-Hispanic white, followed by non-Hispanic blacks. Most NC WIC clients were born in the US, were younger than 30 years, and had no education beyond high school. About one in five women reported smoking at some point during pregnancy, but only one percent reported consuming any alcohol while pregnant. Most women (~75%) began prenatal care during the first trimester of pregnancy. More than half the sample were multiparous, and about 12% of these women had interpregnancy intervals of less than one year.

Twins and higher order multiples comprised only 3% of births among NC WIC clients. The prevalence of low birth weight (9%) and preterm birth (11%) remained stable

between 1996 and 2002. Males made up about half of all births. Approximately one quarter of births to NC WIC clients were by Cesarean section, and about 10 percent of births were attended by midwives.

One fifth of NC clients lived in counties with high ratios of primary care providers, and almost 25% were from counties with high percentages of their populations living below the federal poverty level. More than one-third of the sample lived in counties designated as non-metropolitan.

Outcome 1: Breastfeeding Initiation

The prevalence of breastfeeding initiation among NC WIC participants overall increased from 42 percent in 1996 to 55 percent in 2002 (Table 1), with initiation practices varying by maternal race/ethnicity (Figure 1). African American mothers had the lowest prevalence of breastfeeding initiation among all races/ethnicities each study year. Of note, however, is that the prevalence of breastfeeding initiation among African American mothers increased by 45% from 1996 to 2002, compared with increases of 12% among non-Hispanic white mothers, 18% among Latinas, and 15% among mothers of other ethnicities.

As shown in Table 2, most of the maternal, infant, delivery, and county characteristics selected for analysis were associated with breastfeeding initiation in bivariate analyses. Patterns of association were generally similar across years; thus, text presentation of results is limited to 2002 except in cases where findings varied over time. Latina mothers were much more likely than non-Hispanic white mothers to initiate breastfeeding (OR=4.74, 95% confidence interval [CI]: 4.44, 5.06), while non-Hispanic black mothers (OR=0.60, 95% CI: 0.57, 0.62) and mothers of other ethnicities (OR=0.74, 95% CI: 0.68, 0.82) were less

likely to initiate breastfeeding. Maternal nativity was highly associated with breastfeeding initiation, with mothers who were born in the US being far less likely to initiate breastfeeding (OR=0.17, 95% CI: 0.16, 0.18). Age was also associated with breastfeeding initiation, with mothers who were at least 30 years old more likely than younger mothers to breastfeed (OR=1.33, 95% CI: 1.25, 1.43). Mothers who had some college education were more likely to breastfeed than mothers who a high school diploma or less education (OR=1.79, 95% CI: 1.71, 1.87).

Primiparity was associated with breastfeeding. Women who had no previous children were more likely to breastfeed (OR=1.19, 95% CI: 1.15, 1.23). Women who had short interpregnancy intervals, however, were less likely to initiate breastfeeding (OR=0.79, 95% CI: 0.75, 0.84).

Maternal behaviors also were associated with breastfeeding initiation. Mothers who reported smoking during pregnancy were about half as likely to breastfeed (OR=0.51, 95% CI: 0.49, 0.54), as were mothers reporting alcohol use during pregnancy (OR=0.58, 95% CI: 0.46, 0.73). The odds of initiating breastfeeding were about one-third higher among women who began prenatal care within the first trimester of pregnancy (OR=1.32, 95% CI: 1.27, 1.38) compared with mothers who began prenatal care during or after the fourth month of pregnancy or who received no prenatal care.

In 2002, the only infant characteristic significantly associated with breastfeeding initiation was low birth weight, although the association, which was negative, was fairly weak. Infants who were low birth weight were less likely to be breastfed compared with normal birth weight infants (OR=0.91, 95% CI: 0.85, 0.97). Multiple birth, preterm status, and infant sex were not significantly associated with breastfeeding initiation.

Delivery characteristics were weakly associated with breastfeeding initiation. Women who gave birth by Cesarean section were less likely (OR=0.93, 95% CI: 0.89, 0.97) to breastfeed than mothers who had vaginal births. In 2002, having a midwife instead of a physician as a birth attendant was associated with slightly lower odds of breastfeeding initiation (OR=0.92, 95% CI: 0.87, 0.97), although in 1996, having a midwife-attended birth was associated with higher odds of initiating breastfeeding (OR=1.09, 95% CI: 1.02, 1.17).

County characteristics also were associated with breastfeeding initiation. Women who lived in counties with high ratios of primary care providers were more likely to initiate breastfeeding (OR=1.49, 95% CI: 1.03, 2.16). In contrast, women living in counties with high percentages of the population living below the federal poverty level were much less likely to initiate breastfeeding (OR=0.52, 95% CI: 0.41, 0.66) compared with women living in counties with lower percentages of poverty. Living in a metropolitan county also was associated with higher odds of breastfeeding (OR=1.52, 95% CI: 1.17, 1.97) than living in a rural county.

Table 3 shows the results of multiple logistic regression analyses. Infant sex was excluded from the initial model because it was not significantly associated with breastfeeding initiation in bivariate analyses in any analysis year. In the initial multiple logistic regression model, alcohol use, short interpregnancy interval, multiple birth, and midwife birth attendant were not significant (results not shown), and were excluded from subsequent models. Results are presented before and after inclusion of county variables. Inclusion of county variables had little effect on estimates in terms of magnitude, direction, and significance. The county variable representing metropolitan status was not significant, however, and was dropped, producing the final adjusted model for breastfeeding initiation shown in table 3.

County-level variables did contribute significantly to prediction of breastfeeding (Wald X^2 (2)=51.79, P<0.001).

Outcome 2: Introduction of Human Milk Substitute within the First Week Postpartum Among Women Who Initiated Breastfeeding

Bivariate associations between all variables and early HMS introduction are presented in Table 4. (Unless otherwise noted, text discussion of results is limited to 2002.) As depicted in Figure 2, the prevalence of early introduction of HMS was high in 1996 and increased from 1996 to 2002, with differences evident by race/ethnicity. In 2002, introduction of HMS within the first week postpartum ranged from approximately 58% among non-Hispanic white mothers to 78% among Latina mothers. The magnitude of differences in early HMS introduction between Latinas and non-Hispanic whites increased dramatically between 1996 and 2002. The odds of Latinas introducing HMS early were 1.73 times the odds of non-Hispanic whites in 1996, while in 2002, the odds of early HMS introduction by Latinas was 2.59 times the odds of non-Hispanic whites. Women who were US-born were less likely than foreign-born mothers to give their infants HMS in the first week postpartum (OR=0.52, 95% CI: 0.49, 0.55). her variables showed strong associations with early HMS introduction. Mothers who had completed some college, who began prenatal care in the first trimester, and who did not smoke during pregnancy were less likely to introduce HMS within the first week postpartum compared with their counterparts. Neither maternal age nor alcohol use in pregnancy was associated with early HMS introduction.

The association of infant characteristics and early HMS introduction weakened somewhat over time. Women who had twin or higher order births had 2.1 times the odds of giving their children HMS within the first week in 1996, and 1.5 times the odds (compared with mothers of singletons) in 2002. Women whose babies were low birth weight, as well as those whose babies were preterm, were slightly more likely to begin using HMS early in 1996, but over time, this association decreased and was not significant. Sex of the infant was not associated with early HMS introduction.

Characteristics related to delivery also were associated with early HMS introduction. Women who gave birth by Cesarean section were slightly more likely to introduce HMS early compared with women who had vaginal births (OR=1.12, 95% CI: 1.06, 1.19). North Carolina WIC clients who had a midwife as a birth attendant were less likely to give their children HMS within the first week postpartum compared with those women who had a physician as their birth attendant (OR=0.68, 95% CI: 0.63, 0.74).

Women living in counties with high primary care provider to population ratios were less likely to introduce HMS early (OR=0.70, 95% CI: 0.45, 1.08), although the relationship in 2002 was not statistically significant. Women who resided in counties with high percentages of the population living in poverty were more likely to give their infants HMS within one week of birth, although the association was not statistically significant in any analysis year. Metropolitan status of the county was not associated with early HMS introduction.

Table 5 shows the results of multiple logistic regression analyses, all of which included "year." The first multiple logistic regression model included all maternal, infant, and delivery characteristics that were significant in bivariate analyses in any year (1996,

1999, or 2002). Maternal age, primiparity, smoking during pregnancy, short interpregnancy interval, low birth weight, and preterm status were not significant in this regression, and were excluded from subsequent models (results not shown). Model 1 results show that the odds of early HMS introduction increased significantly from 1996 to 2002 among NC WIC clients. Additionally, the remaining maternal, infant, and delivery characteristics retained their significant associations with early HMS introduction.

Although the county variables related to poverty and metropolitan status were not significantly associated with breastfeeding initiation in bivariate analyses, they were included in the multiple logistic regression, along with the county primary care provider ratio variable, to test their influence on the model. All three county variables were added to Model 1, and another multiple logistic regression was conducted. Metropolitan status was not statistically significant and was dropped.

Adding county variables to the model did not change the direction nor strongly alter the magnitude of the associations of previous variables and early HMS introduction with one exception. The association with early HMS introduction became non-significant for mothers in the Other Race category (OR=1.33, 95% CI: 0.99, 1.79).

County variables related to primary care provider ratios and poverty were significantly associated with early HMS introduction after controlling for maternal, infant, and delivery characteristics. Women who lived in counties with high primary care provider ratios were less likely to introduce HMS in the first week postpartum (OR=0.67, 95% CI: 0.50, 0.90). However, women living in counties with high proportions of the population living below the poverty level were more likely to engage in early HMS introduction (OR=1.27, 95% CI: 1.03, 1.58). The addition of county variables contributed significantly to

the prediction of early HMS introduction beyond the inclusion of time (year), maternal, infant, and delivery variables (Wald X^2 [2]=10.90, P<0.005).

Discussion

This study is unique in two important ways. First, guided by social ecological theory, we examined some potential macro-level influences on feeding practices by including county variables in our models. Our findings showed these variables were significantly associated with and improved our ability to predict breastfeeding initiation and early HMS introduction among NC WIC clients. Second, we examined patterns of *early* HMS introduction, looking at the first week postpartum, which has not traditionally been explored. Our study indicates early introduction of HMS is very common among NC WIC clients and has increased over time. This warrants exploration in future research, not only among low-income women in NC, but in other populations as well.

Our study shows that infant feeding practices among NC WIC clients from 1996 through 2002 remain suboptimal. The prevalence of breastfeeding initiation increased over time, but so did the prevalence of introduction of HMS within the first week postpartum, especially among Latina and non-Hispanic black mothers. Thus, the actual amount of human milk that WIC infants are receiving may be minimal. It may be that women are initiating breastfeeding out of curiosity, but are not fully committed to continuing beyond their hospital stay, or are unsure of how to maintain breastfeeding. This is an area that requires further study, and which may provide an opportunity for intervening to provide such women with additional postpartum breastfeeding support.

With regard to associations between breastfeeding initiation and most individual-level variables, the results of our study were similar to those of other national studies.[10-13] We were surprised, however, that having a midwife as a birth attendant was not associated with breastfeeding initiation (Table 2). It may be that for some or many of the midwife-attended births in our study, midwives had very limited interaction with women in the hospital and possibly none prenatally, which would lessen their ability to educate about, encourage, and assist with breastfeeding. The variable only reflects the attendant who was present at the birth; we have no other information about interactions between midwives and WIC clients in the dataset. Women who had midwives as birth attendants were less likely to introduce HMS in the first week postpartum, which may be due to support midwives are providing after women leave the hospital. The influence of midwives as birth attendants is something that merits further exploration in future studies.

In addition to midwife birth attendants, other individual variables and county variables were associated with early HMS introduction among NC WIC clients. Latinas, who had the highest prevalence of breastfeeding initiation, also have very high prevalence and increased odds of early HMS introduction compared with non-Hispanic white mothers, even after controlling for maternal nativity. This finding could have important implications for WIC staff and health care providers who may presume that because Latinas and mothers who are born outside the US typically initiate breastfeeding, they are not in need of support or additional information about the importance of exclusive breastfeeding for six months. Our study shows that low-income women, regardless of ethnicity or nativity, need education and support to exclusively breastfeed for six months.

Other women who should be targeted for education and support to delay introduction of HMS are those who have no education beyond high school, who smoke during pregnancy, who start prenatal care after the first trimester or have no prenatal care, who have twins or higher order births, and those who have Cesarean sections. Since these characteristics are similar to those associated with decreased odds of initiating breastfeeding, it may be effective and efficient to include discussions of exclusive breastfeeding when promoting breastfeeding initiation to women who have these characteristics or experiences.

As with breastfeeding initiation, macro-level county variables were associated with early HMS introduction. Living in a county with a high primary care provider ratio may enable additional provision of information and support for exclusive breastfeeding that women in counties with lower ratios are unable to obtain. The positive association between early HMS introduction and living in counties with a high percentage of the population living below the federal poverty level may reflect the inability of these poorer counties to devote resources toward breastfeeding support. In contrast to previous studies about the relationship between metropolitan status and breastfeeding in general, we found no association with breastfeeding initiation nor early HMS introduction. Perhaps part of what was captured by metropolitan status was reflected in our other county variables. Or, it could be that "metropolitan" status isn't as meaningful in a state such as North Carolina, in which cities tend to be fairly small. Future studies may want to consider including county-level variables other than metropolitan status to confirm our findings.

Breastfeeding promotion is mandated to be part of the services WIC clinics provide to women and families, and though the prevalence of breastfeeding initiation has increased, it is not clear why improvement is not occurring more rapidly, and, conversely, why rates of early

HMS introduction are so high among NC WIC clients. It is possible that part of the problem is that WIC sends mixed messages to pregnant women and mothers by providing vouchers for HMS, thereby seemingly endorsing it as an acceptable form of nutrition.[12, 20] Our study suggests that it is important for WIC not only to promote breastfeeding, but to inform clients of the importance of 6 months of exclusive breastfeeding, taking care to define that exclusive breastfeeding means giving no other liquids or foods except human milk.

Sole responsibility for suboptimal breastfeeding practices does not lie with WIC, however. Our study points toward other areas and levels of influence on infant feeding, such as health care providers, both prenatally and postpartum. Women who began prenatal care in the first trimester and women who lived in counties with high ratios of primary care providers were more likely to initiate breastfeeding and were less likely to introduce HMS in the first week postpartum. These complementary variables may be areas that can be targeted for improvement. First, outreach efforts may be employed to increase efforts to bring low-income women to prenatal care early. Prenatal care providers, regardless of the trimester in which they see patients, have the opportunity to inform and/or remind women about the importance of exclusive, continued breastfeeding, and to give women information about sources of postpartum breastfeeding support such as mother-to-mother groups or peer counselors. Second, efforts could be developed to increase county primary care provider ratios. Incentives such as payment toward school loans might be offered to entice recent medical school graduates to consider working in counties with low primary care provider ratios. It might also be possible to offer additional breastfeeding training and education to providers currently located in counties with low ratios of providers.

This study has some limitations. Since the samples in PNSS are limited to WIC participants in North Carolina, we cannot generalize the findings to women of all incomes. However, because low-income status, WIC participation, and residing in the southeastern United States are all factors strongly associated with being unlikely to breastfeed,[10, 21, 22] the findings of the study will be important in helping design strategies to improve child feeding practices among NC WIC clients, arguably among those most in need of effective breastfeeding support. Though we did not have data about each woman's income, we know by virtue of her participation in WIC that she must meet certain low-income criteria. We also used county-level poverty information to further delineate the multiple levels of potential effects "low-income" can have on breastfeeding. Additionally, no data were available regarding women's employment or type of occupation, so we were not able to explore the potential effects of these important aspects of women's lives. Although we could not explore each level of the social ecological model, we were able to include measures of potential county level effects on breastfeeding and early HMS introduction. This adds to our understanding of the multiple levels of influence on women's infant feeding practices.

There are several strengths of our study. First, we used a social ecological approach to guide our analyses, going beyond traditional approaches to studying breastfeeding that usually focus only on the influence of individual level factors, and adding exploration of the influence of county-level factors. The social ecological approach is important because, as this study and other literature shows, women's infant feeding decisions and practices are influenced by factors beyond those considered to be solely within the individual level.[18] In addition, some characteristics are not changeable (e.g., demographic characteristics like race / ethnicity and nativity) or questions remain about the feasibility of intervening on many

variables that are considered "individual level" variables. Innumerable interventions that are specifically focused on individual-level variables have been conducted, and while some progress has been made in improving breastfeeding initiation rates, many states and populations are still not meeting *Healthy People 2010* goals. Examining individual-level characteristics associated with low breastfeeding rates may help determine which groups or subgroups of people require more assistance with breastfeeding, and is a strategy that has been used for many years, but racial and ethnic disparities in breastfeeding initiation rates persist, pointing to a need to consider other levels of intervention and how they interact with individual characteristics.

Although the numerous maternal and child health risks of not breastfeeding are well known, many women in the United States do not breastfeed or provide their children with human milk. Women who do initiate breastfeeding in the US are unlikely to meet the recommendation to breastfeed exclusively for six months. Moreover, women with low incomes, especially those who participate in WIC and live in the southeastern US, are among those least likely to initiate and continue breastfeeding, and to exclusively breastfeed for six months. In light of the maternal and child health advantages of breastfeeding, the Surgeon General has included in *Healthy People 2010* specific objectives that call for efforts to increase both initiation and duration of breastfeeding.[9, 23] It is significant to note here that in light of the studies showing the importance of exclusive breastfeeding for the first six months of life, exclusivity is not even a target at this time.

Our study has identified two macro-level variables, primary care provider ratio and percentage of county population living below the federal poverty level, that are related to breastfeeding initiation and early introduction of HMS, and points to the importance of

moving beyond individual-level variables when considering influences on infant and young child feeding practices. Including macro-level variables in future breastfeeding research and interventions may help improve breastfeeding practices and maternal and child health among US families, including WIC clients, who may be among those most susceptible to ill health.

Our study has programmatic and policy implications as well. While strides have been made toward improving initiation of breastfeeding, such high prevalence of early HMS introduction suggests that women may be initiating breastfeeding in the hospital as a means of placating providers whom they may feel are "pushing" them to do so, and that they are not truly committed to breastfeeding. Alternatively, women may be committed to breastfeeding, but may lack the support in the hospital, at home, and at work to continue exclusively breastfeeding for six months. Implementation of the Ten Steps to Successful Breastfeeding in North Carolina hospitals, part of the criteria for being designated "Baby-Friendly," may be one step toward ensuring hospital practices are supportive of breastfeeding.[24]

Legislation may be another way to improve breastfeeding practices in North Carolina, particularly among low-income women. Low-income women may have jobs that are not conducive to taking routine breaks or which do not have places other than restrooms in which women can express their milk.[25] These challenges could discourage low-income women from initiating breastfeeding because they may believe it would not be possible to continue breastfeeding once they return to work. Policies protecting employed women could be one way to improve initiation, exclusivity, and duration of breastfeeding.

Conclusion

Disparities in breastfeeding practices are evident and persistent in the U.S. This study highlights the importance of considering the multiple levels of influence, such as county

characteristics, on women's infant feeding decisions and practices. Further research is needed to identify additional macro-level variables associated with breastfeeding, especially among low-income women, and to understand the mechanisms by which such variables influence infant feeding. Since reduced health risks are associated with human milk in a dose-response manner, it is important to identify factors that are amenable to intervention, particularly among low-income families, who are most vulnerable to poor health and infant mortality.

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Table 2.1. Maternal, infant, delivery, and county characteristics of NC WIC clients in 1996, 1999, and 2002.

	1996 N=44438		1999 N=46550		2002 N=49208	
	n	(%)	n	(%)	n	(%)
Initiated Breastfeeding						
Yes	18666	(42)	23151	(50)	26965	(55)
No	25511	(57)	23146	(50)	21829	(45)
Missing	261		253		414	
Maternal Characteristics						
Race/Ethnicity						
NH White	22472	(50)	21944	(47)	21339	(43)
NH Black	17426	(39)	17587	(38)	17387	(35)
Hispanic	2944	(7)	5230	(11)	8625	(18)
Other	1596	(4)	1789	(4)	1857	(4)
Missing	0		0		0	
Born in US						
Yes	40632	(91)	40380	(87)	39484	(80)
No	3806	(9)	6086	(13)	9626	(20)
Missing	0		84		98	
Maternal Age, *y*						
<30	37601	(85)	39268	(84)	40736	(83)
≥30	6837	(15)	7280	(16)	8471	(17)
Missing	0		2		1	
Maternal Education						
≤ HS	34109	(77)	35729	(77)	37573	(76)
> HS	10252	(23)	10699	(23)	11544	(24)
Missing	77		122		91	
Smoked during Pregnancy						
Yes	9709	(22)	9574	(21)	9484	(19)
No	34693	(78)	36898	(79)	39634	(81)
Missing	36		78		90	
Alcohol Use during Pregnancy						
Yes	520	(1)	334	(1)	311	(1)
No	43871	(99)	46135	(99)	48801	(99)
Missing	47		81		96	
Prenatal Care Initiated in First Trimester						
Yes	33748	(76)	36155	(78)	37690	(77)
No	10431	(24)	10012	(22)	11084	(23)
Missing	259		383		434	
Primiparous						
Yes	19988	(45)	19977	(43)	20310	(41)
No	24445	(55)	26554	(57)	28886	(59)
Missing	5		19		12	
Short Pregnancy Interval						
Yes	5211	(12)	5465	(12)	6079	(13)
No	39069	(88)	40886	(88)	42912	(87)
Missing	158		199		217	

Table 2.1 (continued)

Child Characteristics						
Multiple Birth						
Yes	1216	(3)	1326	(3)	1443	(3)
No	43222	(97)	45224	(97)	47765	(97)
Missing	0		0		0	
Low birth weight						
Yes	3898	(9)	4052	(9)	4198	(9)
No	40231	(91)	42008	(91)	44403	(91)
Missing	309		490		607	
Preterm						
Yes	4973	(11)	5300	(11)	5631	(11)
No	39359	(89)	41213	(89)	43541	(89)
Missing	106		37		36	
Sex						
Male	22641	(51)	23713	(51)	25059	(51)
Female	21796	(49)	22837	(49)	24148	(49)
Missing	1		0		1	
Delivery Characteristics						
Cesarean Section						
Yes	8914	(20)	10042	(22)	12397	(25)
No	35524	(80)	36508	(78)	26811	(75)
Missing	0		0		0	
Midwife Birth Attendant						
Yes	3282	(7)	4489	(10)	5121	(10)
No	41156	(93)	42060	(90)	44087	(90)
Missing	0		1		0	
County Characteristics						
Primary Care Provider to Population Ratio						
Low/Medium	35500	(80)	36588	(79)	38089	(77)
High	8938	(20)	9962	(21)	11119	(23)
Percent Population Below Poverty						
Low/Medium	33894	(76)	37159	(80)	38073	(77)
High	10544	(24)	9391	(20)	11135	(23)
Metropolitan Status						
Metropolitan	27265	(61)	29192	(63)	31567	(64)
Non-metropolitan	17173	(39)	17358	(37)	17641	(36)

Table 2.2. Bivariate Associations between maternal, infant, delivery, and county characteristics and breastfeeding initiation among NC WIC clients who initiated breastfeeding in 1996, 1999, and 2002.

	1996 *n*=18,666				1999 *n*=23,151				2002 *n*=26,965			
	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)
Maternal Characteristics												
Race/Ethnicity												
NH White	10867	(49)	Referent		11684	(54)	Referent		11602	(55)	Referent	
NH Black	5020	(29)	0.43	(0.41, 0.45)	6446	(37)	0.51	(0.49, 0.53)	7195	(42)	0.60	(0.57, 0.62)
Hispanic	2119	(72)	2.78	(2.55, 3.02)	4190	(80)	3.56	(3.31, 3.83)	7295	(85)	4.74	(4.44, 5.06)
Other	660	(41)	0.75	(0.67, 0.83)	831	(47)	0.76	(0.69, 0.83)	873	(47)	0.74	(0.68, 0.82)
Born in US												
Yes	15894	(40)	0.27	(0.25, 0.29)	18310	(46)	0.21	(0.20, 0.23)	18866	(48)	0.17	(0.16, 0.18)
No	2682	(71)	Referent		4834	(80)	Referent		8093	(85)	Referent	
Maternal Age, *y*												
<30	15540	(41)	Referent		19246	(49)	Referent		21849	(54)	Referent	
≥30	3226	(47)	1.28	(1.18, 1.40)	3904	(54)	1.20	(1.13, 1.28)	5116	(61)	1.33	(1.25, 1.43)
Maternal Education*			1.12	(1.11, 1.13)			1.05	(1.04, 1.06)			1.00	(0.99, 1.00)
≤ HS	12770	(38)	Referent		16420	(46)	Referent		19380	(52)	Referent	
> HS	5858	(57)	2.23	(2.13, 2.34)	6653	(62)	1.94	(1.85, 2.03)	7531	(66)	1.79	(1.71, 1.87)
Smoked during Pregnancy												
Yes	3371	(35)	0.68	(0.64, 0.71)	3866	(41)	0.62	(0.59, 0.65)	3945	(42)	0.51	(0.49, 0.54)
No	15280	(44)	Referent		19245	(52)	Referent		22981	(58)	Referent	
Alcohol Use during Pregnancy												
Yes	159	(31)	0.60	(0.50, 0.72)	120	(36)	0.57	(0.45, 0.71)	128	(42)	0.58	(0.46, 0.73)
No	18491	(42)	Referent		22990	(50)	Referent		26797	(55)	Referent	
PNC Initiated in First Trimester												
Yes	15090	(45)	1.62	(1.55, 1.70)	18726	(52)	1.46	(1.40, 1.53)	21274	(57)	1.32	(1.27, 1.38)
No	3476	(34)	Referent		4245	(43)	Referent		5469	(50)	Referent	
Primiparous												
Yes	8718	(44)	1.13	(1.09, 1.17)	10386	(52)	1.17	(1.13, 1.22)	11630	(58)	1.19	(1.15, 1.23)
No	9945	(41)	Referent		12754	(48)	Referent		15327	(53)	Referent	
Short Pregnancy Interval												
Yes	2018	(39)	0.86	(0.81, 0.91)	2548	(47)	0.87	(0.82, 0.92)	3030	(50)	0.79	(0.75, 0.84)
No	16587	(43)	Referent		20490	(50)	Referent		23798	(56)	Referent	

Continued on next page

	1996 *n*=18,666				1999 *n*=23,151				2002 *n*=26,965			
	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)
Child Characteristics												
Multiple Birth												
Yes	494	(41)	0.94	(0.84, 1.06)	600	(45)	0.83	(0.74, 0.92)	756	(53)	0.91	(0.82, 1.01)
No	18172	(42)	Referent		22551	(50)	Referent		26209	(55)	Referent	
Low Birthweight												
Yes	1507	(39)	0.86	(0.80, 0.92)	1955	(49)	0.94	(0.88, 1.00)	2204	(53)	0.91	(0.85, 0.97)
No	17030	(43)	Referent		20975	(50)	Referent		24441	(55)	Referent	
Preterm												
Yes	2075	(42)	0.99	(0.93, 1.05)	2536	(48)	0.92	(0.87, 0.97)	3014	(54)	0.95	(0.90, 1.01)
No	16561	(42)	Referent		20606	(50)	Referent		23947	(55)	Referent	
Sex												
Male	9472	(42)	Referent		11735	(50)	Referent		13748	(55)	0.99	(0.96, 1.03)
Female	9194	(42)	1.01	(0.98, 1.05)	11416	(50)	1.02	(0.98, 1.06)	13217	(55)	Referent	
Delivery Characteristics												
Cesarean Section												
Yes	3656	(41)	0.95	(0.90, 0.99)	4833	(48)	0.92	(0.88, 0.96)	6623	(54)	0.93	(0.89, 0.97)
No	15010	(43)	Referent		18318	(50)	Referent		20342	(56)	Referent	
Midwife Birth Attendant												
Yes	1449	(44)	1.09	(1.02, 1.17)	2266	(51)	1.03	(0.96, 1.09)	2729	(53)	0.92	(0.87, 0.97)
No	17217	(42)	Referent		20885	(50)	Referent		24236	(55)	Referent	
County Characteristics												
Primary Care Provider to Population Ratio												
Low/Medium	14444	(41)	Referent		17434	(48)	Referent		20005	(53)	Referent	
High	4222	(47)	1.29	(1.00, 1.67)	5717	(57)	1.46	(1.03, 2.07)	6960	(63)	1.49	(1.03, 2.16)
Percent Population Below Poverty												
Low/Medium	15283	(45)	Referent		19706	(53)	Referent		22218	(59)	Referent	
High	3383	(32)	0.57	(0.45, 0.72)	3445	(37)	0.51	(0.41, 0.63)	4747	(43)	0.52	(0.41, 0.66)
Metropolitan Status												
Metropolitan	12162	(45)	1.32	(1.04, 1.67)	15366	(53)	1.35	(1.06, 1.71)	18435	(59)	1.52	(1.17, 1.97)
Non-metropolitan	6504	(38)	Referent		7815	(45)	Referent		8530	(49)	Referent	

Note: numbers may not sum to N due to missing

Table 2.3. Adjusted odds ratios and 95% confidence intervals for associations between year, individual-level variables, county-level variables, and breastfeeding initiation among NC WIC clients, 1996 through 2002.

	Model 1: Without County Variables		Model 2: With County Variables	
Independent Variables	**OR**	**(95% CI)**	**OR**	**(95% CI)**
Year				
1996	Referent		Referent	
1999	1.30	(1.18, 1.46)	1.29	(1.16, 1.44)
2002	1.48	(1.32, 1.68)	1.48	(1.31, 1.68)
Maternal Characteristics				
Race/Ethnicity				
NH White	Referent		Referent	
NH Black	0.46	(0.40, 0.52)	0.46	(0.41, 0.52)
Hispanic	1.69	(1.42, 2.02)	1.80	(1.54, 2.12)
Other	0.51	(0.37, 0.70)	0.60	(0.46, 0.77)
Born in US				
Yes	0.33	(0.26, 0.42)	0.37	(0.30, 0.46)
No	Referent		Referent	
Maternal Age, y				
<30	Referent		Referent	
≥30	1.17	(1.11, 1.23)	1.16	(1.10, 1.22)
Maternal Education				
≤ HS	Referent		Referent	
> HS	2.20	(2.04, 2.37)	2.16	(2.01, 2.32)
Smoked during Pregnancy				
Yes	0.67	(0.64, 0.71)	0.66	(0.63, 0.69)
No	Referent		Referent	
Prenatal Care Initiated in First Trimester				
Yes	1.41	(1.33, 1.50)	1.38	(1.32, 1.45)
No	Referent		Referent	
Primiparous				
Yes	1.19	(1.15, 1.24)	1.18	(1.14, 1.23)
No	Referent		Referent	
Infant Characteristics				
Low birth weight				
Yes	1.09	(1.03, 1.16)	1.09	(1.03, 1.16)
No	Referent		Referent	
Preterm				
Yes	1.07	(1.02, 1.11)	1.06	(1.03, 1.16)
No	Referent		Referent	
Delivery Characteristics				
Cesarean section				
Yes	0.92	(0.89, 0.96)	0.94	(0.91, 0.98)
No	Referent		Referent	
County Characteristics				
Primary Care Provider to Population Ratio				
Low/Medium			Referent	
High			1.43	(1.12, 1.83)
Percent Population Below Poverty				
Low/Medium			Referent	
High			0.65	(0.55, 0.77)

Table 2.4. Bivariate associations between year, maternal, infant, delivery, county characteristics, and early introduction of human milk substitute among NC WIC clients who initiated breastfeeding in 1996, 1999, and 2002.

	1996 N=18666				1999 N=22856				2002 N=26497			
	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)
Maternal Characteristics												
Race/Ethnicity												
NH White	4865	(45)	Referent		6092	(53)	Referent		6596	(58)	Referent	
NH Black	2865	(58)	1.63	(1.53, 1.75)	4262	(67)	1.81	(1.69, 1.92)	5083	(72)	1.88	(1.77, 2.01)
Hispanic	1238	(59)	1.73	(1.57, 1.90)	2887	(70)	2.05	(1.90, 2.21)	5531	(78)	2.59	(2.42, 2.77)
Other	324	(50)	1.19	(1.01, 1.39)	503	(62)	1.48	(1.28, 1.71)	582	(68)	1.55	(1.34, 1.80)
Born in US												
Yes	7817	(50)	0.79	(0.72, 0.85)	10429	(58)	0.60	(0.56, 0.65)	11773	(63)	0.52	(0.49, 0.55)
No	1475	(56)	Referent		3313	(69)	Referent		6016	(77)	Referent	
Maternal Age												
<30	7734	(51)	Referent		11436	(60)	Referent		14449	(67)	Referent	
≥30	1558	(49)	0.94	(0.87, 1.02)	2307	(60)	1.00	(0.93, 1.07)	3343	(67)	0.98	(0.92, 1.04)
Maternal Education												
≤ HS	6821	(54)	Referent		10166	(63)	Referent		13445	(70)	Referent	
> HS	2454	(43)	0.63	(0.59, 0.67)	3521	(54)	0.69	(0.66, 0.74)	4301	(58)	0.59	(0.56,0.62)
Smoked during Pregnancy												
Yes	1810	(55)	1.22	(1.13, 1.32)	2326	(61)	1.04	(0.96, 1.11)	2623	(67)	0.99	(0.92, 1.07)
No	7473	(50)	Referent		11394	(60)	Referent		15146	(67)	Referent	
Alcohol Use during Pregnancy												
Yes	87	(56)	1.26	(0.92, 1.73)	67	(57)	0.87	(0.60, 1.25)	79	(64)	0.86	(0.59, 1.24)
No	9195	(50)	Referent		13653	(60)	Referent		17689	(67)	Referent	
Prenatal Care Initiated in First Trimester												
Yes	7344	(49)	0.79	(0.73, 0.85)	10903	(59)	0.79	(0.73, 0.84)	13714	(65)	0.69	(0.64, 0.74)
No	1899	(55)	Referent		2714	(65)	Referent		3908	(73)	Referent	

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	1996 N=18666				1999 N=22856				2002 N=26497			
	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)	n	(%)	OR	(95% CI)
Primiparous												
Yes	4261	(50)	Referent		6085	(59)	Referent		7595	(66)	Referent	
No	5030	(51)	0.93	(0.88, 0.99)	7652	(61)	0.94	(0.89, 1.00)	10192	(68)	0.94	(0.89, 0.99)
Short Pregnancy Interval												
Yes	1071	(54)	1.16	(1.06, 1.27)	1581	(63)	1.14	(1.05, 1.24)	2051	(69)	1.09	(1.01, 1.18)
No	8189	(50)	Referent		12089	(60)	Referent		15640	(67)	Referent	
Child Characteristics												
Multiple Birth												
Yes	332	(68)	2.13	(1.76, 2.58)	418	(71)	1.62	(1.35, 1.94)	565	(76)	1.54	(1.30, 1.83)
No	8960	(50)	Referent		13326	(60)	Referent		17227	(67)	Referent	
Low Birthweight												
Yes	831	(56)	1.26	(1.14, 1.40)	1200	(62)	1.10	(1.00, 1.21)	1424	(65)	0.92	(0.84, 1.01)
No	8388	(50)	Referent		12410	(60)	Referent		16158	(67)	Referent	
Preterm												
Yes	1105	(54)	1.17	(1.06, 1.28)	1525	(61)	1.03	(0.95, 1.12)	1981	(67)	0.97	(0.90, 1.05)
No	8172	(50)	Referent		12216	(60)	Referent		15808	(67)	Referent	
Sex												
Male	4722	(51)	Referent		7021	(61)	Referent		9124	(67)	Referent	
Female	4570	(50)	0.99	(0.94, 1.05)	6723	(60)	0.96	(0.91, 1.01)	8668	(67)	0.97	(0.92, 1.02)
Delivery Characteristics												
Cesarean Section												
Yes	1895	(53)	1.11	(1.03, 1.19)	2990	(63)	1.15	(1.08, 1.23)	4508	(69)	1.12	(1.06, 1.19)
No	7397	(50)	Referent		10754	(59)	Referent		13284	(67)	Referent	
Midwife Birth Attendant												
Yes	576	(40)	0.64	(0.57, 0.71)	1169	(52)	0.69	(0.63, 0.75	1585	(59)	0.68	(0.63, 0.74)
No	8716	(51)	Referent		12575	(61)	Referent		16207	(68)	Referent	

Table continued on next page

	1996 N=18666				1999 N=22856				2002 N=26497			
	N	(%)	N	(95% CI)	N	%	OR	(95% CI)I	N	%	OR	(95% CI)
County Characteristics												
Primary Care Provider to Population Ratio												
Low/Medium	7416	(52)	Referent		10723	(62)	Referent		13582	(69)	Referent	
High	1876	(45)	0.76	(0.60, 0.96)	3021	(53)	0.69	(0.53, 0.91)	4210	(61)	0.70	(0.45, 1.08)
Percent Population Below Poverty												
Low/Medium	7435	(49)	Referent		11543	(59)	Referent		14383	(66)	Referent	
High	1857	(56)	1.31	(0.99, 1.74)	2201	(65)	1.27	(0.90, 1.79)	3409	(72)	1.35	(0.98, 1.86)
Metropolitan Status												
Metropolitan	6030	(50)	0.97	(0.76, 1.24)	9217	(61)	1.09	(0.82, 1.45)	12138	(67)	1.00	(0.73, 1.38)
Non-metropolitan	3262	(51)	Referent		4527	(59)	Referent		5654	(67)	Referent	

Note: Totals may not sum to N due to missing

Table 2.5. Adjusted odds ratios and 95% confidence intervals for logistic regressions of associations between year, maternal, infant, delivery, and county characteristics and early introduction of human milk substitute among NC WIC clients.

	Model 1: Without County Variables		Model 2: With County Variables	
	OR	(95% CI)	OR	(95% CI)
Independent variables				
Year				
1996	Referent		Referent	
1999	1.41	(1.26, 1.61)	1.44	(1.28, 1.61)
2002	1.81	(1.53, 2.16)	1.84	(1.56, 2.18)
Maternal Characteristics				
Race/Ethnicity				
NH White	Referent		Referent	
NH Black	1.89	(1.54, 2.33)	1.96	(1.64, 2.33)
Hispanic	1.76	(1.60, 1.95)	1.73	(1.53, 1.95)
Other	1.40	(1.12, 1.76)	1.33	(0.99, 1.79)
Born in US				
Yes	0.79	(0.69, 0.90)	0.75	(0.66, 0.85)
No	Referent		Referent	
Maternal Education				
≤ HS	Referent		Referent	
> HS	0.67	(0.62, 0.72)	0.67	(0.62, 0.73)
Smoked during Pregnancy				
Yes	1.33	(1.25, 1.42)	1.35	(1.27, 1.44)
No	Referent		Referent	
Prenatal Care Initiated in First Trimester				
Yes	0.88	(0.82, 0.95)	0.90	(0.84, 0.97)
No	Referent		Referent	
Child Characteristics				
Multiple birth				
Yes	1.86	(1.60, 2.16)	1.92	(1.64, 2.24)
No	Referent		Referent	
Delivery Characteristics				
Cesarean section				
Yes	1.09	(1.04, 1.15)	1.08	(1.02, 1.14)
No	Referent		Referent	
Midwife birth attendant				
Yes	0.75	(0.66, 0.84)	0.74	(0.64, 0.85)
No	Referent		Referent	
County Characteristics				
Primary Care Provider to Population Ratio				
Low/Medium			Referent	
High			0.67	(0.50, 0.90)
Percent Population Below Poverty				
Low/Medium			Referent	
High			1.27	(1.03, 1.58)

OR=Odds Ratio; 95% CI=95% confidence interval

Figure 2.1. Percentage of North Carolina WIC clients who initiated breastfeeding, by race/ethnicity, 1996 through 2002.

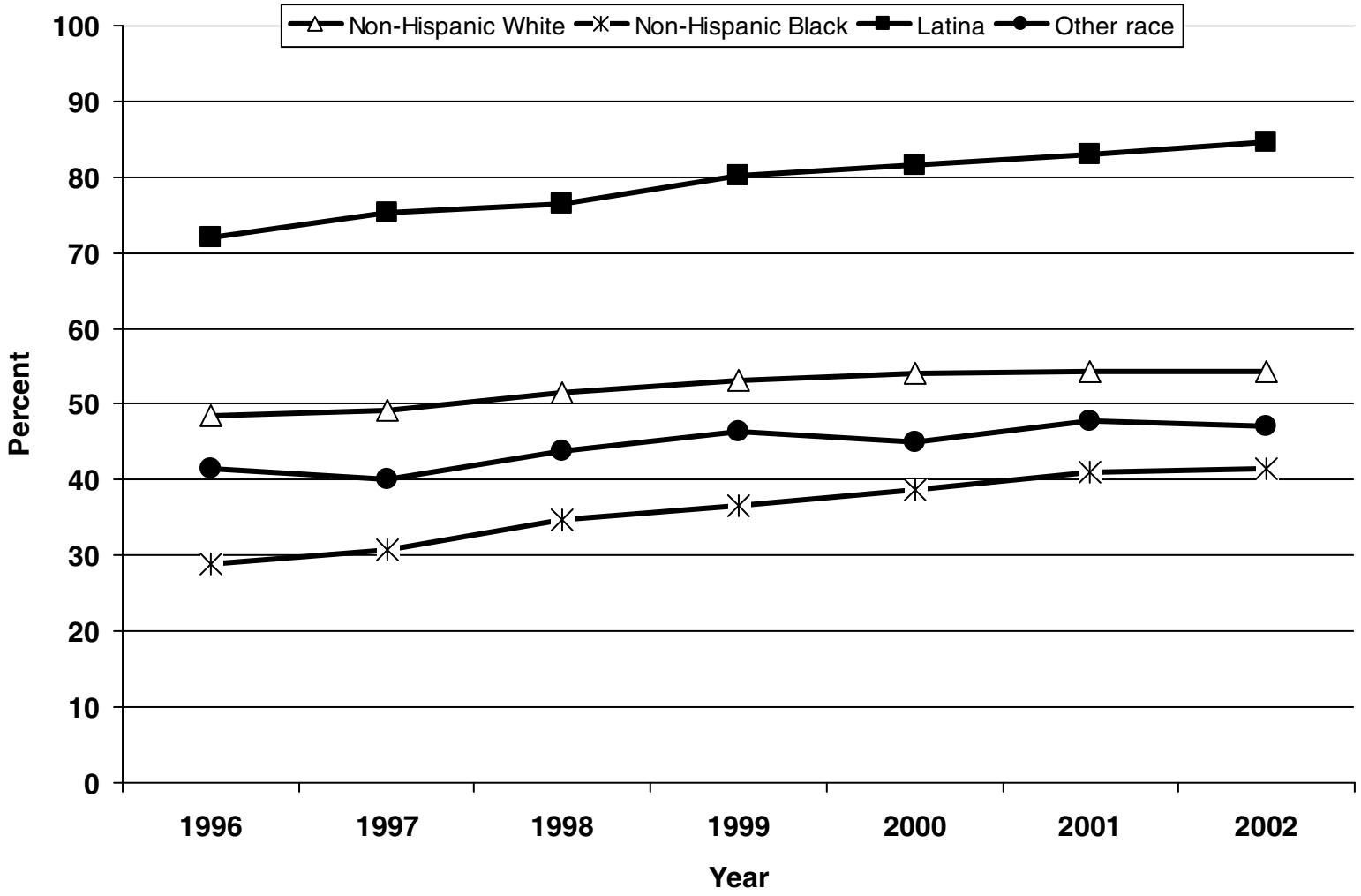
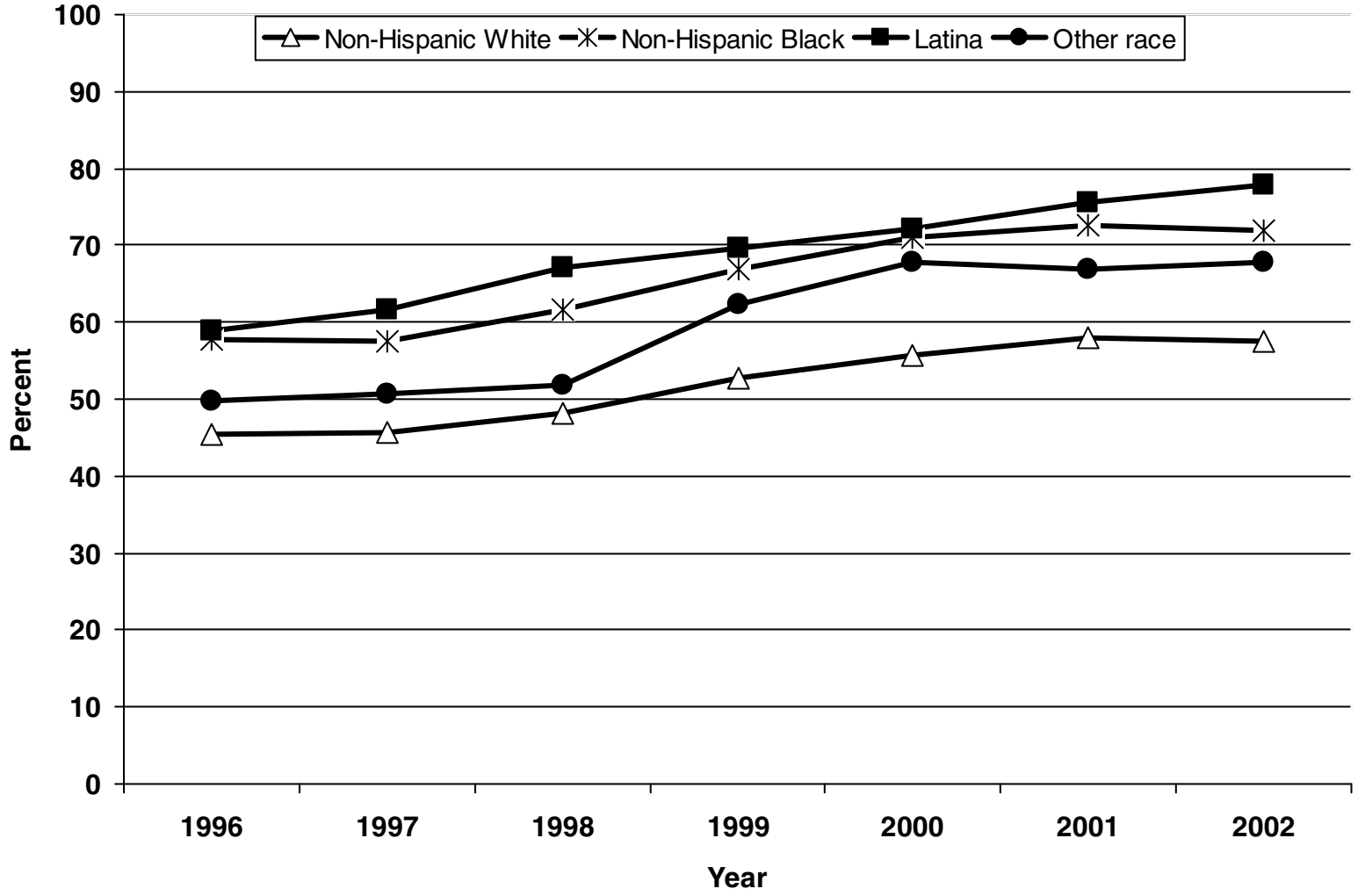


Figure 2.2. Percentage of breastfeeding North Carolina WIC clients who introduced HMS within the first week postpartum, by race/ethnicity, 1996 through 2002.



CHAPTER 3

BREASTFEEDING DURATION AMONG NC WIC CLIENTS: PATTERNS, CORRELATES, AND AN EVALUATION OF AN IN-HOME SUPPORT PROGRAM

Human milk is the ideal form of nutrition for infants for the first six months of life, and it reduces the risk for many illnesses and chronic diseases in both mother and child.[1-6] The United States (US) Public Health Service National Health Objectives for Disease Prevention and Health Promotion for 2010 (*Healthy People 2010*) aim to: (1) increase to 75% the proportion of women who initiate breastfeeding; (2) increase to 50% the proportion of women who continue breastfeeding their babies until six months of age; and (3) increase to 25% the proportion of women who breastfeed their babies until one year of age.[7] Nevertheless, breastfeeding incidence, exclusivity, and duration in the US are well below national goals. In addition, disparities exist in breastfeeding practices. According to national data, the primary demographic factors associated with a decision to breastfeed for a short duration include being non-white, being poor, living in the southeastern United States, completing 12 or fewer years of education, being unmarried, and being younger than age 30[8-12]

Despite *Healthy People 2010* breastfeeding duration goals, findings from the 2002 National Immunization Survey (NIS) indicate that only 35% of US women were breastfeeding at six months postpartum, with 16% continuing for one year. Breastfeeding prevalence among participants in the Special Supplemental Nutrition Program for Women,

Infants and Children (WIC) is even lower. In 2002, only 26% of WIC-enrolled mothers were breastfeeding at six months postpartum, and less than 10% continued breastfeeding at least one year.[8]

Because of the dose-response relationship between intake of human milk and reduced risks for illness, research has been conducted to identify ways to improve breastfeeding practices. Many studies have examined interventions aimed at increasing breastfeeding initiation[13-15], but few have focused specifically on ways to improve breastfeeding duration.[16, 17] Sikorski et al. conducted a systematic Cochrane review of 20 randomized or quasi-randomized trials (n=23,712 mother-infant pairs) involving providing breastfeeding support. Results of the meta-analysis indicated a beneficial effect of postpartum support on breastfeeding duration up to two months postpartum.[18]

Other studies assessing the effects of breastfeeding support have focused on lay health advisors or peer counselors, who are typically volunteers or temporary employees, as opposed to paraprofessional (paid, benefited employees) support personnel. For example, Chapman et al. conducted a prospective, randomized, controlled trial examining the effectiveness of breastfeeding peer counseling with a low-income, predominantly Puerto Rican sample of 165 women in Connecticut. They found that a labor-intensive, multi-modal program using lactation consultant-guided peer counselors had a significant impact on breastfeeding initiation and duration at one and three months postpartum[16]

The North Carolina In-Home Breastfeeding Support Program (IHBSP) was a unique intervention designed to provide comprehensive breastfeeding assistance to low income women in North Carolina. The program included in-home support offered by trained paraprofessionals, with the goal of helping women extend breastfeeding duration. (The

IHBSP focused only on duration, not on improving initiation.) As part of the North Carolina Expanded Food and Nutrition Program (EFNEP), the program included collaboration between the Cooperative Extension Service, North Carolina State University, the local WIC programs, and local hospitals across the state. The IHBSP was implemented in 1991 in Wake County, NC, in response to high rates of breastfeeding cessation within the first two weeks postpartum among WIC participants. At its peak in 2002, the IHBSP was operating in over 35 North Carolina counties. The subsequent year, however, the IHBSP funding was not renewed, and the program virtually dissolved, except in the few counties that were able to identify alternate sources of funding.

The primary objective of the IHBSP was to provide comprehensive breastfeeding education and support to low-income women to help them establish lactation and prolong breastfeeding duration. The program was implemented in other counties that requested it if each program partner (county WIC clinic, local hospital, county health department, county Cooperative Extension Service) agreed to provide financial and/or in-kind support.

An important piece of the IHBSP model was that it hired and extensively trained paraprofessionals, known as Program Assistants, or "PAs," to provide support. Employment criteria included having a high school diploma or GED, having personal breastfeeding experience, and completing the program's training components. PAs were well-paid, and they received health insurance and paid vacation benefits like other university employees. Additionally, they were given program cell phones or pagers so that clients could contact them for help with breastfeeding.

County WIC clinics, health departments, and local hospitals facilitated the pairing of PAs and low-income women who wanted to breastfeed. Ideally, PAs met with clients

prenatally, in the hospital shortly after the woman gave birth, and in the postpartum period. The IHBSP protocol called for PAs to meet with women face-to-face in their homes within 72 hours of hospital discharge and to provide hands-on and other types of support to help women overcome challenges associated with engorgement and latch. In addition to hospital and home visits, clients were routinely contacted by telephone or in person (depending on client's preference or PA's assessment of need) at postpartum weeks 2, 4, and 6, and at 2, 3, 6, 9, and 12 months after childbirth or until breastfeeding ceased, whichever occurred first.

This study explores patterns and correlates of breastfeeding duration among WIC clients in North Carolina, and includes an evaluation of the IHBSP before it ended. Multiple years of North Carolina individual-, program-, and county-level data are used to examine whether an intensive, multi-modal (face-to-face and by telephone) support program is effective at increasing breastfeeding duration among a group typically unlikely to breastfeed, namely, WIC participants in the southeast. The aims are to: (1) determine the median duration of breastfeeding among NC WIC clients from 1996 through 2002; (2) determine whether the median breastfeeding duration changed significantly from 1996 to 2002; (3) examine whether women who live in counties with the IHBSP ("program counties") breastfeed longer than women in counties that did not offer the IHBSP ("non-program counties"); and (4) identify the individual, program, and county variables associated with breastfeeding duration.

Methods

Data Sources

Information on breastfeeding duration and child characteristics was obtained from the 1996 through 2002 North Carolina Pediatric Nutrition Surveillance System (PedNSS). The PedNSS is a child-based public health surveillance system that describes the nutritional status of low-income US children (birth to age 20 years) who attend federally-funded Maternal and Child Health (MCH) programs and nutrition programs. The PedNSS provides data on the prevalence and trends of nutrition-related indicators. Breastfeeding questions are asked of WIC-enrolled mothers with children under 24 months of age at the time of the WIC or other public health clinic visit. Other PedNSS data used for this study included the child's race/ethnicity, sex, and birth weight. Personal identifiers were not available in the datasets; thus, to prevent inclusion of the same child across datasets, samples were limited to babies born in the calendar year (January 1 through December 31) of each annual dataset.

No maternal information was contained in the PedNSS datasets. Thus, aggregate county data on maternal and delivery characteristics were derived from the 1996, 1999, and 2002 Pregnancy Nutrition Surveillance System (PNSS). These aggregated data were merged into the PedNSS data, matching on county and year. The PNSS breastfeeding initiation and infant birth outcome data are collected at the first postpartum WIC clinic visit, which typically occurs approximately six weeks after childbirth. For PNSS, each woman contributes one record representing one

pregnancy, and each record includes the prenatal and postpartum data collected in the clinics.

Data in PedNSS and PNSS are composed of information provided by WIC, Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) service, and Title V MCH programs. Data are collected at the clinic level, then aggregated at the state level and submitted to the CDC for analysis. When multiple records are submitted for a child during the reporting period, the CDC creates one unique record for that child by following specific selection criteria that may contain some data from all available records. The CDC then calculates the nutrition- and health-related indices and sends each state a series of annual tables that summarizes nutrition, health, and infant feeding practices information.

Data related to the IHBSP were obtained from the program administrators, and include information about counties' participation over time. County data were obtained from a combination of sources, including the North Carolina Health Professions Data System (HPDS) and the Log Into North Carolina (LINC) website. The HPDS contains information about types and numbers of healthcare providers located throughout North Carolina and was designed by the Cecil B. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill. The LINC website (http://linc.state.nc.us/) provides an interactive data retrieval system where one can obtain historical information at the state, county, or municipality level on over 900 health, demographic, economic, and other items of interest. Both the HPDS and LINC have compiled data from many different sources, such as the US Census, the US Department of Commerce, the NC Department of Health and Human Services, and other agencies.

Children who were not breastfed were dropped from the PedNSS datasets, leaving sample sizes of 18,826 children in 1996, 24,976 children in 1999, and 22,040 children in 2002. This study was approved by the University of North Carolina School of Public Health Institutional Review Board.

Variable Construction

Outcome Variable. The primary outcome of interest for this study was *breastfeeding duration,* which was based on women's self-report of the number of weeks (from 0 through 52) they breastfed their children. Data were censored for women who reported they were still breastfeeding at the time of the clinic visit (when data were collected), resulting in a potential underestimate of their full breastfeeding duration.

Explanatory Variables.

Time. *Year* reflects the calendar year (January 1 through December 31) in which the child was born and in which data were collected. To examine annual median breastfeeding duration and in analyses examining only one specific year, analyses were run separately for each year of data. To examine the effect of the IHSBP on breastfeeding duration, only data from 2002 were used because it was considered to represent the point at which the program had been in existence longest.

Exposure (Program) Variables. *IHBSP* is a dichotomous variable indicating whether the child lived in a county with or without (referent) the NC In-Home Breastfeeding Support Program. We do not have detailed information about which

individual women or infants participated in the IHBSP, so we are categorizing those who live in program counties, using an "intent-to-treat" approach, as having been exposed to the IHBSP. *Program duration* indicates the total number of years the IHBSP has existed within each county, which is summed separately for each year of data. For example, a county that implemented the IHBSP in 1997 would have a *program duration* value of "2" in 1999. Counties that never implemented the IHBSP have a value of 0, and counties that had lapses in the years they offered the IHBSP received a 0 for those years. Program duration is a reflection of the total number of years the county had the program in place.

Infant Variables. *Infant race/ethnicity* is a constructed variable combining child's race and ethnicity. Dummy variables were created for non-Hispanic white (referent), non-Hispanic black, Hispanic, and Other race/ethnicity. The infant race variable can be thought of as a proxy for maternal race, which was not contained in the PedNSS datasets. *Low birth weight* is a dichotomous variable indicating whether the child's weight at birth was <2500 grams (low birth weight) or ≥2500 grams (normal birth weight, referent). *Infant sex* is a dichotomous variable, with males as the reference group.

Aggregate Maternal Variables. Because the PedNSS does not contain any maternal information, I created separate aggregate county measures of each maternal variable for each year using the PNSS data. *Maternal nativity* indicates whether a mother was born in (referent) or outside the US, and is represented in the dataset as the county proportion of mothers who were foreign-born. *Maternal age* reflects mother's age in years at the time her child was born, and is reflected as the

county median. *Maternal education* is an aggregate measure of the proportion of women in each county who had a high school education or less (referent) compared with those who have at least some college education. *Primiparity* is an aggregate measure of the county proportion of women who have no previous children compared with the county proportion of women who have at least one other child (referent).

Delivery Variable. *Cesarean section* is a measured as the county proportion of births that occur by Cesarean section compared with a vaginal delivery (referent).

County Variables. *Number of primary care providers per 10,000 populations* is a continuous variable. Primary care providers include physicians, physician assistants, nurse practitioners, and certified nurse midwives. This variable is being used as proxy measure of each county's ability to provide women with access to healthcare, particularly by those providers most likely to be needed during prenatal and postpartum periods. *Percentage of persons below poverty* reflects the percentage of persons in each county whose incomes fall below the federal poverty level. Poverty data were available for each year except 1996, for which an average of the 1995 and 1997 poverty values were used. The poverty variable is being used as an indicator of the general financial state of a county and its residents, with the rationale that counties with a higher percentage of persons living below the federal poverty level have fewer economic resources available to devote toward breastfeeding support. *Metropolitan status* delineates whether each county is designated as being metropolitan or non-metropolitan (referent) as defined by the 1990 US Census.

Analysis Plan

Stata version 8.0 statistical software was used for all analyses.[19] Univariate analyses and bivariate analyses of each predictor and breastfeeding duration were conducted to obtain details about the sample in 1996, 1999, and 2002, and to examine median annual breastfeeding duration from 1996 through 2002. Because the outcome variable (breastfeeding duration) is a skewed continuous variable and with some values of breastfeeding duration unknown due to censoring, survival analysis was used to determine which variables were associated with breastfeeding duration. In the Cox proportional hazards models, clustering on county was used to account for potential intraclass correlation between women living in the same counties. To specifically assess whether the county characteristics related to providers, poverty, and metropolitan status contributed to the prediction of breastfeeding duration, I conducted a post estimation log-rank test on that block of variables.

Results

As shown in table 3.1, non-Hispanic white children comprised the largest ethnic group each year. The percentage of breastfed WIC-enrolled children who were non-Hispanic white declined from 67% in 1996 to 43% in 2002. Conversely, the percentage of breastfed NC WIC-enrolled children who were Hispanic increased from 4% in 1996 to 27% in 2002. The percentage of the sample that was non-Hispanic black (27%) and those of Other races (3%) remained fairly stable over time. Males made up about half the sample, and about 9% of infants were born with low birth weight.

Table 3.2 shows the 2002 averages for aggregate and county variables for those living in counties with and without the IHBSP. In most cases, there is little difference between the characteristics of IHBSP and non-IHBSP counties. The mean age of women at childbirth was approximately 23 years in both program and non-program counties, and about 80% of women in all counties were US-born. The percentages of women with less than a high school education (~35%) or a high school diploma or GED (~40%) were fairly comparable in the counties, with IHBSP counties having a slightly higher percentage of women who had at least some college education. About 40% of women were primiparous, and almost one-quarter of women had Cesarean deliveries. The average number of primary care providers per 10,000 county population was similar in non-program (8.16) and program (8.52) counties, as was the mean percent of the population below poverty (~13%). The proportion of program counties designated as being metropolitan was lower (60%), however, compared with the percentage of non-program metropolitan counties (69%).

The median duration of breastfeeding was 1 week in both program and non-program counties, indicating that half of NC WIC clients, regardless of whether they lived in a county offering the IHBSP, quit breastfeeding within the first week postpartum. I further explored this phenomenon by comparing the Kaplan-Meier breastfeeding survival curves for women living in counties with versus without the IHBSP (see Figure 3.1). For both groups, there was a steep drop in breastfeeding "survival" at approximately one week, after which the curves overlap almost completely, suggesting there is no difference in the timing of breastfeeding cessation between these two groups.

In bivariate analyses assessing the associations of predictor variables and breastfeeding duration, all variables were statistically significant except presence of the

IHBSP (χ^2=1.74, *P*=0.19) and infant sex (χ^2=0.51, *P*=0.47). (Other results not presented.) Because one of the primary hypotheses relates to the effect of the IHBSP on breastfeeding duration, IHBSP was kept in subsequent models. Retaining the variables that were significant in the bivariate analyses, a Cox proportional hazards model was fitted, clustering on county of residence. The only variable that remained significant in that model was child race/ethnicity. The modeling procedure was repeated after dropping all non-significant variables except those related to the hypotheses (program and county variables, in this case). The final adjusted Cox proportional hazards model was fitted and is presented in Table 3.3.

Living in a county with the IHBSP was associated with a lower hazard of quitting breastfeeding, although the results were not statistically significant (Hazard Ratio [HR]=0.85, 95% confidence interval [CI]: 0.64, 1.13). Duration of the program also was not significantly associated with the hazard of breastfeeding cessation. Child race was associated with a significantly lower hazard of breastfeeding cessation for Latinas (HR=0.48, 95% CI: 0.42, 0.56) and children in the Other race category (HR=0.81, 95% CI: 0.69, 0.96) compared with non-Hispanic whites. None of the county characteristics, however, was associated with the hazard of breastfeeding cessation. A log-rank test was conducted to assess the improvement of the model due to the addition of the block of county level variables (primary care providers per 10,000 population, percentage of county population below poverty, and metropolitan status), but the result was not significant ($\chi^2(1)$=2.84, *P*=0.09), suggesting that these variables did not enhance the ability to predict the timing of breastfeeding cessation.

Discussion

This study incorporated multiple levels of variables (individual, program, county) to evaluate the NC In-Home Breastfeeding Support Program, a multi-modal postpartum support program designed to increase breastfeeding initiation among low-income women in North Carolina. The low median of breastfeeding (one week) in both the program and non-program counties was surprising, both in terms of how few low-income mothers are breastfeeding beyond the early postpartum period, and also the consistency of the median over time. Though results are focused on 2002, the median breastfeeding duration remained quite stable at one week in both program and non-program counties from 1996 through 2002.

The finding of such a low median breastfeeding duration has potential implications for hospital practices and policies, such as routine early HMS supplementation while mother and newborn are still hospitalized after childbirth. Mothers who supplement early will likely face challenges with breastfeeding after leaving the hospital because early supplementation may interfere with establishment of lactation and breastfeeding. If many WIC clients (and other women) are being advised to give their infants human milk substitutes while in the hospital, it may be predisposing them to breastfeeding failure when they return home. Future studies are needed to explore whether hospital HMS supplementation is being conducted with or against mothers' consent, and if real, informed consent is being obtained prior to any supplementation.

Another possibility, though, is that some or many of the women who quit breastfeeding early were not truly committed to breastfeeding to begin with. Perhaps they felt pressured to initiate or try breastfeeding in the hospital, simply as a means of placating insistent or "pushy" providers, or perhaps they tried breastfeeding simply out of curiosity. Whatever the case, it provides an opportunity to intervene to inform these women about the

health protection continued breastfeeding provides, and to provide additional breastfeeding support so these women could continue breastfeeding after leaving the hospital. Future research could include assessments of interventions with women who had minimal or no commitment to breastfeed.

This study found that child race is associated with breastfeeding duration in the same ways maternal race has been associated in previous studies.[8, 9] Children who were non-Hispanic black had a slightly higher hazard of breastfeeding cessation compared with non-Hispanic white children. In contrast, Latino children (HR=0.48, 95% CI: 0.42, 0.56) and children in the Other race (HR=0.81, 95% CI: 0.69, 0.96) category had lower hazards of discontinuing breastfeeding compared with white children.

Aside from these variables, no other significant associations were found between the predictor variables and breastfeeding duration using the Cox proportional hazards model. Initially, this finding was somewhat surprising. Knowing there were very few predictor variables contained in the PedNSS datasets, great care was taken in specifying the model, using the infant variables in the PedNSS data and adding aggregated maternal- and childbirth-related variables from the PNSS datasets. A limitation of this study is that use of the aggregated variables likely weakened the ability to find an association with breastfeeding duration. It would be preferable to use data for individual women, but PedNSS datasets do not include it.

It may not be the variables that are at issue. At the time this study was first designed, a prospective study following individual IHBSP participants and a control group was planned. When the program lost its funding, however, it became necessary to conduct an

intent-to-treat analysis, using county-level data. Thus, one of the biggest analytical challenges was the potential for misclassification of exposure.

It was not possible to identify which women in the program counties participated in the IHBSP. Instead, the intent-to-treat approach required use of county of residence as a proxy for program participation. Women living in counties that offered the IHBSP were designated as having been "exposed" to the program, regardless of whether they actually received IHBSP services. Similarly, women living in non-program counties were presumed not to have received any services from the IHBSP, even though there could have been occasional cross-contamination of exposure to services as has happened in other studies.[16] Furthermore, data were not available to explore whether women in non-program counties had access to other, non-IHBSP sources of breastfeeding support, whether through a hospital-based program or a mother-to-mother support group, and so forth. Perhaps non-program county women were receiving support for breastfeeding, but it just wasn't from the IHBSP. Regardless, it is more likely that misclassification of exposure occurred most often with regard to women in program counties, thereby potentially biasing results toward the null. Indeed, a cursory exploration of IHBSP data suggests that county IHBSP participation rates varied tremendously, from as low as 12% of eligible women participating, to more than 75% of eligible women agreeing to participate. The intent-to-treat methodology requires that participation rates are assumed to be 100%, which is simply not the case with the IHBSP, nor is it likely to occur with almost any behavioral intervention program.

There are some advantages to using an intent-to-treat approach, such as reduced expense for follow up, efficiency, and the potential ability to evaluate whether an intervention had a "public health" impact. For evaluations of smaller-scale interventions,

however, the intent-to-treat approach may be inefficient and ineffective. Smaller and more detailed evaluations may be more appropriate for interventions that involve a great deal of face-to-face interaction. Including qualitative evaluations, for example, adds richness and context to quantitative data, and may help answer questions that numbers cannot.

On a strictly analytical plane, using mixed levels of variables, combining individual-level data (infant race, birth weight, sex) with county-level data (proportions of women in the county with various education levels, etc.) may have been problematic. Mixed modeling cannot be accommodated in Stata survival analysis. Only a clustering command can be used that controls for potential intraclass correlation between women living in the same county. New statistical software has recently become available that enables incorporation of mixed modeling into survival analysis. The overall findings are unlikely to be different, however it would permit further exploration of associations between individual- and county-level variables, which could offer some insight into areas to explore in future studies of breastfeeding duration.

It is also possible that the best predictor variables were not identified and included in analyses. Limitations existed with regard to the data available in the PNSS and PedNSS datasets, but perhaps there are other individual, program, and county level variables that could be considered in a future evaluation analysis. For example, there was no indication of a woman's support from her family and friends, nor whether she planned to return to work or school, and if so, if she had the time, place, and means to use a breast pump. Perhaps women who discontinued breastfeeding early in the postpartum period did so because they knew they would have to return to work in a short time and they didn't want to continue with breastfeeding at home if they could not do so at work.

Other types of county or regional variables could also be explored in future studies, such as a variable on the number or percentage of births at Baby-Friendly hospitals, or the number of International Board Certified Lactation Consultants per capita. All of these variables could be more predictive of breastfeeding duration than those that were available in the PedNSS and PNSS datasets.

In sum, this study found that WIC clients in North Carolina have a very short median duration of breastfeeding, and this median remained stable from 1996 through 2002. Before we can effectively intervene to increase median breastfeeding duration, however, we may need to conduct some qualitative analyses to uncover why women are ceasing to breastfeed so early in the postpartum period and to identify effective ways to help women breastfeed longer. Hospital staff and health care providers may need to be included in interventions designed to enhance their knowledge and capacity to provide breastfeeding support to women in the hospital. Lastly, if the NC IHBSP can be evaluated more closely, and include assessment of at least some of the qualities known to be part of an effective postpartum support program (such as face-to-face contact, and hands-on help with breastfeeding in the home),[16] positive findings could justify reinstituting some of the lost IHSBP funding and further expansion of the program.

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Table 3.1. Sample characteristics of those NC WIC-enrolled children who were breastfed. (Pediatric Nutrition Surveillance System Datasets, 1996, 1999, 2002.)

Child Characteristics	1996 N=18826 n	(%)	1999 N=24976 n	(%)	2002 N=22040 n	(%)
Race/Ethnicity						
NH White	12550	(67)	12363	(51)	9589	(43)
NH Black	5276	(28)	6814	(27)	5864	(27)
Hispanic	697	(4)	4623	(18)	6015	(27)
Other	303	(1)	903	(4)	572	(3)
Sex						
Male	9658	(51)	12593	(50)	11169	(51)
Female	9168	(49)	12383	(50)	10871	(49)
Low birth weight						
Yes	1575	(8)	2122	(9)	2092	(10)
No	17155	(92)	22694	(91)	19792	(90)
Missing	96		160		156	

Table 3.2. Comparison of aggregated characteristics and median breastfeeding duration of North Carolina counties with and without the In-Home Breastfeeding Support Program, 2002.

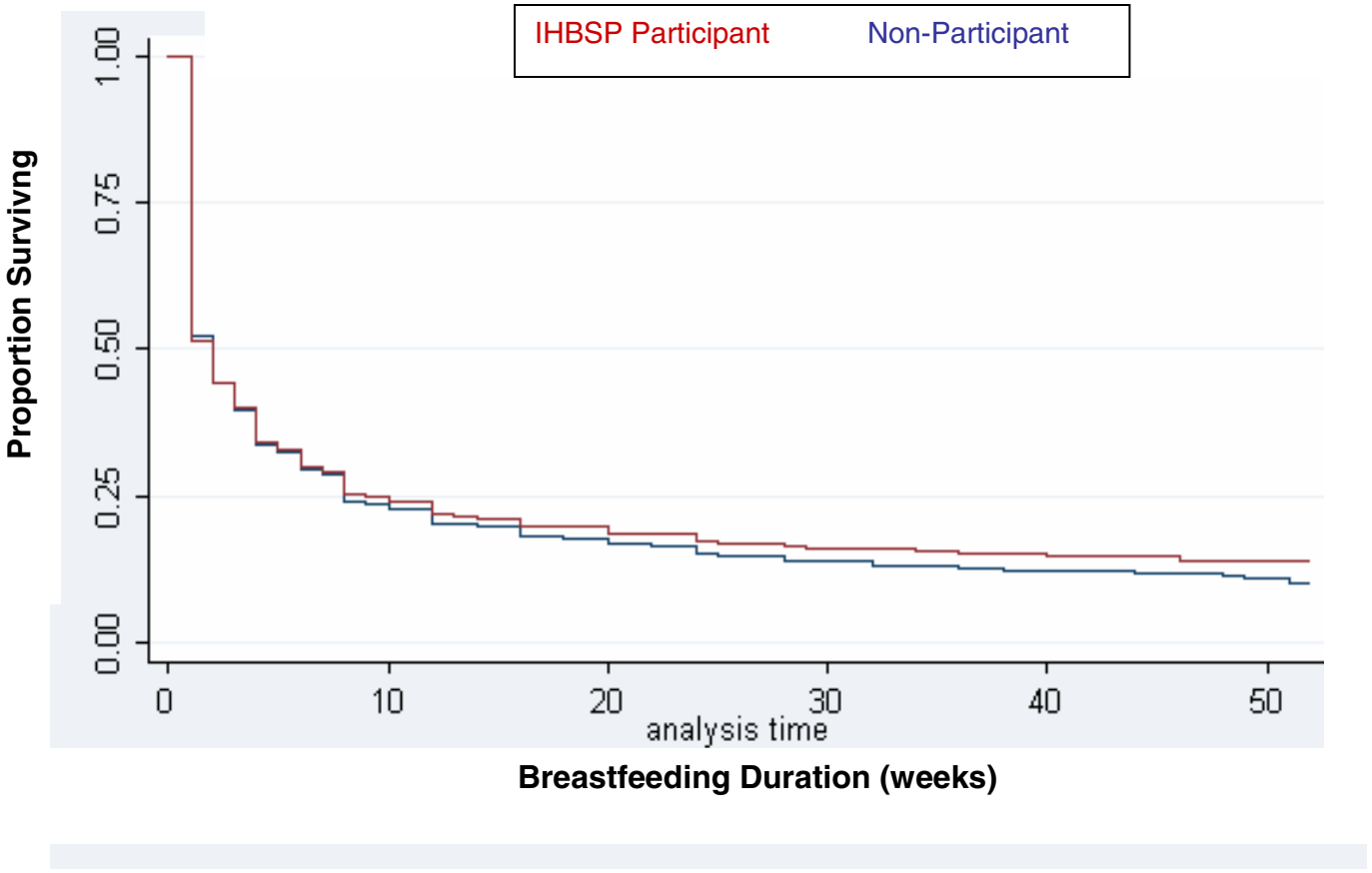
Characteristics	Counties with the In-Home Breastfeeding Support Program *N=37* Mean	(SD)	Counties without the In-Home Breastfeeding Support Program *N=63* Mean	(SD)
Maternal Characteristics				
Age, *y*	23.24	(0.71)	23.04	(0.63)
% mothers US born	80.29	(13.50)	79.16	(11.55)
Education				
% mothers with <HS education	34.64	(9.65)	37.53	(8.94)
% mothers with High School diploma/GED	39.19	(5.94)	40.24	(5.80)
% >HS education	26.17	(6.75)	22.23	(6.25)
Parity				
% mothers with no previous children	40.91	(3.98)	41.52	(2.87)
% mothers with 1 previous child	31.75	(3.32)	31.00	(2.23)
% mothers with 2+ previous children	27.34	(2.91)	27.48	(2.97)
Delivery Characteristic				
% Cesarean section deliveries in counties	24.85	(3.87)	24.85	(4.49)
County Characteristics				
Number of primary care providers per 10,000 population	*8.52*	(5.10)	8.16	(3.89)
Percentage population below poverty	13.62	(3.73)	12.98	(3.21)
Percentage of counties with population living in metropolitan counties	59.9		68.7	
Median duration of breastfeeding, weeks, (25th percentile, 75th percentile)	1.00 (0, 2)		1.00 (0, 2)	

SD=standard deviation

Table 3.3. Hazard ratios and 95% confidence intervals from adjusted Cox proportional hazards model estimating associations of program, infant, and county characteristics with breastfeeding cessation among NC WIC-enrolled infants, 2002.

Characteristic	Hazard Ratio	95% Confidence Interval
Program Variables		
Program County		
Yes	0.85	(0.64, 1.13)
No	Referent	
Program duration	1.02	(0.99, 1.05)
Infant Variables		
Infant Race / Ethnicity		
Non-Hispanic White	Referent	
Non-Hispanic Black	1.09	(1.00, 1.18)
Hispanic	0.48	(0.42, 0.56)
Other Race / Ethnicity	0.81	(0.69, 0.96)
County Variables		
Number of primary care providers per 10,000 population	1.00	(0.98, 1.01)
Percentage of county population living below federal poverty level	1.00	(0.97, 1.02)
Metropolitan status	0.84	(0.68, 1.03)

Figure 3.1. Kaplan-Meier survival estimates of breastfeeding duration by program status, 2002.



CHAPTER 4

CONCLUSION

Human milk is the optimal form of nutrition for virtually all infants for the first six months of life. Breast milk has unique properties that make it the best source of nutrients for infants, but the health advantages associated with human milk are not limited just to babies. Reduced health risks are associated with human milk in a dose-response manner; the more breast milk consumed by infants and young children, and the more breastfeeding women do, the greater the mutual protection against disease and infection. Many health and professional organizations, such as the American Academy of Pediatrics, the American Public Health Association, and the World Health Organization, recommend initiation of breastfeeding, continuation of exclusive breastfeeding for six months, and breastfeeding combined with timely introduction of appropriate weaning foods for at least one year.[1-3]

Despite knowledge about the reduced health risks associated with breastfeeding, most women do not follow the recommendations. Prevalence of breastfeeding initiation, exclusivity, and duration are generally below what is recommended in *Healthy People 2010*, which is that 75% of women will initiate breastfeeding, 50% will continue for six months, and 25% will continue at least one year.[4] Disparities are evident as well, with African American mothers identified as being among those least likely to breastfeed.

This dissertation examined patterns and correlates of breastfeeding initiation and duration among NC WIC clients from 1996 through 2002, and included an evaluation of the

NC IHBSP in an attempt to learn whether its postpartum breastfeeding support helps extend breastfeeding duration. The social ecological framework was used to guide this dissertation research.[5-8] As applied to breastfeeding, social ecological theory posits that there are multiple influences operating in the micro – through macro-level arenas, and that they interact with each other as well as act on their own to influence women's decisions and practices related to breastfeeding.[5] Microlevel influences are akin to individual or interpersonal factors, such as a woman's own knowledge and beliefs or those of her family. Demographic characteristics would also be considered microlevel in nature.

In chapter two, I argue that it is time to move beyond exploration of the associations between individual-level variables such as maternal age, ethnicity, and education level, and to begin incorporating more intermediate and macrolevel variables into studies of breastfeeding, such as the influence of work or hospital policies on breastfeeding, or the impact of legislation like paid maternity leave or public breastfeeding ordinances. Another powerful macrolevel influence on behavior is social norms, which can be influenced by the media. Therefore, it could be useful to investigate associations between media advertising, television shows, and print, and ways in which the media either positively or negatively portray breastfeeding, or whether they refer to it at all. To move toward achievement of the *Healthy People 2010* national breastfeeding goals, interventions must implemented on multiple levels simultaneously. Only then will a true population impact be obtained.

In my first paper, I used several years of data from the NC Pregnancy Nutrition Surveillance System to explore the associations of maternal, infant, delivery, and county level variables with breastfeeding initiation and introduction of HMS in the first week postpartum. Though the prevalence of breastfeeding initiation among African American

women was lower than any for other ethnic group, they also achieved the largest increase in breastfeeding prevalence from 1996 to 2002. Unfortunately, I also found that although the prevalence of breastfeeding initiation had increased among NC WIC clients overall from 1996 through 2002, the prevalence of early HMS introduction has also skyrocketed. Given the importance of exclusive breastfeeding for the first six months of life, it is important to identify ways to help women delay supplementation as long as possible, up to six months postpartum. Future research may consider the role of early supplementation in the hospital. Is it occurring, and if so, is it with parents' true, informed consent? Or, is HMS being given while babies are in the hospital nursery, without parents' knowledge? What are the impacts of hospital supplementation (regardless of consent) on establishing lactation and maintaining breastfeeding upon leaving the hospital? These are just some of the pressing questions that could be addressed in research designed to improve breastfeeding practices among NC WIC clients.

The third chapter of this dissertation involves an ecological evaluation of the NC In-Home Breastfeeding Support Program (IHBSP). The IHBSP was once a large-scale postpartum support program targeting low-income women in approximately 40 counties across the state. After operating for over 10 years, funding for the program was drastically cut, and the program almost dissolved. Some counties, however, were able to identify alternate sources of funding and have continued to provide postpartum support. The IHBSP used a paraprofessional model, with extensively trained women who met certain employment criteria (personal breastfeeding experience, high school diploma, etc.) to deliver services to women who wanted their help. Visits in the hospital after childbirth, followed by at least one in-home visit after returning home from the hospital, and continued contact and support was

given for at least one year or as long as the woman breastfed; whatever occurred first. The primary goal of the program was to help women meet their breastfeeding duration goal.

The study of the IHBSP found that median duration of breastfeeding (one week) was extremely short among NC WIC clients, and remained very stable from 1996 through 2002. I explored the limited predictor variables in the datasets, including some county-level variables I constructed, and after adjusting for other factors, the primary finding was the association between infant race/ethnicity and breastfeeding duration among NC WIC clientele. There was no support for a program effect, and no significant associations between county level variables and breastfeeding duration. This finding could be due to a true lack of association, to the analytical design of the study, or it could be that the county variables I was using were not those which are most highly associated with breastfeeding. There are other county-level characteristics that may be worthy of consideration and which may be more highly associated with feeding practices, such as the number of international board certified lactation consultants (IBCLCs) or the number of mother-to-mother support groups.

There were limitations to our evaluation of the IHBSP, foremost among them being the inability to accurately classify women in terms of their exposure to (participation in) the IHBSP. The intent-to-treat approach I was forced to use once the program lost its funding resulted in very limited ability to truly evaluate the effectiveness of the support that the program may have provided. Though intent-to-treat approaches may be considered the means by which to determine an intervention's true public health impact (at the population level), for a relatively small program like the IHBSP, it has the effect of diluting or obscuring the appearance of an effect. Including in future research information about the percent of eligible county population participating would be a useful addition. In addition, a more

focused evaluation might be able to determine precisely which aspects of the program seemed useful or were appreciated by participants.

In our evaluation, we had no information on program components aside from knowing the counties in which the program had been implemented. A better evaluation design for the IHBSP would be one that followed women prospectively, from some point in the prenatal period until some pre-determined point postpartum or until she stopped breastfeeding, whichever came first. More research, preferably ethnographic, is warranted to understand why women actually begin breastfeeding but then discontinue so quickly. Does it have to do with intention or lack of practical postpartum support or something else entirely? Quantitative data can only go so far in answering these kinds of questions; we need to ask women why they make the choices they do, and ask them what kind of support they want and would find useful with regard to improving initiation, exclusivity, and duration of breastfeeding.

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