Rates and Determinants of Breastfeeding Exclusivity and Duration in Nova Scotia Women

by

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The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled "RATES AND DETERMINANTS OF BREASTFEEDING EXCLUSIVITY AND DURATION IN NOVA SCOTIA WOMEN" by Catherine R. L. Brown in partial fulfilment of the requirements for the degree of Master of Science.

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DEDICATION PAGE

This thesis is dedicated to my grandmothers, Ruth and Louise, who inspire me with their humility, intellectual curiosity, and passion for life.

It is also dedicated to my grandmother Catherine, known to me only in spirit through my extended family. They taught me of her gutsy determination – dare I say stubbornness –, her love of the English language, her strong moral compass, and like my other two grandmothers, her abiding zest for life.

I am grateful to have been a breastfed gal, from a breastfed gram, from a breastfed gran!

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ABSTRACT

This population-based retrospective cohort study describes breastfeeding patterns and identifies the determinants of longer exclusive breastfeeding among 4,533 mother-infants pairs in two regions of Nova Scotia, Canada between 2006 and 2009. Multivariate logistic and proportional hazard regression analyses were used to model breastfeeding practices. While 64.1% (95% CI=62.7-65.5) of mothers initiated breastfeeding, only 10.4% (9.5-11.4) of mothers exclusively breastfed for the recommended six months; 21% (19.7-22.3) of mothers continued to breastfeed at six months, but not exclusively. Six risk factors are independently associated with poorer breastfeeding practices: lower maternal education, no partner, higher pre-pregnancy body mass index, smoking during pregnancy, no breast contact between dyads within one hour of birth, and no intention of breastfeeding. Rates of exclusive breastfeeding remain lower in these districts than elsewhere in Canada. Understanding determinants of longer exclusive breastfeeding is critical to assist policy makers and health care providers in better supporting mothers and newborns.

LIST OF ABBREVIATIONS AND SYMBOLS USED

χ^2	Chi-squared
<	Less than
≤	Less than and equal to
>	Greater than
≥	Greater than and equal to
ABF	Any breastfeeding
AOR	Adjusted odds ratio
ARR	Adjusted relative risk
BF	Breastfeeding
BFHI	Baby-Friendly Hospital Initiative
BMI	Body mass index
CBDHA	Cape Breton District Health Authority
CCHS	Canadian Community Health Survey
CI	Confidence interval
DHA	District Health Authority
df	Degree of freedom
EBF	Exclusive breastfeeding
FSA	Forward sortation area
GA	Gestational age
GASHA	Guysborough Antigonish Straight Health Authority
GWG	Gestational weight gain
HC	Health Canada
HCN	Health card number
HR	Hazard ratio
IWK	Izaak Walton Killam Health Centre in Halifax, Canada
IOM	Institute of Medicine
MES	Maternity Experiences Survey
MEX	Maternal Experiences – Breastfeeding (module within CCHS)
MLE	Maximum likelihood estimate

N	Quantity
NICU	Neonatal intensive care unit
NPHS	National Population Health Survey
NS	Nova Scotia
NSAPD	Nova Scotia Atlee Perinatal Database
OECD	Organization of Economic Cooperation and Development
OR	Odds ratio
p	P-value
p	Page number
pp	Page numbers
PHAC	Public Health Agency of Canada
PHD	Public Health Database
PHN	Public health nurses
PNE	Prenatal education
RCP	Reproductive Care Program of Nova Scotia
SCN	Special care nursery
URR	Unadjusted relative risk
vs.	Versus
WHO	World Health Organization

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CHAPTER 1 INTRODUCTION

1.1 Benefits of Breastfeeding

Breast milk is the best food source for optimal infant growth and development.[1,2] Existing research offers compelling evidence that exclusive breastfeeding provides health benefits to both infant and mother throughout their lifespan, thereby significantly reducing health care costs.[3] Breast milk provides the optimal balance of nutrients for the infant's growth and development.[1,2] In addition, there is strong evidence that breastfeeding provides immunological benefits to the infant by decreasing the occurrence and severity of infectious diseases such as gastrointestinal illness, urinary tract infection, respiratory illness, and ear infection.[4-7] Some evidence demonstrates an association between breastfeeding and a reduced risk of sudden infant death syndrome, asthma, allergies, childhood leukemia, and childhood obesity.[8,9] Recent evidence from a large randomized control trial also suggests that breastfeeding improves a child's cognitive development.[10]

In addition, breastfeeding provides health benefits to the mother, with mothers who breastfeed in the short-term returning to their pre-pregnancy weight more quickly and reducing their risk for anaemia and post-partum bleeding.[2,8] In women with type 2 and gestational diabetes, breastfeeding improves glucose tolerance.[6] Over the long-term, breastfeeding offers a reduced risk of hypertension and osteoporosis, as well as endometrial, ovarian, and premenopausal breast cancers.[2,8,11] Moreover, breastfeeding provides important emotional benefits to both mother and infant.[12]

To maximize these benefits for both mother and child, infants should be breastfed exclusively for at least six months, with complementary feeding for up to two years and beyond.[13] Any breastfeeding, however, is better than no breastfeeding.[3]

1.2 Current Canadian Guidelines and Breastfeeding Rates

In 2004, Health Canada, the Canadian Paediatric Society, and the Public Health Agency of Canada (PHAC) adopted the World Health Organization's (WHO) recommendation that infants be exclusively breastfed for six months.[12,14,15] Prior to this date, Health Canada recommended exclusive breastfeeding for the first four to six months of life.[16] Exclusive breastfeeding involves offering only breast milk and any necessary vitamins, minerals, and medicine, while excluding all other liquids, breast milk substitutes, and solid foods. After six months, continued breastfeeding should be supplemented with nutrient-rich, solid foods until age two and beyond.[1,12] While rare, some mothers are unable to exclusively breastfeed for medical reasons. For instance, medical contraindication to exclusive breastfeeding may occur for very premature babies (born at less than 32 weeks gestational age or weighing less than 1,500 grams) or if there are worries about powerful medications crossing into the breast milk (such as select psychotherapeutic drugs or chemotherapy).[17]

As seen in Table 1-1 (p5), recent comprehensive studies on breastfeeding patterns confirm that the rate of exclusive breastfeeding at six months is very low in Canada.[16,18-22] National statistics from the 2007-2008 Canadian Community Health Survey (CCHS) estimate that while 87.9% of Canadian mothers ever breastfed their infant, only 23.1% exclusively breastfed their infant for the recommended six months.[20] The percent of mothers who exclusively breastfed their infant for six months or more has increased significantly every data collection cycle since the module began in CCHS 2.1 (2003).[20] Two estimates based on the 2006-2007 Maternity Experiences Survey suggest that the percent of mothers who exclusively breastfed their infant for six months or more may, however, be lower than reported in CCHS cycles, between 13.8% and 14.4%.[16,19] One author suggests that this discrepancy in Canadian rates may be attributable to variation in study design, sample selection, or even a true decline in the rate of exclusive breastfeeding.[16]

Within Canada, a clear geographic gradient exists: exclusive breastfeeding at six months is highest in Western Canada and the Northern Territories and lowest in Quebec and the Atlantic Provinces.[20,23] The latest provincial rates available are from the 2006-

2007 Maternal Experiences Survey. Approximately 6.5% of mothers in Newfoundland and Labrador and Prince Edward Island reported exclusively breastfeeding their infants for six months or more.[23] While gradually increasing, Nova Scotia's rate was the third lowest in Canada, with 9.6% (95% confidence interval [CI] = 6.7–12.6) of mothers meeting the recommendation (Table 1-1, p5).[23] This survey data, however, should be interpreted with caution because of the cross-sectional nature, the higher potential for recall bias, and the small sample size of 344 mothers in Nova Scotia.[23,24] Stemming from this low rate, a 2010-2011 mandate statement of the Nova Scotia Department of Health Promotion and Protection is to "improve the health status of mother and babies by increasing breastfeeding duration in Nova Scotia" by 2015.[25] This target will be measured by the rate of exclusive breastfeeding at six months.

Canada is below the Organization of Economic Co-operation and Development (OECD) average for ever breastfed, those infants who are introduced to breastfeeding either partially or exclusively, although the rate is 10% higher than in the United States.[26] While less data are available for an OECD comparison of exclusive breastfeeding practices, Canada lags far behind countries like Japan, Portugal, and Hungary. In these nations, the percent of mothers who exclusively breastfed their infant for six months or more is over 35%, more than twice the Canadian rate and three times the Nova Scotia rate.[26]

1.3 Thesis Project

The low percentage of Nova Scotia and Canadian mothers whose breastfeeding practices match current recommendations is a significant challenge for public health. This places mothers and infants at a higher risk of ill-health and is associated with significant economic costs. The challenge is to find interventions that aim to bridge the gap between current breastfeeding practices and the WHO recommendation for exclusive breastfeeding. More specifically, since Health Canada's exclusive breastfeeding recommendation only recently changed from four-to-six months to six months, few Canadian longitudinal studies have been conducted on the factors that contribute to increased rates of breastfeeding. Little is known about the role of potentially modifiable

behaviours such as maternal smoking, obesity, cesarean births, and intention to breastfeed on breastfeeding exclusivity. Ongoing research is required in order for policies, programs, and practices to be effective and reflect the needs of infants, mothers, and families.

This thesis aims to understand the determinants of breastfeeding duration and exclusivity. In particular, this research focuses on short-term potentially modifiable factors that are associated with cessation of exclusive breastfeeding before six months. This thesis does not attempt to look at longer-term factors that could increase exclusive breastfeeding rates such as social determinants of health, maternity leave benefits, or social support, as it is beyond the scope of this MSc thesis. By understanding the factors associated with breastfeeding duration and exclusivity, policy makers in Nova Scotia and Canada will be better equipped to promote, protect, and support breastfeeding.

Table 1-1 Reported rates from Canadian surveys and perinatal databases of intention to breastfeed, breastfeeding initiation, and breastfeeding duration among Canadian and Nova Scotia mothers since 2004

	Survey	Sample Size	Intention to BF (95% CI)	BF Initiation (95% CI)	EBF 4 Months	ABF 6 Months (95% CI)	EBF 6 Months (95% CI)
Canada	CCHS 3.1 (2005)	7,179	-	87.0 (85.9–88.0)	43.1	-	16.4 (15.2–17.6)
	MES (2006-2007)	6,421	90.0 (89.3–90.7)	90.3 (89.6–91.0)	-	53.9 (52.6–15.2)	14.4 (13.5–15.4)
	CCHS 2007/2008	6,955	-	87.9	42.8	-	23.1
	CCHS 2009/2010	6,520	-	87.3	44.2	-	25.9
Nova Scotia	NSAPD (2004-2009)	51,381	-	68.2 (2004) –76.4 (2009)	-	-	-
	CCHS 3.1 (2005)	274	-	75.1 (68.8–81.3)	36.5	-	13.8 (7.9–19.6)
	MES (2006-2007)	344	82.5 (79.1–86.0)	83.2 (79.8–86.5)	-	39.7 (34.8–34.6)	9.6 (6.7–12.6)
	CCHS 2007	216*	-	76.1	-	-	16.3
	CCHS 2008		-	73.5	-	-	16.8
	CCHS 2009	192†	-	76.7	-	-	13.1

Note. *Abbreviations*: 95% CI – 95% confidence interval; ABF – any breastfeeding; CCHS – Canadian Community Health Survey; EBF – exclusive breastfeeding; MES – Maternity Experiences Survey; NSAPD – Nova Scotia Atlee Perinatal Database.

Symbols: * – Combined Nova Scotia sample size for CCHS 2007/2008 (cycle 4); † – Combined Nova Scotia sample size for CCHS 2009/2010 (cycle 5).

Data Sources: Canada – CCHS 3.1, CCHS 2007/2008, and CCHS 2009/2010 [20]; MES [23].
Nova Scotia – NSAPD [27]; CCHS 3.1 (2005)[28]; MES [23]; CCHS 2007, 2008, and 2009[29].

CHAPTER 2 LITERATURE REVIEW

2.1 Determinants of Exclusive Breastfeeding Duration: Overview

An understanding of the determinants of breastfeeding patterns is crucial to promote, protect, and support breastfeeding practices. Breastfeeding is a complex health behaviour shaped by interactions among biological, psychosocial, demographic, and social factors.[30,31] Positive breastfeeding patterns, including higher rates of breastfeeding initiation, longer breastfeeding duration, and a higher proportion of mothers who breastfeed exclusively, are associated with a number of factors. Table 2-1 (p19) shows the factors, after adjusting for other variables, protective of breastfeeding exclusivity and duration in Canadian studies conducted after 1995. Factors from all domains, including socio-demographic, pre-pregnancy health, pregnancy-related behaviours and health, parental beliefs and intentions, delivery-related, infant-related, and postpartum behaviours and health, are important predictors of positive breastfeeding patterns.

With respect to social and demographic influences, Canadian evidence suggests that breastfeeding tends to be stratified by socio-demographic factors: mothers are more likely to breastfeed for longer and to do so exclusively if they are older, better-educated, married, and wealthier.[16,18,32-36] International literature from high-income countries corroborates these associations.[30,31] Indeed poorer, less-educated, single mothers tend to experience family and work conditions that do not promote breastfeeding, such as short maternity leaves, inflexible work schedules, and environments that interfere with breastfeeding routines and the ability to pump breast milk.[37] American literature identifies race as an important socio-demographic predictor of breastfeeding, with White mothers having better breastfeeding practices;[38] however, Canadian cross-sectional data suggest that mothers from a Black, Asian, or other cultural/racial background as well as recent immigrant mothers have significantly higher rates of exclusive breastfeeding than White and non-immigrant mothers.[20] Breastfeeding practices are also associated with location of mother's residence, and in Canada, mothers in the Atlantic region are least likely to meet recommended breastfeeding practices.[16,18]

Other studies have demonstrated the importance of positive maternal attitudes towards breastfeeding, adequate family support, appropriate suckling technique, and good mother-infant bonding.[39,40] Indeed, the practice of infants and mothers sharing 20 minutes of skin-to-skin contact after birth is believed to extend exclusive breastfeeding for 0.4 months and overall breastfeeding duration by 1.4 months.[41] Personal lifestyle choices are also important, as some women view breastfeeding as pleasurable and empowering, whereas others find it a burden.[37] Moreover, health-compromising behaviours such as maternal smoking and excessive gestational weight gain have been associated with shorter duration of any breastfeeding.[16,42-51] Less is known about the relationship of maternal smoking and excessive gestational weight gain to exclusive breastfeeding.

In addition to these factors, poorer health in either the infant or mother is linked with poorer breastfeeding outcomes. Adverse neonatal factors such as low birth weight or admission into an intensive care unit are associated with a decreased likelihood of initiating breastfeeding.[16] These infants are often fed formula rather than pumped breast milk or breast milk from a breast milk bank. Canadian mothers who have a poorer self-rated health status during pregnancy have significantly lower rates of exclusive breastfeeding at six months.[16] For example, women with diabetes are less likely to initiate breastfeeding than women without diabetes.[52] Similarly, women with hypertensive disorders in pregnancy, either pre-existing or gestational, and women who suffer from severe nausea and vomiting during pregnancy have lower rates of breastfeeding initiation.[53,54]

Conflicting evidence exists as to the whether childbirth-related factors are associated with poorer breastfeeding patterns. Labour epidural analgesia is effective in reducing maternal pain, but it is also associated with an increased risk of assisted vaginal birth (*e.g.* forceps delivery, vacuum delivery, or episiotomy) and of cesarean birth for fetal distress, which may affect mother-infant bonding.[55] Cohort studies in Sweden[56], Wales[57], and Australia[58,59] found mothers with epidural analgesia during childbirth had a reduced breastfeeding initiation rate and an increased likelihood of early breastfeeding cessation. In contrast, a recent British randomized controlled trial of three epidural types with a non-randomized "control" group found no difference in breastfeeding initiation

between the epidural and non-epidural groups,[60] and an older Canadian cohort study found epidural labour analgesia was not associated with breastfeeding success at six to eight weeks.[61]

Breastfeeding patterns may also be associated with the practice of inducing and augmenting labour with oxytocin, a hormone critical for milk ejection. Use of oxytocin for induction and augmentation of labour may interfere with endogenous patterns of oxytocin secretion and sensitivity of oxytocin receptors, thus interfering with breastmilk descent.[57] In a cross-sectional study of elective induction of labour and its determinants in 37,444 Latin American women with low-risk pregnancies, mothers who underwent elective labour induction were three times more likely not to initiate breastfeeding within the first seven days of the newborn's life.[62] Conversely, in a large Welsh retrospective cohort study of 48,366 healthy women who gave birth to healthy singleton babies at term, induction and augmentation of labour with oxytocin was not significantly associated with breastfeeding rates at 48 hours postpartum.[57] A paucity of evidence exists relating induction of labour to breastfeeding exclusivity and duration.

Trauma to the perineum is the most common obstetric injury.[63] Evidence from a small randomized controlled trial suggests that significantly more women who receive sutures for first- and second-degree perineal tears instead of allowing the perineum to heal spontaneously considered that the laceration had a negative influence on breastfeeding, although no difference in breastfeeding duration was noted between the two groups [64] The authors hypothesize that suturing lacerations immediately after birth delays the first mother-infant interaction, and thus potentially breastfeeding initiation. The literature indicates no studies that have examined whether high-order third- and fourth- degree perineal tears, which generally require surgical repair, are associated with poorer breastfeeding patterns.

Little research has been conducted to identify the relative importance among the factors that predict longer breastfeeding duration and higher rates of breastfeeding exclusivity to six months. Indeed, many studies do not provide a thorough discussion of the correlation among these factors, rather they discuss only societal, maternal, or infant factors independently. Many factors are likely to interact with each other. For instance, the Public Health Agency of Canada has already established that, on average, women

who smoke during pregnancy tend to be less well educated and younger, whereas women who do not smoke are more likely to be better educated and older.[65] In addition, lower intention to breastfeed has been linked to higher maternal smoking.[51] Similar correlations probably exist between other variables such as intention to breastfeed, education, and age, or excessive gestational weight gain, gestational diabetes, and admittance into an intensive care unit. More research is needed to better understand the interactions among such factors.

2.2 Potentially Modifiable Behaviours: Maternal Obesity, Maternal Smoking, Cesarean Birth, and Intention to Breastfeed

Some factors that predict breastfeeding outcomes, such as maternal age and education level, are mostly non-modifiable in the short-term. These factors may be associations, not causal factors, so modifying them does not necessarily mean it will alter breastfeeding rates. Others, such as maternal smoking, appropriate gestational weight gain, delivery via cesarean birth, and intention to breastfeed, are potentially modifiable, though with many associated challenges. Nova Scotia mothers in particular have higher rates of maternal smoking and are more often overweight and obese than the Canadian national average.[65] While the prevalence of maternal smoking of Canadian mothers, at 13.4%, has been gradually declining, the rate in Nova Scotia mothers, at 23.6%, has actually increased over the past decade.[65] Similarly, while 13.6% of mothers are obese nationally, Nova Scotia's maternal obesity rate is 22.7%.[23] Understanding the influence of non- or less-modifiable factors on breastfeeding is important; however, it is the potentially modifiable factors in the short term that are of immediate interest to policy makers.

Obesity is a major public health concern because levels are rising in women of reproductive age, and even a small apparent association with increased artificial feeding may lead to a greater risk of obesity in children.[9] There are many possible mechanisms, with a mix of potentially causal and non-causal components, for a negative association between high maternal weight and lower breastfeeding duration and exclusivity.[43,45,47]

Physiologically, overweight and obese mothers tend to have a lower prolactin response than normal weight women, which likely compromises an overweight woman's ability to produce milk, and over time, this could lead to premature cessation of lactation.[46,66] Women with large breasts may also have practical and mechanical difficulties with latching the baby to the breast.[43] In addition, women with medical conditions such as diabetes or polycystic ovarian syndrome, both associated with obesity, tend to produce less breast milk.[43] Obstetric complications, including birth by caesarean, may reduce exclusive breastfeeding rates since this "artificial method" of birth results in a delayed prolactin response in mothers.[46,66] Psychologically, obese women tend to have lower self-esteem and poorer mental health, which might result in postpartum women being embarrassed to expose their breasts in public or, due to their poor health, having less desire to overcome the challenges of learning how to breastfeed a child.[43] Finally, women who are obese tend to belong to social groups that are less likely to breastfeed, such as women from lower socioeconomic status.[43] Indeed, obese women in general tend to practice fewer health conscious behaviours such as regular Pap smears and screening mammography, so it is not unexpected that there are lower exclusive breastfeeding rates in this population.[43,45]

A number of studies, mostly small, have found a negative association between being overweight or obese and breastfeeding duration and exclusivity.[16,43,45-47] A large study from New York state conducted by Hilson and Rasmussen provides some of the strongest evidence of such an association by demonstrating that both maternal adiposity before conception and inappropriate weight gain during pregnancy are important in the etiology of failure to initiate and sustain breastfeeding.[47] Normal weight and obese women who exceeded the recommended gestational weight gain (GWG) had higher odds of failing to initiate breastfeeding. In addition, underweight, overweight, and obese women who exceeded the recommendations for GWG, as well as obese women who gained within the GWG recommendations, had a higher risk of early termination of exclusive breastfeeding. Further, obese women who gained within or exceeded the recommendations for GWG had a higher risk of early termination of any breastfeeding. Excessive GWG in all categories of women was strongly associated with a measure of failure to initiate and/or sustain breastfeeding.[47]

A systematic review of maternal obesity and breastfeeding intention, initiation, and duration largely confirmed Hilson and Rasmussen's findings, although the evidence is mixed. Most studies found an effect size of a 50% to 150% reduction in breastfeeding duration, although others found no evidence of an effect.[43] One interesting tendency noted by two authors, but not associated with any statistical significance, is that gaining less weight than recommended by the Institute of Medicine is also associated with shorter breastfeeding duration.[38,47] As such, in addition to conceiving at a healthy weight, it is important to gain no more, and likely no less, than the recommended amount of weight during pregnancy for successful breastfeeding.

Maternal smoking has long been associated with an increased risk of early weaning and lower breastfeeding initiation.[42,48-51] There is stronger evidence of an association between smoking and reduced breastfeeding duration than there is for obesity. A meta-analysis found that in smoking versus non-smoking mothers, the adjusted odds ratio for weaning before three months was 1.5.[48] There are many mechanisms that might explain this 50% increased risk. Mothers who smoke may be less health conscious overall, as seen by their tendency to have a lower number of antenatal care visits.[48] Moreover, physiologically lower milk output volumes have been reported in smoking mothers.[42,67] Nicotine increases dopamine secretion in the hypothalamus, thereby reducing prolactin levels, which in turn, tend to diminish milk yield.[42] Early weaning may also be related to the lower fat concentrations regularly found in milk from smoking mothers, which would exacerbate the energy deficit induced by low milk volumes, and lead to the need for complementary food supplementation.[48] In contrast, one large study associated the lower motivation to breastfeed as the largest risk factor rather than a physiological effect of smoking on their milk supply.[51] Of importance, mothers who quit smoking, including mothers who relapse post-partum, have better breastfeeding outcomes than smokers when it comes to breastfeeding duration, suggesting this risk factor is potentially modifiable.[42,48,50]

A third potentially modifiable factor is the percent of mothers who gave birth by cesarean. These women have a higher risk of poor breastfeeding outcomes.[38,45] A Prince Edward Island study conducted in 2004 and 2005 found that a vaginal birth versus a cesarean birth was associated with higher exclusive breastfeeding at one month (adjusted

odds ratio [AOR]=2.42, 95% confidence interval [CI]=1.05-5.55).[68] Among Nova Scotia mothers, 30.8% delivered by cesarean section, 5% above the Canadian average.[23] The four most important indicators for cesarean birth among Nova Scotia mothers mirror Canadian mothers: repeat cesarean, dystocia (difficult childbirth), breech presentation, and non-reassuring fetal heart rate.[69] Beyond these indications, the Reproductive Care Program of Nova Scotia attributes the rising rate of cesarean sections to a higher proportion of nulliparous women over time, a higher proportion of pregnancies in older women, and a higher proportion of obese mothers.[69]

Not surprisingly, intention to breastfeed is very strongly associated with breastfeeding duration. An English study found that women who intended to breastfeed for less than one month compared to women who intended to breastfeed for at least four months had a far higher risk of not breastfeeding at six months (AOR=8.1, 95% CI=6.4–10.1).[51] Intention alone, however, may be insufficient to meet current breastfeeding recommendations: in their cohort study of primiparous mothers who planned to breastfeed exclusively for at least six weeks, Semenic and colleagues found no association between intention to breastfeed exclusively for six months and exclusive breastfeeding to six months. Notably in Nova Scotia, intention to breastfeed is nearly 10% lower than the Canadian average.[23]

2.3 Framework and Operationalization for Understanding Breastfeeding Outcomes

Although many factors are known to be associated with breastfeeding behaviours, there are many other factors whose association with breastfeeding has yet to be adequately explored. Glanz, Rimer, and Lewis outline five broad levels of social-ecological influence for health related behaviours: intrapersonal, interpersonal, institutional or organizational, community, and public policy (Figure 2-1, p23).[70] Each of these levels affects breastfeeding outcomes to some extent. In addition, a reciprocal causation relationship between a mother's breastfeeding behaviours and her environment exists: not only is breastfeeding influenced by the social environment, the action of

choosing whether to breastfeed also influences the environment. Ideally, one should have data available for all of these levels, although this is not always possible in the real world.

This thesis will attempt to operationalize the social ecological model for exclusive breastfeeding (Table 2-2, p19). In doing so, a theoretically grounded model for comparison with the statistically-driven models will be offered. The major limitation of operationalizing this model is the imperfect choice of variables that could potentially act as proxies for environmental constraints, especially at an institutional, community, or societal level.

2.3.1 Intrapersonal Level

With respect to exclusive breastfeeding, mothers acquire breastfeeding skills and knowledge through prenatal education, initial post-partum breastfeeding experiences in hospital, and previous pregnancies. Multiparous mothers likely have practical experience, so they are more likely to have stronger breastfeeding skills. Women who engage in prenatal education likely have stronger knowledge about the challenges and benefits associated with breastfeeding, leading to a stronger foundation to develop breastfeeding skills. Initial post-partum breastfeeding experience includes whether a mother initiates breastfeeding in hospital. A woman can also receive support in-hospital from trained lactation consultants or nurses to improve breastfeeding ability. Within the variables available for analysis, factors that influence this domain include: whether a mother accessed prenatal education; previous breastfeeding experiences, of which the mother's parity is a proxy; early breast contact; and breastfeeding initiation.

Behavioural intention measures an individual's intention to perform a behaviour.[71] Strong intention to breastfeed is critical for exclusive breastfeeding: without some intention to exclusively breastfeed, a woman is unlikely to initiate breastfeeding, let alone exclusive breastfeeding by ensuring no water or formula is provided to her child in hospital. For this analysis, I will use intention to breastfeed, collected at a pre-natal visit or at admission to hospital at time of delivery.

There are no variables available for analysis that could serve as a proxy for the three predictors of intention: a person's attitude, subjective norms, and perceived behavioural control. An attitude is the sum of personal beliefs.[71] A mother can have

multiple positive and negative beliefs about breastfeeding; however, her attitude is based on the evaluation of her beliefs. A mother's attitude towards breastfeeding is a function of whether her beliefs that breastfeeding will lead to more benefits, such as improved health and economic benefits, for herself and her baby are stronger than her beliefs that breastfeeding will lead to bad outcomes, such as pain associated with latching or frustration at achieving proper milk flow. A subjective norm is an individual's perception of expectations from people or groups who are important to him or her about performing a behaviour.[71] A mother's subjective norms towards breastfeeding are influenced by whether other significant people in her life think she should or should not breastfeed. If she has a supportive partner and family, she will be motivated to comply with those norms; in contrast, if her partner and family are unsupportive of breastfeeding, she may feel social pressure not to breastfeed. Further, if the mother has family or friends who breastfed, she may be influenced by their success. Finally, perceived behavioural control is an individual's perceived ease or difficulty of performing a behaviour.[71] The more the mother perceives that she *can* breastfeed, that she has or can develop the necessary skills and abilities to breastfeed including to overcome challenges associated with breastfeeding, the stronger her breastfeeding self-efficacy.

Demographic, personality, attitudinal, and other individual factors indirectly influence breastfeeding behaviours. Here, women from similar backgrounds may hold similar beliefs with respect to one aspect of breastfeeding while holding very different beliefs about another. For instance, a well-educated mother is more likely to know and understand the benefits of breastfeeding, and her partner is more likely to be supportive of breastfeeding. As such, her attitude and norms will favour intention to breastfeed more than a poorly educated woman. If a woman smokes throughout pregnancy, she is also more likely to practice other health-compromising behaviours. As such, she is less likely to have a strong positive attitude towards breastfeeding than a mother who does not smoke or quit smoking when she learned about her pregnancy. For this analysis, I will examine factors that indirectly influence whether a mother chooses to breastfeed. These include: maternal age, maternal education, mother's prenatal education, smoking status, and pre-conception folic acid supplementation.

2.3.2 Interpersonal Level

At the least complex level, if a women's environment constrains breastfeeding, she is far less likely to breastfeed. For instance, if her partner does not believe in breastfeeding, she may choose not to breastfeed, or if her workplace colleagues are not supportive of breastfeeding, she may choose to cease breastfeeding earlier than if they were supportive of breastfeeding. For the analysis in this study, marital status will be used as loose proxy for partner support. No variables are available that directly represent the influence from friends, families, or breastfeeding peers; however, neighbourhood income quintile will be used as a loose proxy for the type of breastfeeding support a woman might receive from her interpersonal relationships.

Exclusive breastfeeding is not recommended for some mothers and infants. For instance, infants born at less than 32 weeks gestational age or weighing less than 1,500 grams may require other food in addition to breast milk.[17] Many of these premature babies will be in the special care nursery, so the mother may be physically unable to contact her infant. Further, if the mother worries about potentially harmful drugs passing into her breast milk, she will also be constrained from breastfeeding. Other mothers may choose to halt breastfeeding due to nipple soreness and cracks. For this analysis, I will use variables such as 3rd or 4th degree lacerations and delivery type as a loose proxy for complicated births that might make breastfeeding more difficult in the mother. I will use pre-term birth and admittance to the special care nursery as proxies for breastfeeding contraindications in the infant.

2.3.3 Institutional Level

This level of influence stems from many environments where social relationships occur including workplaces; childcare availability; community locations such as schools, libraries, restaurants, or recreational sites; and support from medical institutions and professionals such as hospitals, doctor's offices, and lactation professionals. For instance, if a mother has no support from her workplace to take pumping or nursing breaks, or even if the workplace is supportive, but it has no room to nurse or pump in privacy, a mother may be less inclined to exclusively breastfeed for six months. Since

data for this study comes from existing hospital and public health databases, there are no variables in the model that could represent these institutions.

Hospital policies, such as ensuring the implementation of the WHO 10-step Baby Friendly Health Initiative, are also influential on breastfeeding outcomes in Canada.[19] If a hospital's standard practice is to help a mother initiate breastfeeding only if she asks for assistance or to separate the newborn and mother after birth, this will make it far more difficult for the mother to initiate exclusive breastfeeding. No variable exists in the dataset that could represent hospital policies or available lactation counseling services; however, none of the hospitals in Cape Breton District Health Authority (CBDHA) and Guysborough Antigonish Straight Health Authority (GASHA) where babies are born or the IWK Health Centre in Halifax (where some high-risk infants from GASHA or CBDHA are born) are currently designated as "Baby Friendly".[72]

Lastly, women who live in more rural locations may find it more difficult to access public health services that offer lactation counseling. For this analysis, forward sortation area from the mother's postal code will be used as a measure of rural locations. Further, mother's DHA and county of residence are considered as a proxy for institutional influences.

2.3.4 Community Level

The community level encompasses the relationship among institutions and organizations that either lead to supporting or hindering women to breastfeed. At this level, entities such as civic and faith organizations, public health services, breastfeeding advocacy and support organizations, the health care system, industry, and media come into play. For instance, when hospitals accept money, gifts, and samples from the formula industry, they are more likely to push formula use in the hospital. In contrast, if breastfeeding advocacy organizations like the La Leche League have a strong presence in the community, mothers may feel more supported to exclusively breastfeed for at least six months. Cultural attitudes towards breastfeeding are also important as they heavily influence individuals who have relationships with the mother at the institutional and interpersonal levels.[73]

No variables within the database exist to represent this level; however, I will use infant's year of birth as a proxy for the timing of external influences such as government media campaigns and flu pandemics that may promote or hinder breastfeeding. For instance, Public Health Services in Nova Scotia implemented their Business Continuity Plan during the 2009 H1N1 influenza outbreak.[74] This disruption of services, which included postpartum visits, may have impacted breastfeeding rates.

2.3.5 Public Policy

At a human rights level, all women in Nova Scotia have the right to breastfeed their child in any public location and workplace.[75] Despite this, some breastfeeding mothers feel uncomfortable breastfeeding at their workplace and in public places in their community. At the public policy level, Health Canada has recommended since 2004 that all healthy infants be exclusively breastfed for the first six months of their life.[12] Within Nova Scotia, the government is expending considerable effort to support its 2010-2011 mandate statement to "improve the health status of mother and babies by increasing breastfeeding duration in Nova Scotia" by 2015.[25] There are no variables in this analysis that can serve as proxies for the public policy level of influence.

2.4 Summary

Breastfeeding is a complex behaviour, shaped by a multitude of influences at different levels (Table 2-1, p19). While there is strong, consistent evidence that shorter exclusive breastfeeding duration is associated with some predictors such as a lower level of maternal education, evidence is either conflicting or scarce for many suspected influences such as receiving epidural analgesia during labour. Many of these predictors are social determinants of health, which are difficult to change in the short-term, whereas others are potentially, albeit challenging, to modify such as maternal smoking during pregnancy, obesity, cesarean birth, and no intention to breastfeed.

This thesis will examine the associations between breastfeeding practices and a wide variety of potential breastfeeding predictors including sociodemographic factors,

pregnancy-related behaviours and factors, maternal breastfeeding intention, birth-related factors, and infant health factors. It will also attempt to operationalize the social ecological model for breastfeeding to help conceptualize a predictor's level of influence.

Table 2-1 Factors, after adjusting for other variables, positively associated with breastfeeding exclusivity and duration in Canadian studies conducted after 1995

	Yang†	Simard†	Dubois	Clifford	Semenic	Millar†	Kehler	Al-Sahab
Breastfeeding Outcome	Any BF at 6 months	Any BF at 6 months	EBF at 4 months	"Full"‡ BF to 6 months	EBF to 6 months	EBF at 6 months	ABF cessation before 6 months	EBF at 6 months
Study Design	Cross-sectional	Cohort	Cross-sectional	Cohort	Cohort	Cross-sectional	Cohort	Cross-sectional
Sample Size	1,113			856	189	7,266	1,147	5,615
Location	Alberta (NPHS)	Quebec	Quebec	London ON	Montreal QC	Canada (CCHS)	Calgary AB	Canada (MES)
Collection Date of Study Data	1996/97	1996/97	1998	1999	2003	2003	2005/06	2006
Factors Protective of Breastfeeding	**Better Breastfeeding Patterns**							
Sociodemographic Factors								
Mother has partner	No	No	No	No	N/A	No	No	Yes
Higher level of maternal education	No	Yes	Yes	No	No	Yes	Yes	Yes
Higher level of paternal education	—	No	—	—	—	—	—	—
Higher income level	No	No	No*	No	—	No	No	No*
Older maternal age for present birth	Yes	No	Yes	No*	No	Yes	No*	No*
Older maternal age at first pregnancy	—	—	—	—	—	—	—	Yes
Mother "White" or "Non-Immigrant"	Yes	No	—	—	—	No	No	No*
Urban location of residence	—	—	—	N/A	N/A	Yes	N/A	No
Mother lives in Western Canada	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes
At least one parent works	—	—	No	—	—	—	—	—
Homemaker employment status	—	—	—	Yes	—	—	—	—
No shift work prior to delivery	—	—	—	No	—	—	—	—
Pre-Pregnancy Factors								
No maternal history of depression	—	—	—	—	—	—	No*	—
Lower pre-pregnancy BMI (non-obese)	—	—	—	—	—	—	Yes	Yes
Higher parity	—	Yes	—	—	N/A	—	—	Yes
No history of domestic abuse	—	—	—	—	—	—	No	—
No parental history of atopy	—	—	—	No	—	—	—	—
Pregnancy-Related Behaviours and Factors								
Prenatal class attendance	—	—	—	No	Yes	—	—	No
Non-physician prenatal care provider	—	—	—	—	—	—	—	No*
Lower number of prenatal visits	—	—	—	—	—	—	—	No

	Yang[†]	Simard[†]	Dubois	Clifford	Semenic	Millar[†]	Kehler	Al-Sahab
Higher social support during pregnancy	—	—	—	No*	—	—	No*	Yes
Higher maternal health during pregnancy	No	—	—	—	—	—	—	Yes
No health problems during pregnancy	—	—	—	—	—	—	—	No*
Stressful events/anxiety during pregnancy	—	—	—	—	—	—	Yes	No
No depression during pregnancy	—	—	—	—	—	—	No*	—
Higher self-esteem during pregnancy	—	—	—	—	—	—	No	—
Mother met recommended exercise level	No	—	—	—	—	—	—	—
Lower weight gained during pregnancy	—	—	—	—	—	—	—	No
Higher quality of mother's diet	—	No	—	—	—	—	—	—
No alcohol drinking during pregnancy	No	No	—	No	—	—	No	No
No smoking during pregnancy	Yes	No	—	Yes	—	—	No*	Yes
No recreational drugs during pregnancy	—	No	—	—	—	—	No	—
No caffeine during pregnancy	—	—	—	Yes	—	—	—	—
Parental Beliefs and Intention								
Previous BF experience	—	—	—	Yes	N/A	—	—	—
Pro-breastfeeding paternal feeding belief	—	—	—	—	No*	—	—	—
Pro-breastfeeding maternal feeding belief	—	—	—	—	No*	—	—	—
Intention to exclusively BF to six months	—	—	—	—	No	—	—	—
Mother happy to be pregnant	—	—	—	—	—	—	—	No
Delivery-Related Factors								
Non-hospital birth location	—	—	—	—	—	—	—	Yes
Vaginal birth	—	—	—	No	Yes	—	—	Yes
No obstetric anesthesia/analgesia	—	—	—	Yes	—	—	—	—
Rooming in of infant	—	—	—	No	—	—	—	—
Higher labour support	—	—	—	No	—	—	—	—
Infant Health Factors								
Female infant sex	—	—	—	No	—	—	No	—
Higher gestational age/full-term infant	—	—	—	N/A	N/A	—	No	No*
Higher infant birth weight	—	No	—	—	No	—	No	No*
Infant not admitted to NICU	—	—	—	—	—	—	—	Yes
Infant not hospitalized after birth	—	—	—	—	—	—	—	No*
Infant colicky post-birth	—	—	—	No	—	—	—	—

	Yang†	Simard†	Dubois	Clifford	Semenic	Millar†	Kehler	Al-Sahab
Postpartum Factors								
No in-hospital formula supplementation	—	—	—	—	Yes	—	—	—
Fewer breastfeeding problems	—	—	—	—	No	—	—	—
Higher breastfeeding self efficacy	—	—	—	—	Yes	—	—	—
Higher post-partum support	—	No	—	—	No	—	—	No*
Lower levels of postpartum depression	—	—	—	No*	—	—	No	No
Mother does not plan to return to work within first six months/year after birth	—	—	—	No*	No	—	Yes	Yes
Lower levels of postpartum anxiety/stress	—	No	—	Yes	—	—	—	—
BF is scheduled instead of on cue	—	—	—	No	—	—	—	—
Pacifier use post-birth	—	—	—	No	—	—	—	—
Later introduction of solid foods	—	Yes	N/A	N/A	N/A	N/A	N/A	N/A
No smoking postpartum	—	Yes	—	No*	—	—	—	—
No alcohol or caffeine postpartum	—	—	—	No*	—	—	—	—
Infant's crying considered non-problematic	—	—	—	No	—	—	—	—

Note. *Abbreviations*: AB – Alberta; BMI – body mass index; CCHS – Canadian Community Health Survey; EBF – exclusive breastfeeding; MES – Maternity Experiences Survey; NICU – neonatal intensive care unit; NPHS – National Population Health Survey; ON – Ontario; QC – Quebec.

Symbols: * – Significant unadjusted association with breastfeeding outcome; N/A – not applicable (*e.g.* factor an exclusion criteria); † – Study does not present unadjusted associations (*i.e.* unadjusted odds ratios); ‡ Clifford *et al.* follow Labbok and Krasovek's definition of "full" that includes exclusive and almost exclusive breastfeeding[76]; '—' – Study does not consider factor in analysis.

Data Sources: Yang (2004)[32]; Simard (2005)[77]; Dubois (2003)[33]; Clifford (2006)[34]; Semenic (2008)[35]; Millar (2005)[18]; Kehler (2009)[36]; Al-Sahab (2010)[16]

Table 2-2 Operationalization of social ecological model of health behaviours using predictive or proxy variables available for this analysis

Level of Influence in Social Ecological Model				
Individual	Interpersonal	Organizational	Community	Societal/Public Policy
Maternal age	Delivery method	Lresidence	Infant's year of birth	None
Highest level of maternal education	3rd or 4th degree lacerations	District Health Authority of residence		
Mother's prenatal education	Epidural analgesia during labour	County of residence		
Smoking status	Pre-term birth			
Pre-conception folic acid supplementation	Admittance to special care nursery			
Pre-pregnancy body mass index	Neighbourhood income quintile			
Intention to breastfeed	Marital status			
Parity	Infant birth weight < 2,500 grams			
Early breast contact				

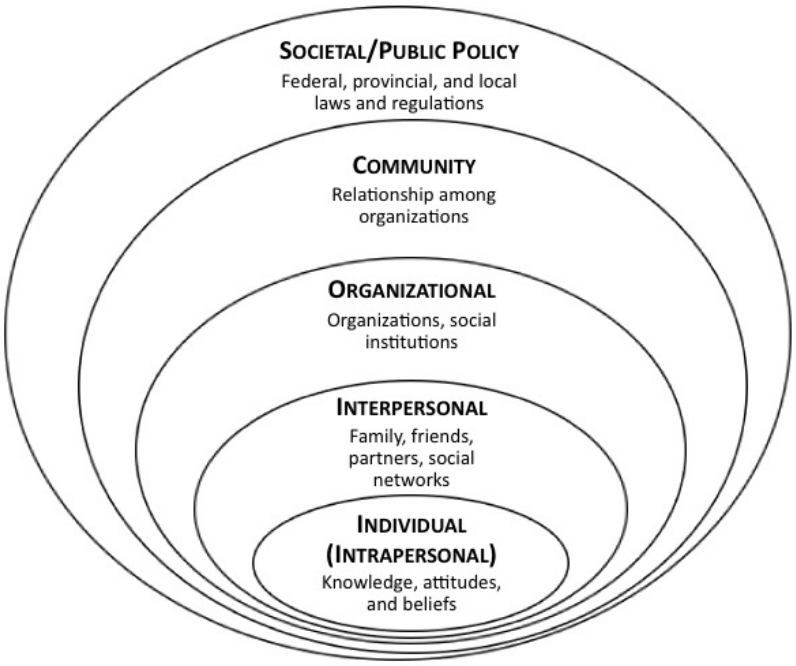

Figure 2-1 Social ecological model of health behaviours

Note: *Data Source:* Glanz, Rimer, & Lewis (2002)[70]

CHAPTER 3 RESEARCH OBJECTIVES

This study aims to quantify the rates and determinants of exclusive and any breastfeeding duration in Cape Breton District Health Authority (CBDHA) and Guysborough Antigonish Straight Health Authority (GASHA), Nova Scotia for infants born between January 1, 2004 and December 31, 2009. Specifically, the objectives are to:

I. Identify the rates and determinants of cessation of exclusive breastfeeding before six months, using statistically- and theoretically-driven models.

II. Identify the rates and determinants of cessation of any breastfeeding before six months, using statistically-driven models.

III. Identify the determinants of exclusive breastfeeding duration, including trends over time.

IV. Identify the determinants of any breastfeeding duration, including trends over time.

CHAPTER 4 METHODOLOGY

4.1 Overview of Study Design, Ethics, and Funding

This retrospective cohort study describes breastfeeding patterns of infants born between 2004 and 2009 in two District Health Authorities (DHAs) in Nova Scotia, Canada, and it uses data obtained via a record linkage between a perinatal database and a public health database. From the linked data, rates and trends of breastfeeding exclusivity and duration were determined, both in the overall population and by the DHAs. Further, the determinants of any and exclusive breastfeeding were identified and quantified.

This thesis project is a subset of a larger Nova Scotia Health Research Foundation grant led by Dr. Linda Dodds. The larger project received ethics approval from the Research Ethics Boards of the IWK Health Centre, CBDHA, and GASHA. It also received approval from the Joint Data Access Committee of the Reproductive Care Program. The Nova Scotia Health Research Foundation and the IWK Graduate Student Research Scholarship provided funding for this project.

4.2 Data Sources

This study uses data from the Public Health Database (PHD) and the Nova Scotia Atlee Perinatal Database (NSAPD) for the cohort of infants born in CBDHA and GASHA between January 1, 2004 and December 31, 2009. Data collection began for the PHD in January 2004. This time period allows analysis of trends in the proportion of mothers who ceased exclusive breastfeeding before six months between 2004, when the Health Canada guidelines shifted from recommended four-to-six months to six months of exclusive breastfeeding, and 2009, five years after the recommended shift. The linked database holds records that follow 6,437 women from their first prenatal visit until their infant became six months old.

Using each mother's provincial health card number, mother's date of birth, and infant's date of delivery, an authorized researcher through the IWK Health Centre linked

the NSAPD to the PHD using deterministic methods. A woman appears twice in the linked file if she gave birth to more than one live child between January 1, 2004 and December 31, 2009. For multiple births, infants were linked using birth weight. All major identifiers such as health card numbers, names, birthdates, and postal codes were stripped before the restricted access was given to the analysis file.

4.2.1 Healthy Beginnings Public Health Database

As one of four key programs within its Early Childhood Development Initiative, Nova Scotia's Public Health Services launched the Health Beginnings Enhanced Home Visiting Initiative in June 2002. This program enhanced Nova Scotia's pre-existing perinatal programs by funding a universal screening of infants shortly after birth to identify families who are facing significant life stressors such as poverty, unemployment, abusive relationships, and children with developmental delays. Following identification, families are supported through enhanced home visiting and referrals to other community resources.[78] Uniquely in Nova Scotia, on January 1, 2004, Public Health Nurses (PHN) in CBDHA and GASHA began collecting additional information on breastfeeding patterns of all mothers as part of the Healthy Beginnings database. This included mothers' self-reported breastfeeding status collected prospectively at time of hospital discharge and at five well-baby checks (timed at one and six weeks; two, four, and six months after birth).

Specifically, this database contains information on the type of breastfeeding at each time point: whether breastfeeding is exclusive breastfeeding (including expressed breast milk), breastfeeding with supplementation, or stopped breastfeeding. For women who stopped breastfeeding, nurses recorded the reason for stopping and mothers could provide an open-ended detailed response. In addition to data regarding breastfeeding, this database contains information regarding two other maternal factors: highest level of maternal education and the extent of prenatal education the mother received.

The PHD is located and maintained at the Public Health Service offices in Sydney (CBDHA) and Antigonish (GASHA), Nova Scotia. PHN collected breastfeeding data

through the use of telephone or face-to-face interviews. If the follow-up was late, the PHN recorded the breastfeeding information for the intended visit time.

Quality controls are regularly performed on the PHD.[74] All PHN from GASHA and CBDHA received standardized training on how to input data into the PHD. A data entry guide is also available for PHN to consult.[79] Each mother is assigned a single PHN. When the PHN opens the Health Beginnings Database, the PHN receives automated notifications indicating when a mother requires a breastfeeding follow-up. If the PHN attempts to contact the mother, but is unsuccessful connecting with her, the PHN makes three separate contact attempts with the mother before stopping contact attempts. For these women who are lost to follow-up, the PHN forwards the mother's file to her manager as an exception report for incomplete breastfeeding data. Managers, of whom there is one in each DHA, can close files with incomplete breastfeeding data. For other situations that result in incomplete breastfeeding data (*e.g.* the mother moved and public health services do not know the new contact information), the PHN is responsible for forwarding the mother's file to the manager to close the file from further follow-up with the mother.[74]

Despite these quality controls, mother's highest level of education is missing for 36% of files. Further, among mothers who initiated breastfeeding, 27% were lost to follow-up at some point prior to six months postpartum. Treatment of missing data is discussed later in the methodology chapter.

4.2.2 Nova Scotia Atlee Perinatal Database

The PHD was linked with the Nova Scotia Atlee Perinatal Database, which includes all hospital deliveries in Nova Scotia and which began data collection in 1988. The NSAPD contains extensive maternal, prenatal, labour, delivery, and in-hospital breastfeeding information for all pregnancies that resulted in the birth of an infant. The Reproductive Care Program of Nova Scotia maintains the Atlee database, which is located at the IWK Health Centre in Halifax, Canada.

This database captures information on all hospital births of Nova Scotia residents, including mothers who gave birth in New Brunswick. Mothers who delivered infants at

home before 2009 are not captured. Trained coders abstract and enter information into the NSAPD from standardized-clinical prenatal forms, labour and delivery records, and post-partum records following established coding manuals.[80] Data entry quality is regularly verified. The extent of missing data is close to 0% for labour, delivery, and infant factors. Smoking data is missing in about 7% of the records and pre-pregnancy weight is less complete, with about 18% of data missing. Height is the least complete with 26% missing.

4.3 Study Population

This study examines the cohort of infants born to mothers residing in CBDHA and GASHA between 2004 and 2009. Together, these two DHAs represent approximately 17% of Nova Scotia's births.[81] As reported in the most recent Canadian Community Health Survey Summary Report to the DHAs (2005), breastfeeding initiation among CBDHA mothers is 15% below the Nova Scotia average of 75.1%, and the rate of exclusive breastfeeding at four months among CBDHA mothers is 6% below the Nova Scotia average of 36.5%. In contrast, breastfeeding initiation among GASHA mothers is slightly above the provincial average, while the rate of exclusive breastfeeding at four months among GASHA mothers is 12% above the Nova Scotia average.[28] No published data at the DHA level are available for the rates of exclusive breastfeeding at six months.

CBDHA has a shrinking population, estimated in the 2006 census at 125,375 individuals. About 5% of CBDHA's population is Aboriginal, and 1.5% identify as a visible minority. The median income for families living in CBDHA is $49,231, over $6,000 below the Nova Scotia average and $13,000 below the Canadian average.[81] On average, CBDHA residents have poorer health than the rest of Nova Scotia: over 80% of individuals report at least one chronic health condition. Further, CBDHA residents are at higher risk for a number of health-compromising behaviours compared with the provincial average including smoking (28.6% *vs.* 22.0%), physical inactivity (58.2% *vs.* 49.5%), being overweight or obese (63.4% *vs.* 50.9%), and inadequate fruit and vegetable consumption (72.3% *vs*. 56.2%).[82]

GASHA also has a shrinking population, estimated in the 2006 census at 44,815 residents. Similar to CBDHA, GASHA is largely Caucasian: 3.4% of GASHA's population identify as Aboriginal and 2.1% identify as a visible minority. The median income for families living in GASHA is $51,343, over $4,000 below the Nova Scotia average and $11,000 below the Canadian average.[81] On average, individuals in GASHA tend to be healthier than CBDHA. Compared to the Nova Scotia average, individuals in GASHA have lower smoking rates (18%) and higher physical activity levels (56%); however, they are more overweight or obese (68%) and have an inadequate fruit and vegetable consumption (61%).[83]

The inclusion criterion for this study is all newborns having a live birth in Nova Scotia whose mother resided in CBDHA and GASHA between January 1, 2004 and December 31, 2009. Nova Scotia residents who migrated into either DHA within the infant's first six months of life, thereby captured in the PHD, are also included.

While the original intention was to include all infants, the unadjusted and multivariate analyses were restricted to infants born between 2006 and 2009. This restriction was enacted since the percent of missing data in 2004 and 2005 is greater than 50% for two important predictive variables of interest, highest level of maternal education and pre-pregnancy BMI. Further, throughout 2004 and some of 2005, a data entry person back entered the breastfeeding information from paper tracking sheets; in subsequent years, public health nurses entered the breastfeeding information during or immediately after the follow-up telephone or in-person visit.[74] This back entry of data resulted in a large amount of incomplete follow-up: 711 mothers in 2004 and 2005 were known to have initiated breastfeeding and to have stopped breastfeeding by four months, but no information on breastfeeding type was available at hospital discharge, at one and six weeks, and at two months. The 1,719 infants born in 2004 and 2005 were eliminated from the analysis due to these concerns.

Multiple births were excluded from the primary analyses. This was primarily since multiple births have unique feeding challenges, although also to preserve independence of participants. Siblings were included, although statistical adjustments discussed in the data analysis section were performed to account for non-independence. Live infants whose birth weight was less than 500 grams or whose gestational age was

less than 20 weeks were excluded. Finally, when a deterministic linkage between databases was not possible, the infant was excluded.

4.4 Study Measures

4.4.1 Breastfeeding Variables

Infants were considered exclusively breastfed if the mother indicated at a follow-up that she provided her infant only breast milk. Feeding was considered supplementary if the mother indicated at a follow-up that she supplemented breast milk with formula, cow's milk, water, or other foods. Any breastfeeding includes infants whose feeding was either exclusive or supplementary.

Eight breastfeeding variables are available from the PHD: 1) never breastfed; 2) breastfeeding initiated, but stopped before hospital discharge; 3) breastfeeding type at hospital discharge; 4) breastfeeding type at one week; 5) breastfeeding type at six weeks; 6) breastfeeding type at two months; 7) breastfeeding type at four months; and 8) breastfeeding type at six months. The values of never breastfed were reversed to derive a dichotomous breastfeeding initiation variable. For each of the six breastfeeding follow-up time points, breastfeeding was categorized as exclusive, supplementary, or stopped.

Six primary breastfeeding patterns are considered in this analysis: cessation of exclusive breastfeeding (EBF) before six months; cessation of any breastfeeding (ABF) before six months; cessation of EBF before six weeks; cessation of ABF before six weeks; among mothers who initiated breastfeeding, duration of EBF; and, among mothers who initiated breastfeeding, duration of ABF. Cessation of EBF and ABF before six months were both dichotomized using the variable breastfeeding type at six months. If the mother was exclusively breastfeeding at six months, then EBF was considered to have *not ceased* before six months; otherwise, if the mother was supplementary breastfeeding or had stopped breastfeeding before or at six months, then EBF was considered to have ceased before six months. Similarly, if the mother was exclusively or supplementary breastfeeding at six months, then ABF was considered to have *not ceased* before six months; otherwise, if the mother had stopped breastfeeding before or at six months, then ABF was considered to have ceased before six months. Cessation of EBF and ABF

before six weeks were dichotomized using the variable breastfeeding type at six weeks in the same manner.

Breastfeeding duration was the time, measured in months, between the infant's birth and when the infant stopped exclusive or any breastfeeding. Duration was derived by interval censoring the follow-up data using mid-point imputation (Figure 4-1, p47). Specifically, EBF duration was the time between the previous assessment where the mother did report exclusive breastfeeding and the following visit where she had introduced supplementary feeding or had stopped breastfeeding altogether. ABF duration was the time between the previous assessment where the mother did report exclusive or supplementary breastfeeding and the following visit where she had stopped breastfeeding altogether. For mother-infant pairs who never initiated breastfeeding, duration was 0 months. If the mother was lost to follow-up (*i.e.* breastfeeding initiation is confirmed, but at later time points, there is no information on when a mother stopped breastfeeding), breastfeeding duration was right censored using left-point imputation. Table 4-1 (p41) shows the derivation of EBF duration and Table 4-2 (p44) shows the derivation of ABF duration for the observed permutations of breastfeeding follow-up visits.

To remove the logical inconsistencies noted in the PHD breastfeeding data (*e.g.* for a particular mother-infant pair, the dataset indicates the mother never initiated breastfeeding, but at a later time point was exclusively breastfeeding), the dataset was systematically reviewed. Rules were developed to uniformly handle the logical inconsistencies. The "cleaned-up" dataset assumes women who are not breastfeeding during the first week after birth can resume exclusive or supplementary breastfeeding at a later time point as if they had not stopped. This assumption is consistent with other Canadian studies[34,35] that have used Labbok and Krasonec's definition of "almost exclusive breastfeeding" for exclusive breastfeeding.[76] Indeed relactation, where a nursing mother resumes breastfeeding after stopping, is more likely to occur with younger newborns and with shorter gaps since the infant last suckled.[84] After the first week post-discharge, however, the "cleaned-up" dataset assumes that the types of breastfeeding are inherently sequential, so that the feeding type can only progress from exclusive to supplementary to stopped. In contrast, the "hierarchical" dataset assumes that breastfeeding from initiation is inherently sequential, so that a women cannot resume

breastfeeding if she stops. This assumption is necessary for survival analyses. The following rules were developed to make the necessary transformations of the breastfeeding PHD variables for the analysis:

Cleaned-up dataset:

1. If "BF initiated" is "Yes" and "BF at discharge" is "Exclusive" or "Supplementary", but "BF initiated but stopped before discharge" is "Yes", then change "BF initiated but stopped before discharge" from "Yes" to "No".
2. If "BF initiated is "Yes" and "BF at discharge" is "Stopped", but "BF initiated but stopped before discharge" is "No", then change "BF initiated but stopped before discharge" from "No" to "Yes".
3. If "BF initiated" is "No", but "BF type at discharge" is "Exclusive" or "Supplementary", then change "BF initiated" from "No" to "Yes".
4. If "BF initiated" is "Yes", but "BF at discharge" is "Stopped" and "BF initiated but stopped before discharge" is "No", then change "BF initiated" from "Yes" to "No".
5. If "BF initiated" is "Yes" and "BF initiated but stopped before discharge" is "Yes", but "BF at discharge" is missing, then change "BF at discharge" from missing to "Stopped".
6. If "BF at discharge" or "BF at week 1" is "Stopped", but at a later time point is "Exclusive" or "Supplementary", then change nothing.
7. If "BF at discharge" or "BF at week 1" is "Supplementary", but at a later time point is "Exclusive", then change nothing.
8. Starting at six weeks, if BF type at a later time point is "Exclusive", but BF type at an earlier time point is "Supplementary", "Stopped", or missing, then change BF type at the earlier time point(s) to "Exclusive".
9. Starting at six weeks, if BF type at a later time point is "Supplementary", but BF type at an earlier time point is "Stopped" or missing, then change BF type at the earlier time point to "Supplementary".

Hierarchical dataset:

1. From the Cleaned-up Dataset, if "BF at discharge" and/or "BF at week 1" is "Stopped" or "Supplementary", but at a later time point breastfeeding is "Exclusive", then change "BF at discharge" and/or "BF at week 1" to "Exclusive".
2. From the Cleaned-up Dataset, if "BF at discharge" and/or "BF at week 1" is "Stopped", but at a later time point is "Supplementary", then change "BF at discharge" and/or "BF at week 1" to "Supplementary".

4.4.2 Predictive Variables

This study considered 25 predictive variables for analysis. Treatment of predictive variables is described in Table 4-3 (p45). Additional detail about certain variables is provided below.

Mother's postal code linked to Canadian census data was used as an approximation for neighbourhood income quintile, although this method was used with caution since it is an aggregate value estimated from census data applied to the individual level.[85] Categorization of mother's neighbourhood income quintile in the NSAPD was performed by the Reproductive Care Program of Nova Scotia.

Urban and rural location of residence was distinguished using Canada Post's forward sortation areas (FSA). An FSA is a geographic region in which all postal codes are represented with the same first three alpha-numeric characters.[86] Canada Post distinguishes rural from urban FSA through the second character: if the numeral is 0, the FSA is considered rural whereas if the numeral is 1-9, the FSA is considered urban. This distinction is somewhat arbitrary since Canada Post defines rural as areas where there are no letter carriers.[87] Notwithstanding this limitation, urban and rural location of residence were dichotomized into urban (for FSA 1-9) and rural (for FSA 0).

Boundaries of district health authorities do not align with county boundaries in Nova Scotia (Figures 4-2 and 4-3, p48). Cape Breton and Victoria counties are located entirely in CBDHA, and Antigonish and Guysborough counties are located entirely in GASHA. Inverness and Richmond counties are distributed between the two DHAs.

No Canadian standards for body weight classification exist for females less than 18 years old; however, Health Canada recommends at the population level using the cut-offs proposed by Cole and colleagues.[88] In contrast, the Institute of Medicine suggests that adolescent pre-pregnancy body mass index (BMI) can be adequately categorized using adult cut-offs.[89] Therefore, for women of all ages, mother's pre-pregnancy BMI was derived using the formula BMI = pre-pregnancy weight (in kg) / height (in m)^2. This continuous variable was classified into four categories following the *Canadian Guidelines for Body Weight Classification in Adults* criteria: underweight (< 18.5), normal (18.5 ≤ BMI < 25), overweight (25 ≤ BMI < 30), or obese (≥ 30).[90]

Gestational weight gain was abstracted from the difference between in-hospital pre-delivery weight with pre-pregnancy weight. This continuous variable was then classified into three categories following the Institute of Medicine's 2009 GWG guidelines (Table 4-4, p46): sub-optimal (less than recommended GWG), optimal (within the recommended GWG), and excessive (exceeded the recommended GWG).[89]. Health Canada defers to the Institute of Medicine GWG guidelines.[91]

Maternal smoking status was classified into one of three categories: non-smoker, smoker who quit during pregnancy, and smoker throughout pregnancy. Non-smokers include mothers who did not smoke any cigarettes at pre-pregnancy, at first pre-natal visit, or at time of admission for delivery. Smokers who quit during pregnancy include mothers who smoked at least one cigarette pre-pregnancy or at the first pre-natal visit, but had ceased smoking at admission for delivery. Smokers throughout pregnancy include mothers who smoked at least one cigarette at admission for delivery.

Health condition during pregnancy was derived from five other variables: if the mother suffered from any one of pre-existing diabetes, gestational diabetes, pre-existing hypertension, pregnancy induced hypertension, or hyperemesis gravidum, she was classified as having a health condition during pregnancy.

4. 5 Power

The cohort's size is predetermined by the number of live births in the two DHAs and by the number of these women who initiate breastfeeding. Over the four years of the

study, 4,533 dyads are available, of whom 413 exclusively breastfed for the recommended six months. For a multiple regression analysis, it is ideal to have 10 events per independent variable.[92] Since 25 predictive variables are examined, with 413 events, there should be adequate power to perform any combination of the factors.

Smallest detectable relative risk calculations for smoking and obesity were performed assuming a level of significance (α) of 0.05 and a power ($1 - \beta$) of 80%. Despite evidence from the literature supporting the likelihood that smokers and obese mothers are less likely to breastfeed exclusively, to be conservative, a two-sided test was used. All power calculations were conducted using OpenEpi software.[93]

Nova Scotia data from the Public Health Agency of Canada's *2008 Perinatal Report* provided prevalence estimates for smoking and obesity. Based on reported breastfeeding rates from the Maternity Experiences Survey, a conservative rate of exclusive breastfeeding at six months of 9% was used.[23] Maternal smoking rates are estimated at 23.6%.[65] Given 4,500 mothers, 1,062 are assumed to smoke, providing 3.24 non-smoking mothers per smoking mother. The anticipated effect size is 1.5 as estimated in a meta-analysis.[48] Given the ratio of sample size and desired effect size, at least 2,807 mothers are required, well within the cohort's sample size.

Obesity rates in Canadian mothers are estimated at 13.6%.[65] Given 4,500 mothers, 612 are assumed to be obese, providing 6.35 non-obese mothers per obese mothers. Although no meta-analysis exists on the association between obesity and breastfeeding, a systematic review suggests the relative risk lies between 1.5 to 2.5.[43] Given the ratio of sample size and desired effect size, at least 4,243 mothers are required, within the cohort's sample size.

A similar effect size is anticipated for most predictive variables, except those with very low prevalence or high variability.

4.6 Data Analysis

Unless noted otherwise, statistical significance for all analyses was defined at the 2-sided P=0.05 level. All analyses with one exception were conducted using SAS Enterprise Guide 4.2. Kaplan-Meier survival curves were plotted in SPSS 16.0.

To preserve sample size in the multivariate logistic and proportional hazard regression models, dummy "missing" categories were created for all predictive variables with greater than 10% missing between 2006 and 2009. Prevalence rates, unadjusted and adjusted relative risks, and hazard ratios are not shown for the "missing" category.

4.6.1 Objective I: Identify Rates and Determinants of Cessation of Exclusive Breastfeeding Before Six Months

The proportion of mothers who ceased EBF before six months was determined using the derived dichotomous variable cessation of EBF before six months. This analysis was restricted to mothers-infant pairs who had complete follow-up. Trends in the proportion of mothers who ceased EBF before six months between 2006 and 2009 were stratified by DHA. A Cochran-Armitage trend test was used to assess the presence of an association between infant's year of birth and ceasing EBF before six months.

To identify maternal and perinatal factors associated with cessation of EBF before six months, Cochran-Mantel-Haenszel χ^2 statistics and odds ratios using 95% confidence intervals were calculated for all predictive variables. Since the outcome of EBF at six months is so rare, these odds ratios were interpreted as relative risks.

Adjusted relative risks were determined through multivariate logistic regression. The dependent variable was whether a mother had ceased EBF before six months. To be conservative, all predictive variables with an unadjusted relative risk at $P<0.1$ were included in the model. The logistic regression models used backward stepwise modeling. No variables were forced into the model. Final predictors were considered significant using the Likelihood Ratio test. A variable was entered into the regression model if its inclusion resulted in a significant change in the -2 Log Likelihood from the previous step. A variable remained in the model if its removal resulted in a significant change in the -2 Log Likelihood. Overall model evaluation was tested using the Likelihood Ratio, Score, and Wald tests. The Homer & Lemeshow test was used to determine goodness-of-fit. The final linear regression model was rerun using a generalized estimating equation, a class of semi-parametric models, to account for non-independence among siblings.[94] Siblings accounted for 561 dyads (12.3%) among the cohort. Adjusted relative risks and

95% confidence limits are reported from the generalized estimating equation. An exchangeable correlation matrix, which assumes correlations among all siblings is equal, was used.

To test the theoretical model explaining a mother's choice to cease EBF before six months, a second multivariate logistic regression was developed. This logistic regression model used forward modeling. As previously, the dependent variable was whether a mother had ceased EBF before six months. The independent variables included were those identified in Table 2-2 (p22). Since the model predicts that each level (individual, interpersonal, organizational, community, and policy) independently influences a mother's choice to exclusively breastfeed for at least six months, the strongest predictor from each level as determined by the -2 Log Likelihood was forced into the model. Next, all remaining predictors were assessed for eligibility. If a variable was not forced into the model, it was included only if its inclusion resulted in a significant change in the -2 Log Likelihood from the previous step. As such, the final model consisted of factors that are statistically significant or that were forced into the model. This second model with strong theoretical underpinnings was qualitatively compared to the first exploratory, statistically driven model.

4.6.2 Objective II: Identify Rates and Determinants of Cessation of Any Breastfeeding Before Six Months

The rates and determinants of cessation of ABF before six months were calculated using the same methodology as Objective 1; however, as outlined in the objectives, no theoretical logistic regression model for cessation of ABF before six months was developed.

4.6.3 Objective III: Identify Determinants of Exclusive Breastfeeding Duration

For all survival analyses, the hierarchical dataset was used. A descriptive analysis of EBF duration was performed using the derived variable EBF duration for two populations: the entire cohort and for only those mothers who initiated breastfeeding.

The mean and median EBF were determined using the maximum-likelihood estimation (MLE):

(i) Mean duration EBF = 1 / MLE

(ii) Median duration EBF = (Mean duration EBF)*log(2)

where MLE = $\frac{\text{(Number of mother-infant dyads)*(Mean of censoring variable)}}{\text{(Number of mother-infant dyads)*(Mean of EBF duration variable)}}$

Since there is no simple formula for the 95% confidence interval, the presented confidence intervals contain values that would not be rejected by a likelihood ratio test.[95] This test rejects values for which the difference in 2*loglikelihood exceeds 3.841 (1.96^2, the z-score for two standard deviations from the mean). The confidence limits were determined by a systematic search of 1,001 possible values of the MLE. Trends in the mean and median EBF over time are presented. Two years were considered significantly different if the 95% confidence intervals do not overlap.

At the univariate level, Kaplan-Meier survival analysis for all predictor variables was performed. Survival curves were stratified by each level of a predictor, and differences in the survival curves were tested by a log-rank test of equality across strata. The survival curves were also visually examined for violation of the proportionality assumption.

Cox's proportional hazards regression model was used to determine which factors are independently associated with duration of EBF. Initially, to be conservative, all predictive variables with an unadjusted test of equality of $P<0.1$ were included in the model. The model was built using backward modeling. No variables were forced into the final model. Final predictors were considered significant using the Likelihood Ratio test. Hazard ratios and associated 95% confidence intervals were determined using the profile likelihood. Ties were accounted for using the exact method.

4.6.4 Objective IV: Identify Determinants of Any Breastfeeding Duration

The trends and determinants of ABF duration were examined using the same data analysis techniques outlined in Objective 3.

4.6.5 Additional Analyses of Interest

Additional analyses were performed to better understand specific sub-populations or trends. Mothers who breastfeed multiple babies have unique challenges as they try to feed two or more infants simultaneously. Further, multiple births are known to be at higher risk of complications, so these infants may be at higher risk of poorer EBF outcomes. Indeed, many previous studies have excluded this population due to these influences, so less is known about their breastfeeding patterns.[19,23,45,68,96] As such, a separate descriptive analysis was performed on this population. The proportion of multiple births who initiated breastfeeding and were EBF and ABF at six weeks and six months was compared to singleton births. For this analysis, where more than five multiple births experienced the breastfeeding outcome, a Cochran-Mantel-Haenszel χ^2 test was used; where five or fewer multiple births experienced the breastfeeding outcome, Fisher's exact test was used.

Second, intention to breastfeed was identified as the strongest predictor for better breastfeeding patterns. As such, a logistic regression analysis following the methodology outlined in Objective 1 was performed to determine the determinants of breastfeeding intention. For this analysis, only predictors that could influence a mother's intention were included. Labour and post-partum predictors such as type of delivery were excluded since they are not relevant for an analysis of breastfeeding intention.

Third, the determinants of EBF and ABF at six weeks were determined following the data analysis methodology outlined in Objectives 1 and 2. Nova Scotia has identified the first six weeks as a critical intervention window to help mothers breastfeed for longer. In 2009, Nova Scotia invested considerable resources – approximately $500,000 – in promoting breastfeeding for this duration, through a television, print and on-line advertisements, posters and bookmarks, and the Internet website www.first6weeks.ca. [97]

Finally, due to the uncertainty around trends in descriptive statistics for breastfeeding at six months and six weeks because of the high proportion of dyads lost to follow-up, a sensitivity analysis was undertaken. First, all infants with incomplete follow-up were considered to have ceased EBF before six months for a low sensitivity

estimate. Second, all infants with incomplete follow-up were considered still to be EBF at six months for a high sensitivity analysis. This sensitivity analysis was repeated for ABF at six months, EBF at 6 weeks, and ABF at six weeks.

Table 4-1 Treatment of variables in Atlee and Public Health Databases

Variable	Description	Database	Treatment of Variable
Maternal Factors			
Birth Year	Infant's year of birth	Atlee	Retained as six categories: 2004, 2005, 2006, 2007, 2008, and 2009
Maternal age	Mother's age at time of delivery	Atlee	Transformed into five categories: 19 years or younger, 20-24, 25-29, 30-34, and 35 years or older
Marital status	Marital status, as collected after delivery	Atlee	Dichotomized: no partner (including single, widowed, divorced, or separated) and partner (including married or common-law)
Mother's education level	Mother's highest education level, as collected before delivery	PHD	Collapsed from five categories into four: less than high school, graduated high school, college education, and university degree
Forward sortation area	Mother's location of area, based on forward sortation area	Atlee	* Forward sortation area dichotomized into two categories: urban (1-9) and rural (0)
Mother's DHA	NS District Health Authority mother resided in at delivery	Atlee	* Restricted to two categories: CBDHA and GASHA
Mother's county	NS county mother resided in at delivery	Atlee	* Restricted to six categories: Antigonish, Cape Breton, Guysborough, Inverness, Richmond, and Victoria
Mother's neighbourhood income quintile	Neighborhood income based on mother's postal code	Atlee	* Neighbourhood income collapsed into quintiles
Mother's height	Measured or self-reported, in metres	Atlee	Used to derive pre-pregnancy BMI and GWG category
Pre-pregnancy weight	Women's self-reported pre-pregnancy weight as reported at first prenatal visit, in kilograms	Atlee	Used to derive pre-pregnancy BMI and GWG category
Pre-pregnancy BMI	Mother's pre-pregnancy BMI	Derived	* Classified according to IOM guidelines: underweight, normal weight, overweight, and obese
Prenatal Factors			
Parity	Total number of live births and still births (GA > 24 weeks), including present pregnancy	Atlee	Dichotomized: primiparous or multiparous
Pre-natal Education	Types of pre-natal education mother received	PHD	Dichotomized: received pre-natal education, yes or no
Pre-conception folic acid supplementation	Yes or no	Atlee	None
Smoking status	Whether mother smoked pre-pregnancy, at first pre-natal visit, and at time of admission for delivery (yes or no)	Derived	* Classified into three categories: non-smoker, quit smoking during pregnancy, and smoker throughout pregnancy

Variable	Description	Database	Treatment of Variable
Pre-existing diabetes or gestational diabetes	Yes or no	Atlee	Used to derive health condition during pregnancy
Pre-existing or pregnancy induced hypertension	None, mild, or severe	Atlee	Used to derive health condition during pregnancy
Hyperemesis gravidum	Yes or no	Atlee	Used to derive health condition during pregnancy
Health condition during pregnancy	Mother experienced at least one health condition during pregnancy	Derived	* Yes or no
	Birth Factors		
Mother's pre-delivery weight	Measured weight at the time a women comes into hospital to deliver, in kilograms	Atlee	Used to derive GWG category
Mother's gestational weight gain category	GWG using mother's pre-pregnancy BMI and weight at delivery	Derived	* Classified according to IOM guidelines: sub-optimal, optimal, excessive
Number of fetuses	Singleton, twins, or triplets	Atlee	None
Labour type	Spontaneous, induction of labour, or no labour	Atlee	None
Mode of delivery	Vaginal or cesarean section	Atlee	None
3rd or 4th degree laceration	Yes or no	Atlee	None
Epidural analgesia administered during labour	Yes or no	Atlee	None
	Infant Factors		
Gestational age of infant	In weeks	Atlee	Dichotomized: pre-term (<37 weeks) and full-term (≥37 weeks)
Low infant birth weight	In grams	Atlee	Dichotomized: ≤ 2,500 grams or > 2,500 grams
Infant admitted to special care nursery	Yes or No	Atlee	None
Presence of major anomaly in infant	Yes or No (*e.g.* heart disease, Down's syndrome, cleft palate)	Atlee	None
Outcome at discharge	Fetal death before birth, fetal death in hospital, or infant lived to discharge	Atlee	None
	Breastfeeding Variables		
Intent to breastfeed	Yes or no	Atlee	None
Early breast contact (within 1	Yes or no	Atlee	None

Variable	Description	Database	Treatment of Variable
hour)			
Never breastfed	Yes or no	PHD	Used to derive breastfeeding initiation
Breastfeeding initiation	Yes or no	Derived	† None
Breastfeeding initiated, but stopped before discharge	Yes or no	PHD	Used to derive duration of EBF and ABF
Breastfeeding type at discharge, 1 week, 6 weeks, 2 months, 4 months, and 6 months	Exclusive, supplementary, or stopped	PHD	Used to derive (i) cessation of EBF and ABF before six months and (ii) duration of EBF and ABF
Cessation of EBF and ABF before six months	Yes or no	Derived	† None
Cessation of EBF and ABF before six weeks	Yes or no	Derived	† None
Breastfeeding censored	Infants censored if unknown when they stopped breastfeeding (*i.e.* lost to follow-up or still breastfeeding at six months)	Derived	None
Duration of EBF and ABF	In months	Derived	† None
Reason for stopping breastfeeding	At time point first stopped breastfeeding: open-ended answer	PHD	None

Note. *Abbreviations*: ABF – any breastfeeding; Atlee – Nova Scotia Atlee Perinatal Database; BMI – body mass index; CBDHA – Cape Breton District Health Authority; EBF – exclusive breastfeeding; GA – gestational age; GASHA – Guysborough Antigonish Straight Health Authority; GWG – gestational weight gain; IOM – Institute of Medicine; NS – Nova Scotia; PHD – Public Health Database.

Symbols: * – treatment of variable discussed at greater length in methodology, "Predictive Variables"; † – derivation of variable discussed at greater length in methodology, "Breastfeeding Variables".

Table 4-2 Derivation of exclusive breastfeeding duration in months from all observed permutations of the cohort's breastfeeding follow-up visits

Initiation	Discharge	1 week	6 weeks	2 months	4 months	6 months	Breastfeeding Duration	Censored
N							0	0
Y	N						0	0
Y	—	—	—	—	N		0	0
Y	—	N					0	0
Y	—	—	—	—	—	—	0	1
Y	Y	—	—	—	—	—	0.125	1
Y	Y	N					0.1875	0
Y	Y	Y	—	—	—	—	0.25	1
Y	Y	Y	N				0.875	0
Y	Y	Y	Y	—	—	—	1.5	1
Y	Y	Y	Y	N			1.75	0
Y	Y	Y	Y	Y	—	—	2	1
Y	Y	Y	—	—	N		2.125	0
Y	Y	Y	Y	—	N		2.75	0
Y	Y	Y	Y	Y	N		3	0
Y	Y	Y	Y	Y	Y	—	4	1
Y	Y	Y	Y	Y	Y	N	5	0
Y	Y	Y	Y	Y	Y	Y	6	1

Note. *Y(es)* indicates infant was exclusively breastfeeding at time point; *N(o)* indicates infant was not exclusively breastfeeding at time point; — indicates missing data.

For censoring, *1* indicates survival was right-censored (*i.e.* exclusive breastfeeding cessation never indicated); *0* indicates mother ceased exclusive breastfeeding.

Table 4-3 Derivation of any breastfeeding duration in months from all observed permutations of the cohort's breastfeeding follow-up visits

Initiation	Discharge	1 week	6 weeks	2 months	4 months	6 months	Breastfeeding duration	Censored
N							0	0
Y	—	—	—	—	—	—	0	1
Y	N						0.0625	0
Y	—	N					0.125	0
Y	Y	—	—	—	—	—	0.125	1
Y	Y	N					0.1875	0
Y	Y	Y	—	—	—	—	0.25	1
Y	Y	Y	N				0.875	0
Y	Y	Y	Y	—	—	—	1.5	1
Y	Y	Y	Y	N			1.75	0
Y	—	—	—	—	N		2	0
Y	Y	Y	Y	Y	—	—	2	1
Y	Y	—	—	—	N		2.0625	0
Y	Y	Y	—	—	N		2.125	0
Y	Y	Y	Y	—	N		2.75	0
Y	Y	Y	Y	Y	N		3	0
Y	Y	Y	Y	Y	Y	—	4	1
Y	Y	Y	Y	Y	Y	N	5	0
Y	Y	Y	Y	Y	Y	Y	6	1

Note. *Y(es)* indicates infant was any breastfeeding at time point; *N(o)* indicates infant had ceased to any breastfeed at time point; — indicates missing data.

For censoring, *1* indicates survival was right-censored (*i.e.* any breastfeeding cessation never indicated); *0* indicates mother ceased any breastfeeding.

Table 4-4 Recommended range of total gestational weight gain by pre-pregnancy body mass index category

Pre-Pregnancy BMI category	Recommended range of total weight gain (kg)
Underweight (< 18.5)	12.5 – 18
Normal weight (18.5 to 24.9)	11.5 – 16
Overweight (25 to 29.9)	7 – 11.5
Obese (≥ 30)	5 – 9

Source. Adapted from the Institute of Medicine (2009).[89]

Abbreviations: BMI – body mass index; kg – kilograms.

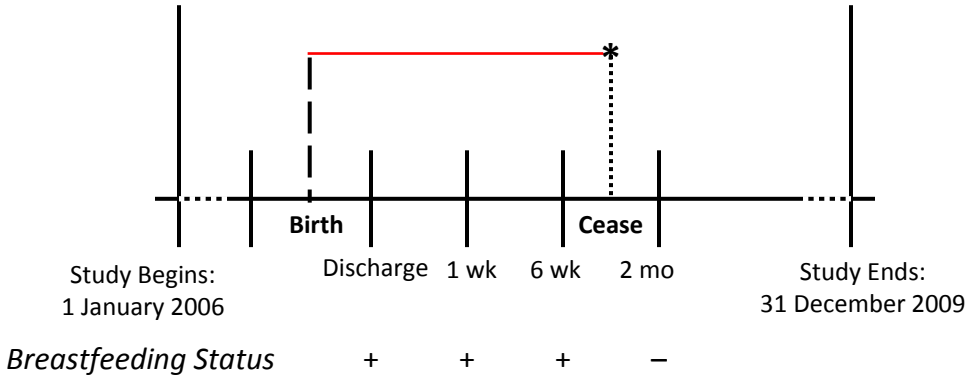

Figure 4-1 Depiction of interval-censoring using mid-point imputation

Note. Vertical ticks represent prenatal and follow-up visits with the mother. Since it is unknown precisely when a mother stopped breastfeeding, only that the exact time falls within a specific time period (between the last visit where a mother was breastfeeding and the following visit where she had stopped breastfeeding), this is interval censoring. Mid-point imputation indicates that the duration of breastfeeding has been censored at the mid-point between the two follow-up time periods (*i.e.* in Figure 4-1, between six weeks and two months, so at 7 weeks).

Abbreviations: mo – month; wk – week.

Figure 4-2 Counties of Nova Scotia.

Note. *Data Source:* Government of Nova Scotia (2012)[98]

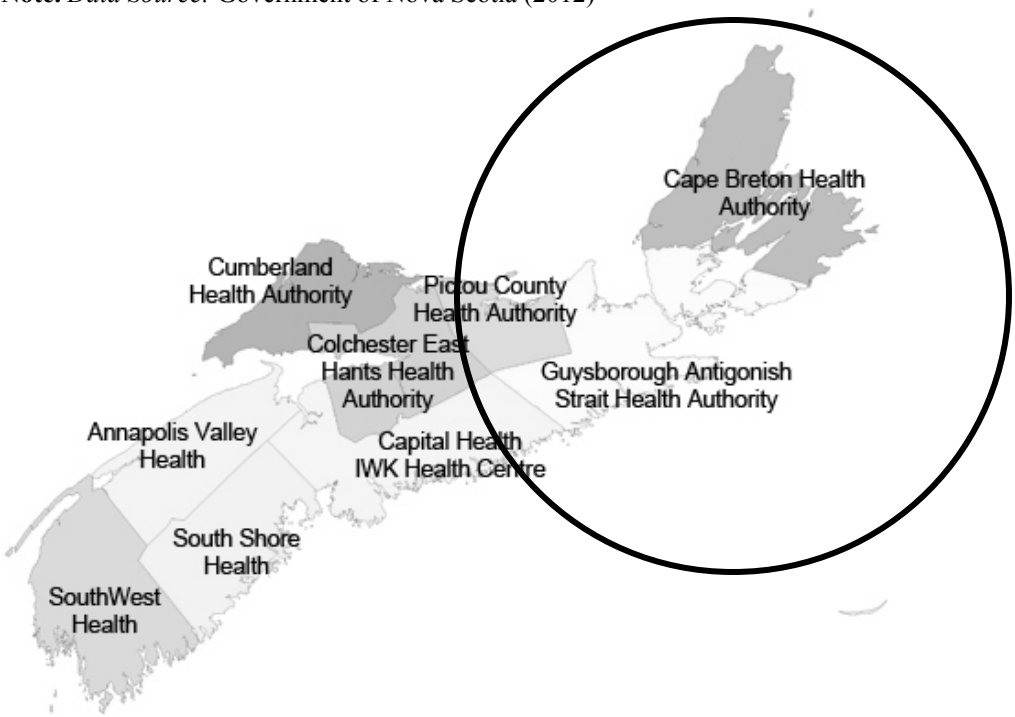

Figure 4-3 District Health Authorities of Nova Scotia

Note. *Data Source:* Government of Nova Scotia (2011).[99]

CHAPTER 5 RESULTS

5.1 Description and Characteristics of Cohort

Of the 7,606 mother-infant dyads available in the PHD, 6,212 were included in the cohort (Figure 5-1, p93). 1,169 pairs were unable to be linked to data in the NSAPD and 225 pairs were excluded from the analysis. In terms of linking data, for 429 dyads, the mother's health card number was unavailable to match since they either had no health card number in the PHD (N=409) or their health card number was unusable (*e.g*. out-of-province, N=20). For 358 dyads, the mother's health card number did not match any health card number in the NSAPD. A further 382 pairs were matched on mother's health card number, but no match was made on date of delivery. After applying the exclusion criteria, 23 dyads were excluded due to fetal death, 198 dyads due to multiple births, two dyads for a birth weight less than 500 grams, two dyads for a gestational age of less than 20 weeks, and 1,719 dyads for the infant being born in 2004 and 2005.

The final cohort comprised 4,533 mother-infant pairs. Completeness of follow-up varied by type and duration of breastfeeding. In total, 576 dyads had incomplete follow-up for exclusive breastfeeding. This included 21 dyads at hospital discharge, 106 dyads at one week, 282 dyads at six weeks, 373 dyads at two months, 515 dyads at four months, and 576 dyads at six months. In total, 716 dyads had incomplete follow-up for any breastfeeding. This included 21 dyads at hospital discharge, 134 dyads at one week, 338 dyads at six weeks, 448 dyads at two months, 627 dyads at four months, and 716 dyads at six months.

Table 5-1 (p61) shows the transformed datasets, which follow the assumptions and guidelines outlined in the methodology section. For the Cleaned-Up Dataset, breastfeeding variables were changed for 203 (4.5%) of the mother-infant pairs. "BF at Discharge" was changed from missing to stopped for a further 146 (3.2%) dyads. For the Hierarchical Dataset, breastfeeding variables were changed for 123 (2.7%) of pairs.

As seen in Table 5-2 (p62), the cohort fares worse than both Canadian and Nova Scotia mothers on a variety of sociodemographic and behavioural characteristics known to be associated with breastfeeding practices. The cohort has a younger age distribution,

lower educational status, a higher proportion of single mothers, a higher proportion of smoking mothers, and a lower proportion of pre-conception folic acid supplementation than Canadian and Nova Scotia mothers. While the cohort has a similar BMI distribution to Nova Scotia mothers, the cohort is far more overweight and obese than the Canadian average. The cohort's uptake of prenatal education is higher than either Canadian or Nova Scotia mothers, although this might be attributable to a broader definition of prenatal education activities used among the cohort compared with the Maternity Experience Survey. On average, mother's health among the cohort is slightly poorer than Nova Scotia mothers with a higher prevalence of pre-existing hypertension and gestational diabetes. The cohort has a slightly elevated cesarean section rate compared to the Canadian average.

Eight predictive variables have a 2006-2009 average of greater than 10% missing values among the cohort (Table 5-3, p64). Mother's education is consistently about 13 to 16% missing. The percent missing for pre-pregnancy BMI decreases from 47.9% in 2006 to less than 25% missing in 2009, largely since height was collected irregularly in earlier years. Similarly, GWG category is 42.6% missing over the study period, although this number decreases over time. The percent missing for pre-conception folic acid supplementation decreases from 54.8% in 2006 to 19.3% in 2009. Breast contact at one hour only began data collection on April 1, 2007, so it is 100% missing in 2006, but only 10.3% missing in 2009. The percent missing for marital status and prenatal education increases slightly over the study, from 14.15% to 20.1% for marital status and 6.5% to 13.8% for prenatal education. For all eight predictive variables with greater than 10% missing values, a dummy "missing" category was created. This increased the proportion of dyads available for a complete-subject analysis from 17.4% to 91.8%.

Among mothers who initiated breastfeeding, 576 mothers (19.8%) were lost to follow-up for exclusive breastfeeding and 716 mothers (24.6%) were lost to follow-up for any breastfeeding. As seen in Table 5-4 (p64), infants born in 2009 are approximately twice more likely to be lost to follow-up than infants born between 2006 and 2008. Figure 5-2 (p94) shows a comparison of trends in the proportion of mother-infant pairs exclusively breastfeeding at six months with the proportion of dyads lost to follow-up by

month and year of birth. When the percent of dyads lost to follow-up is high, the percent of mothers exclusively breastfeeding their infant at six months is lower.

5.2 Breastfeeding Rates and Trends over Time

Overall, 64.1% (95% CI=62.7-65.5) of mothers initiated breastfeeding. Breastfeeding initiation is significantly higher in GASHA (72.9%, 70.2-75.6) than in CBDHA (61.2%, 59.5-62.8). Type of breastfeeding was not collected at breastfeeding initiation; therefore, the percent of mother-infant pairs who initiated EBF is unknown. Breastfeeding rates fall sharply within the first six weeks after birth: at six weeks, 33.6% (32.2-35.0) are EBF and 42.3% (40.8-43.8) are ABF. Only 10.4% (9.5-11.4) of dyads meet the Canadian recommendation of exclusive breastfeeding for six months; 21.0% (19.7-22.3) are ABF at six months.

The percent of mothers who initiated breastfeeding increased significantly from 60.5% in 2006 to 66.6% in 2009 (p=0.0013). While the increasing initiation rates are significant in both DHAs, breastfeeding initiation increased faster in GASHA (67.0% to 77.5%) than in CBDHA (58.3% to 63.2%).

Tables 5-5 to 5-8 (pp65-66) provide three estimates of four breastfeeding practices by DHA: EBF at six months, ABF at six months, EBF at six weeks, and ABF at six weeks. The first estimate includes all dyads with complete follow-up. The second and third estimates show the low and high estimates of breastfeeding rates from the sensitivity analysis. For all four breastfeeding practices, there is no significant trend in breastfeeding rates over time for dyads with complete follow-up. The sensitivity analysis, however, suggests that a trend may be occurring, although the direction of the trend is at times contradictory. For example, Table 5-5 (p65) shows that in GASHA, a significant decrease in exclusive breastfeeding at six months is possible with a low sensitivity estimate, yet a significant increase in exclusive breastfeeding at six months is also possible with the high sensitivity estimate. Across all practices, GASHA has higher breastfeeding rates than CBDHA.

The average EBF duration for the 4,533 infants born between 2006 and 2009 is 1.72 (95% CI = 1.67-1.78) months. Breastfeeding duration is positively skewed since the

median EBF duration was 1.19 (1.16-1.23) months. Among the 2,907 mothers who initiated breastfeeding, the average EBF duration is 3.18 (3.04-3.29) months while the median EBF duration is 2.21 (2.11-2.31) months. Compared with mothers in CBDHA, mothers in GASHA have a significantly higher mean (4.08 *vs*. 2.86 months) and median (2.83 *vs.* 1.98 months) duration of EBF.

The average ABF duration for all 4,533 infants is 2.36 (2.29-2.44) months. Similar to EBF duration, ABF is positively skewed: the median duration is 1.64 (1.58-1.69) months. Among the 2,907 mothers who initiated breastfeeding, the average ABF duration is 4.52 (4.32-2.74) months while the median ABF duration is 3.14 (2.99-3.28) months. Compared with mothers in CBDHA, mothers in GASHA had a significantly higher mean (5.72 *vs*. 4.10 months) and median (3.97 *vs.* 2.84 months) duration of ABF.

As seen in Figure 5-3 (p95), the mean duration of EBF among mothers who initiated breastfeeding in GASHA is significantly higher than CBDHA in all years except 2009. Among mothers in GASHA, there is a non-significant decrease in mean EBF duration from 4.98 (4.09-6.15) months in 2006 to 3.39 (2.83-4.12) months in 2009. No trend in EBF duration over time is found among mothers living in CBDHA. In the same way, Figure 5-4 (p95) shows the mean duration of ABF among mothers who initiated breastfeeding in GASHA is significantly higher than CBDHA in all years except 2009. Among mothers in GASHA, there is a non-significant decrease in mean ABF duration from 6.70 (5.47-8.33) months in 2006 to 5.25 (4.32-6.45) months in 2009. No trend in ABF duration over time is noted among mothers living in CBDHA.

5.3 Determinants of Early Breastfeeding Cessation

The determinants of early breastfeeding cessation are summarized in Table 5-9 (p67). Six risk factors are independently associated with a significant risk for early cessation of both exclusive and any breastfeeding at six weeks and at six months: lower level of maternal education, no partner, higher pre-pregnancy BMI, smoking during pregnancy, no intention to breastfeed, and no breast contact between the mother and neonate within one hour of birth.

In addition, seven other risk factors are significantly associated with early cessation of breastfeeding for at least one of the four breastfeeding practices (EBF and ABF at six weeks and at six months). Infants with a later year of birth are significantly associated with early cessation of ABF and EBF at six months. Younger maternal age is significantly associated with early cessation of ABF at six months as well as ABF and EBF at six weeks. Lower neighbourhood income quintile is significantly associated with early cessation of EBF at six months as well as ABF and EBF at six weeks. Living in Cape Breton DHA or county is significantly associated with early cessation of EBF and ABF at six months and of ABF at 6 six weeks. No folic pre-conception folic acid supplementation and epidural analgesia in labour are significantly associated with early cessation of EBF at six weeks. Finally, being a primiparous mother is significantly associated with early cessation of EBF at six months.

5.3.1 Cessation of Exclusive and Any Breastfeeding before Six Weeks

Table 5-10 (p68) shows the frequencies and unadjusted relative risks of the 4,251 mother-infant dyads for cessation of EBF before six weeks and the 4,195 dyads for cessation of ABF before six weeks. In the unadjusted analysis, 19 risk factors are significantly associated with cessation of EBF before six weeks at the α=0.1 level of significance: younger maternal age, lower level of maternal education, no partner, lower neighbourhood income quintile, urban location of residence, living in CBDHA, living in a county located in CBDHA, no pre-conception folic acid supplementation, higher pre-pregnancy body mass index, extreme gestational weight gain category, smoking throughout pregnancy, no prenatal education, cesarean birth, epidural analgesia in labour, low infant birth weight, major anomaly in infant, admission to special care nursery, no intention to breastfeed, and no breast contact between mother and neonate within one hour of birth. Fifteen risk factors are significantly associated with cessation of ABF before six weeks; these factors are identical to those significantly associated with cessation of EBF before six weeks except that extreme gestational weight gain category, cesarean delivery, low infant birth weight, and major anomaly in infant are not significantly associated at the unadjusted level.

After adjustment in the logistic regression model, 10 risk factors are significantly associated with cessation of EBF before six weeks (Table 5-11, p72): younger maternal age, lower level of maternal education, lower neighbourhood income quintile, no partner, higher pre-pregnancy BMI, smoking throughout pregnancy, no pre-conception folic acid supplementation, epidural analgesia in labour, no breast contact between mother and neonate within one hour of birth, and no intention to breastfeed.

For cessation of ABF before six weeks, nine risk factors are significantly associated in the multivariate model (Table 5-12, p74). Similar to early cessation of EBF at six weeks, younger maternal age, lower level of maternal education, lower neighbourhood income quintile, no partner, higher pre-pregnancy BMI, smoking throughout pregnancy, no breast contact between mother and neonate within one hour of birth, and no intention to breastfeed are significant risk factors. In addition, living in CBDHA is significantly associated with a higher risk of ceasing ABF before six weeks.

5.3.2 Cessation of Exclusive Breastfeeding before Six Months

Table 5-13 (p76) shows the frequencies and unadjusted relative risks of the 3,957 mother-infant dyads for cessation of EBF before six months. In the unadjusted analysis, 19 risk factors are significantly associated with cessation of EBF before six months at the α=0.1 level of significance: later year of infant's birth, younger maternal age, lower level of maternal education, no partner, lower neighbourhood income quintile, urban area of residence, living in CBDHA, living in a county located in CBDHA, higher pre-pregnancy BMI, smoking during pregnancy, no pre-conception folic acid supplementation, no prenatal education, primiparous mothers, epidural analgesia during labour, premature birth, low infant birth weight, admission to special care nursery, no intention to breastfeed, and no breast contact between mother and neonate within one hour of birth.

After adjustment in the logistic regression model, 10 predictors remain significantly associated with cessation of EBF before six months (Table 5-14, p80). A later year of birth significantly increases the risk of cessation of EBF before six months in 2007 (adjusted relative risk [ARR]=1.70, 95% CI=1.05-2.74) and 2009 (1.96, 1.15-3.35) compared with 2006, despite that a later year of birth had significantly higher breastfeeding initiation rates. A lower level of maternal education significantly increases

the risk of early cessation for those with less than high school graduation (2.47, 1.22-5.00), high school graduation (1.98, 1.41-2.80), and a college diploma (1.70, 1.22-2.37) compared with a university degree. Mothers who live in lower neighbourhood income quintiles tend to have a higher risk of early cessation: mothers in the upper-middle (1.66, 1.13-2.42), middle (1.68, 1.16-2.44), and lower-middle (1.49, 1.04-2.14) neighbourhood income quintiles are at significantly higher risk; however, there is no significant difference between mothers living in the lowest and highest neighbourhood income quintiles. Living in Cape Breton (2.20, 1.59-3.06), Inverness (3.10, 1.86-5.16), and Richmond (2.81, 1.27-6.22) county significantly increases the risk of cessation of EBF before six months compared with living in Antigonish county. There is no significant difference among mothers in Antigonish, Guysborough, and Victoria counties. Being single increases the risk of early cessation by 65% (1.17-2.32) compared to having a partner. Obese mothers are nearly twice more likely (1.94, 1.29-2.92) to cease EBF before six months than mothers with a normal pre-pregnancy BMI. Mothers who smoked throughout pregnancy are at a significantly higher risk of early cessation than non-smoking mothers (2.68, 1.63-4.42). Multiparous mothers are less likely to cease EBF before six months (0.63, 0.49-0.80) than primiparous mothers. Dyads with no breast contact within the first hour after birth are twice (2.11, 1.56-2.87) more likely to cease EBF before six months. Finally, mothers who do not intend to breastfeed are vastly (22.42, 9.47-53.06) more likely to cease exclusive breastfeeding before six months than mothers who intend to breastfeed.

There is no difference in the predictive variables associated with early cessation of breastfeeding between the statistical model and the theoretically driven model. For the community level, birth year is the sole option to enter into the model. For the organizational level, county of residence is the strongest predictor. For the interpersonal level, marital status is the strongest predictor. Finally, for the individual level, no intention to breastfeed is the strongest predictor.

5.3.3 Cessation of Any Breastfeeding before Six Months

Table 5-13 (p76) shows the frequencies and unadjusted relative risks of the 3,817 mother-infant pairs for cessation of ABF before six months. Nineteen risk factors are

significantly associated with cessation of ABF before six months. These factors are identical to those significantly associated with cessation of EBF before six months, except that lower parity is not significantly associated, but the risk factor major anomaly in the infant is also significantly associated at the unadjusted level.

After adjustment in the logistic regression model, nine risk factors are independently associated with cessation of ABF before six months (Table 5-15, p82). Later year of birth significantly increases the risk of cessation of ABF before six months in 2007 (ARR=1.58, 95% CI = 1.13-2.23), 2008 (1.48, 1.00-2.18), and 2009 (2.02, 1.36-2.99) compared with 2006. Mothers with high school graduation (1.66, 1.28-2.16) and college education (1.56, 1.20-2.03) have a significantly increased risk of early cessation of ABF at six months compared to university-educated mothers. Mothers who live in CBDHA compared to GASHA are 60% more likely to cease ABF before six months (1.60, 1.28-2.00). Obese mothers are significantly more likely to cease ABF before six months (1.67, 1.23-2.27) than normal weight mothers. Mothers who smoke throughout pregnancy are twice as likely to cease earlier (2.26, 1.64-3.12) compared to mothers who are non-smoking. Dyads with no breast contact within the first hour after birth are twice (2.22, 1.75-2.80) more likely to cease ABF before six months. Finally, mothers who did not intend to breastfeed are vastly (23.14, 13.67-39.17) more likely to cease any breastfeeding before six months than mothers who intend to breastfeed.

5.4 Determinants of Breastfeeding Duration

Figures 5-5 to 5-14 (pp96-100) illustrate a series of Kaplan-Meier curves for exclusive and any breastfeeding duration. Figure 5-5 (p96) shows the survival curves for exclusive any breastfeeding to six months among the 2,907 mothers who initiated breastfeeding. Figure 5-6 (p96) shows the survival curve for exclusive breastfeeding to six months among all 4,533 mothers in the cohort, and Figure 5-7 (p97) shows the survival curve for any breastfeeding to six months among all 4,533 mothers in the cohort. Figure 5-8 (p97) presents Kaplan-Meier curves for exclusive breastfeeding to six months stratified by DHA. The remaining figures present Kaplan-Meier curves of exclusive breastfeeding to six months stratified by each of the six predictors that are independently

associated with a significant risk for early cessation of both exclusive and any breastfeeding at six weeks and at six months: maternal education (Figure 5-9, p98), marital status (5-10, p98), pre-pregnancy BMI category (5-11, p99), smoking status (5-12, p99), breast contact between dyads within one hour of birth (5-13, p100), and intention to breastfeed (5-14, p100). All presented curves are significantly different across strata ($p<0.0001$).

5.4.1 Exclusive Breastfeeding Duration

Twenty-one risk factors have significant tests of equality across strata at the $\alpha=0.1$ level of significance for EBF duration in the Kaplan-Meier analysis (Table 5-16, p84): later year of birth, younger maternal age, lower level of maternal education, lower neighbourhood income quintile, living in CBDHA, living in a county located in CBDHA, no partner, higher pre-pregnancy BMI, extreme gestational weight gain category, smoking throughout pregnancy, no pre-conception folic acid supplementation, lower parity, health condition during pregnancy, cesarean delivery, epidural anesthesia in labour, premature infant, low infant birth weight, major anomaly in infant, admission to special care nursery, no intention to breastfeed, and no breast contact between mother and neonate within one hour of birth.

After adjustment in the proportional hazards model, 10 risk factors are independently associated with EBF duration (Table 5-17, p85). Compared to mothers with a university degree, mothers with a college diploma (hazard ratio [HR]=1.25, 95% CI=1.08-1.43), high school diploma (1.35, 1.18-1.54), and less than high school graduation (1.66, 1.35-2.04) are more likely to cease EBF. Mothers living in lower neighbourhood income quintiles are at 27 to 38% increased risk of ceasing EBF early than mothers in the highest neighbourhood income quintile. Mothers who live in CBDHA are 21% (1.08-1.37) more likely to cease EBF than mothers who lived in GASHA. Single mothers are at higher risk of early EBF cessation (1.24, 1.10-1.41) than mothers with a partner. While obese mothers are significantly more likely to cease EBF than mothers of normal weight (1.43, 1.23-1.65), mothers who are underweight or overweight no more likely to cease EBF before six months than normal weight mothers. Mothers who smoked throughout pregnancy are at higher risk of early EBF cessation

compared to non-smoking mothers (1.39, 1.21-1.60); however, mothers who quit during pregnancy are at a similar risk of EBF cessation than non-smoking mothers. Mothers who did not take pre-conception folic acid supplements are 15% more likely to cease EBF early (1.01-1.30) than mothers who took supplements. Multiparous mothers are at decreased risk of early EBF cessation (0.76, 0.69-0.84) compared to primiparous mothers. Dyads who did not have breast contact within one hour are at higher risk of early EBF cessation (1.44, 1.29-1.62), as are mothers who did not intend to breastfeed (1.78, 1.44-2.16).

5.4.2 Any Breastfeeding Duration

Twenty risk factors have significant (p<0.1) tests of equality across strata for ABF duration in the Kaplan-Meier analysis (Table 5-16, p84). These predictors are identical to the EBF duration risk factors except that the factor major anomaly in infant is not associated with ABF duration.

After adjustment in the proportional hazards model, ten risk factors remain significantly associated with ABF duration (Table 5-18, p87). Compared to mothers with a university degree, mothers with a college diploma (HR=1.32, 95% CI =1.14-1.53), high school diploma (1.29, 1.11-1.49), and less than high school graduation (1.41, 1.10-1.78) are more likely to cease ABF. Teenaged mothers (1.61, 1.20-2.14) and mothers in their early twenties (1.27, 1.05-1.53) are more likely to engage in ABF than mothers older than 35 years, whereas mothers in their late twenties and early thirties are no more likely to cease ABF than mothers older than 35 years. Mothers living in a lower neighbourhood income quintile are 35 to 44% more likely to cease ABF early than mothers living in the highest neighbourhood income quintile. Single mothers who lived in CBDHA are 32% (1.17-1.50) more likely to cease ABF than mothers in GASHA. Mothers without a partner are more likely (1.26, 1.10-1.44) to cease ABF than mothers who had a partner. Obese mothers are 33% (1.14-1.55) more likely to cease ABF than mothers of normal weight. Underweight and overweight mothers are at similar risk of ceasing any breastfeeding as normal weight mothers. Mothers who smoked throughout pregnancy are 46% (1.27-1.68) more likely to cease ABF than non-smoking mothers. Multiparous mothers are at decreased risk of early ABF cessation (0.82, 0.74-0.92). Dyads who did

not have breast contact within one hour are at higher risk of early ABF cessation (1.39, 1.23-1.56), as are mothers who did not intend to breastfeed (1.93, 1.56-2.36).

5.5 Breastfeeding Patterns among Multiple Births

Between 2006 and 2009, 135 twins and 5 triplets were born live who weighed more than 500 grams and whose gestational age was greater than 20 weeks. For all breastfeeding patterns, twins and triplets have poorer outcomes than singleton births. Significantly fewer multiple births intended to breastfeed (56.8% *vs.* 69.3%, p=0.0050) and initiated breastfeeding (55.7% *vs.* 64.13%, p=0.0412) than singleton births. No multiple birth exclusively breastfed for the recommended six months (0% *vs*. 10.4%, p<0.0001). Significantly fewer multiple births than singleton births engaged in any breastfeeding for six months (3.4% *vs*. 21.1%, p<0.0001). Further, significantly fewer multiple births than singleton births were breastfeeding exclusively at six weeks (10.1% *vs*. 33.7%, p<0.0001) and fewer, also, were engaged in any breastfeeding at six weeks (30.8% *vs*. 42.3 %, p=0.0114).

5.6 Determinants of Intention to Breastfeed

Among the 4,043 mothers who indicated their intention at a prenatal visit or on admission for delivery, 30.7% (95% CI=29.3-32.2) did not intend to breastfeed. The proportion of mothers who did not intend to breastfeed decreased significantly from 33.7% in 2006 to 27.3% in 2009 (p=0.0010).

Table 5-19 (p89) shows the frequencies and unadjusted relative risks of 4,043 mothers who indicated their intention to breastfeed at a pre-natal visit. Thirteen risk factors are significantly associated with no intention to breastfeed: earlier infant's year of birth, lower maternal age, a lower level of education, a lower neighbourhood income quintile, urban area of residence, living in CBDHA, living in a county located within CBDHA, no partner, obese and underweight BMI, smoking during pregnancy, no pre-conception folic acid supplementation, no prenatal education, and higher parity.

After adjustment in the multivariate logistic regression model, nine risk factors remain significantly associated with intention to breastfeed (Table 5-20, p91). Mothers whose infant was born in 2009 are significantly more likely to intend to breastfeed (ARR=0.78, 95% CI=0.62-0.97) than mothers whose infant was born in 2006. Mothers with less than high school graduation (3.03, 2.21-4.17), high school graduation (2.17, 1.72-2.73), and college diploma (1.69, 1.32-2.17) are at greater risk of not intending to breastfeed compared to mothers with a university degree. Mothers living in Cape Breton (2.28, 1.74-3.00), Richmond (2.31, 1.45-3.68), and Victoria (1.88, 1.20-2.94) counties have less intention compared to mothers living in Antigonish county. There is no difference in risk among mothers living in Guysborough, Inverness, and Antigonish counties. Teenaged mothers are at significantly higher risk of not intending to breastfeed (1.86, 1.24-2.81) than mothers older than 35 years. There is no difference in risk of not intending to breastfeed among mothers older than 20 years compared to mothers older than 35 years. Being single (1.71, 1.41-2.08) increases the risk of not intending to breastfeed compared to having a partner. Mothers who smoked (1.61, 1.34-1.94) are at a significantly higher risk of not intending to breastfeed, while mothers who quit smoking during pregnancy were no more or less likely to intend to breastfeed compared to non-smoking mothers. Mothers who did not take a pre-conception folic acid supplement (1.66, 1.33-2.08) and mothers who did not attend pre-natal classes (1.32, 1.11-1.57) are at higher risk for no intention to breastfeed. Finally, multiparous mothers are at significantly higher risk of not intending to breastfeed compared to primiparous mothers (0.50, 0.39–0.63).

Table 5-1 Breastfeeding variables for 6,437 mother-infant pairs comparing the original dataset, the cleaned-up dataset, and the hierarchical dataset

ORIGINAL DATASET										
	No	%	Yes	%	Excl.	%	Suppl.	%	Stopped	%
BF Initiation	1638	**36.1**	2895	**63.9**	-		-		-	
Stopped in Hospital	4293	**94.7**	240	**5.3**	-		-		-	
Discharge	-		-		2179	**48.1**	457	**10.1**	43	**0.9**
1 week	-		-		1936	**42.7**	440	**9.7**	202	**4.5**
6 weeks	-		-		1400	**30.9**	365	**8.1**	422	**9.3**
2 months	-		-		1127	**24.9**	341	**7.5**	211	**4.7**
4 months	-		-		754	**16.6**	299	**6.6**	259	**5.7**
6 months	-		-		413	**9.1**	389	**8.6**	195	**4.3**

CLEANED-UP DATASET										
	No	%	Yes	%	Excl.	%	Suppl.	%	Stopped	%
BF Initiation	1626	**35.9**	2907	**64.1**	-		-		-	
Stopped in Hospital	4353	**96.0**	180	**4.0**	-		-		-	
Discharge	-		-		2230	**49.2**	467	**10.3**	189	**4.2**
1 week	-		-		1953	**43.1**	441	**9.7**	202	**4.5**
6 weeks	-		-		1427	**31.5**	349	**7.7**	421	**9.3**
2 months	-		-		1137	**25.1**	335	**7.4**	209	**4.6**
4 months	-		-		758	**16.7**	296	**6.5**	259	**5.7**
6 months	-		-		413	**9.1**	389	**8.6**	195	**4.3**

HIERARCHICAL DATASET										
	No	%	Yes	%	Excl.	%	Suppl.	%	Stopped	%
BF Initiation	1626	**35.9**	2907	**64.1**	-		-		-	
Stopped in Hospital	4353	**96.0**	180	**4.0**	-		-		-	
Discharge	-		-		2339	**51.6**	367	**8.1**	180	**4.0**
1 week	-		-		1995	**44.0**	402	**8.9**	199	**4.4**
6 weeks	-		-		1427	**31.5**	349	**7.7**	421	**9.3**
2 months	-		-		1137	**25.1**	335	**7.4**	209	**4.6**
4 months	-		-		758	**16.7**	296	**6.5**	259	**5.7**
6 months	-		-		413	**9.1**	389	**8.6**	195	**4.3**

Note. *Abbreviations:* BF – breastfeeding; Excl. – exclusive breastfeeding; Suppl. – supplementary breastfeeding.

Table 5-2 Comparison on the characteristics of the 6,437 mother-infant pairs with the Canadian and Nova Scotia populations

	Cohort Characteristics			Comparison to Canadian Data (%)			
	N	%	Missing	Canada	Source	NS	Source
Maternal Sociodemographic Characteristics							
Maternal age							
19 years or younger	409	6.4		3.0		4.5	
20 to 24 years	1,345	20.9		13.0		14.1	
25 to 29 years	1,924	29.9	0	33.1	MES	32.6	MES
30 to 34 years	1,848	28.7		32.9		31.5	
Older than 35 years	911	14.2		17.5		17.0	
Highest level of maternal education							
Less than High School Graduation	497	12.0		7.6		6.4	
High School Graduation	1,328	32.2	2,309	19.2	MES	27.8	MES
College Diploma	898	21.8		37.0		32.5	
University Degree	1,405	34.0		35.1		33.3	
Marital status							
Married/Common-Law	3,406	62.8	1,012	66.7	MES	66.7	MES
Single/Widowed/Divorced/Separated	2,019	37.2		33.3		33.3	
Location of residence							
Rural	1,460	22.7	0	32.2	MES	-	
Urban	4,977	77.3		67.8		-	
Maternal Behaviours and Practices							
Pre-pregnancy BMI (kg/m^2)							
Underweight	128	3.4		6.1		2.6	
Normal Weight	1,776	47.2	2,672	59.3	MES	49.0	MES
Overweight	925	24.6		21.0		25.7	
Obese	936	24.9		13.6		22.7	
Smoker	1,730	27.3	98	22.0	MES	22.0 – 22.9	NSAPD
Among smokers, cigarettes/day pre-pregnancy							
1 to 9 cigarettes/day	237	22.9	664	31.8	MES	-	
10+ cigarettes/day	797	77.1		57.6		-	
Among smokers, cigarettes/day at admission							
1 to 9 cigarettes/day	554	48.9	423	68.2	MES	-	
10+ cigarettes/day	578	51.1		42.4		-	
Pre-conception folate intake	1,290	35.3	2,787	57.8	CPHR	51.1	CPHR
Prenatal education	3,601	63.1	729	32.7	MES	33.7	MES
Intention to breastfeed	3,893	70.7	928	90.0	MES	82.5	MES
Mother's Health							
Primiparous	2,645	41.1	1	44.7	MES	46.4	MES
Pre-existing diabetes	53	0.8	0	-		0.6 – 0.9	NSAPD
Pre-existing hypertension	107	1.7	0	-		0.9 – 1.4	NSAPD

	Cohort Characteristics			Comparison to Canadian Data (%)			
	N	%	Missing	Canada	Source	NS	Source
Gestational diabetes	235	3.7	0	-		3.2 – 3.6	NSAPD
Severe pregnancy-induced hypertension	113	1.8	0	-		1.6 – 1.9	NSAPD
Delivery-Related Factors							
Initiation of labour							
Spontaneous onset of labour	3,841	59.7		-		-	
Artificial induction of labour	1,664	25.9	0	21.8	CPHR	25.3	CPHR
No labour	932	14.5		-		-	
Cesarean section	1,810	28.1	0	26.3	MES	26.8 – 28.1	NSAPD
Post-partum hemorrhage	284	4.4	0	-		5.0 – 8.5	NSAPD
3rd or 4th degree laceration	174	2.7	0	3.8	CPHR	3.7	CPHR
Infant-Related Factors							
Pre-term birth (<37 weeks)	458	7.2	36	6.2	MES	7.2 – 7.8	NSAPD
Birth weight for gestational age							
Small for GA (<10th percentile)	594	9.3	43	7.8	CPHR	7.9 – 9.5	NSAPD
Large for GA (>90th percentile)	927	14.4		11.6	CPHR	13.7 – 16.5	NSAPD
Multiple delivery (2+ fetuses)	199	3.1	0	3.0	CPHR	3.4	CPHR
Neonate admitted to special care nursery	979	15.2	0	12.7	MES	14.0	MES

Note. When Nova Scotia data is presented in a range, this represents the highest and lowest value from the Nova Scotia Atlee Perinatal Database between 2004 and 2009.

Abbreviations: BF – breastfeeding; BMI – body mass index; CPHR – Canadian Perinatal Health Report; GA – gestational age; MES – Maternity Experiences Survey; NSAPD – Nova Scotia Atlee Perinatal Database.

Data Sources: Maternity Experiences Survey, data collected in 2006-2007;[23] Canadian Perinatal Health Report, surveillance from 2005;[65] Nova Scotia Atlee Perinatal Database, statistics from 2004-2009[27]

Table 5-3 Percent missing values by infant's year of birth for variables with greater than 10% missing values

Variable	AVERAGE	2006	2007	2008	2009
Mother's education	**15.3**	16.0	16.3	15.5	13.4
Pre-pregnancy BMI	**37.6**	47.9	43.5	36.2	24.4
GWG category	**42.6**	53.0	48.7	40.3	29.9
Marital status	**19.3**	14.2	20.4	19.9	21.6
Pre-conception folic acid supplementation	**38.2**	54.8	52.5	29.3	19.0
Prenatal education	**12.0**	6.5	9.7	13.4	17.8
Intention to breastfeed	**10.8**	12.8	12.1	10.1	8.5
Breast contact at one hour	**37.0**	100.0	37.2	12.6	10.3

Note. *Abbreviations:* BMI – body mass index; GWG – gestational weight gain.

Table 5-4 Among mothers who initiated breastfeeding, percent of mothers lost to follow-up for exclusive and any breastfeeding at six months

Infant's Year of Birth	N	EBF Lost to Follow-Up		ABF Lost to Follow-Up	
		n	%	*n*	%
2006	581	118	20.3	132	22.7
2007	746	111	14.9	144	19.3
2008	814	89	10.9	115	14.1
2009	766	258	33.7	325	42.4
Overall	*2,907*	*576*	*19.8*	*716*	*24.6*

Note. *Abbreviations:* ABF – any breastfeeding; EBF – exclusive breastfeeding; N – Number of mothers who initiated breastfeeding; n – number of mothers lost to follow-up.

Table 5-5 Three estimates of the percentages of dyads exclusively breastfeeding at six months by infant's year of birth and District Health Authority

Infant's year of birth	All Mothers			CBDHA			GASHA		
	Complete	Low	High	Complete	Low	High	Complete	Low	High
2006	**10.7**	9.4	21.6	**7.5**	6.5	20.1	**20.4**	18.7	30.0
2007	**9.7**	8.8	18.1	**7.3**	6.6	16.5	**15.0**	13.7	22.1
2008	**12.2**	11.3	18.5	**9.6**	9.0	15.0	**20.8**	18.7	28.9
2009	**8.9**	6.9	29.3	**7.6**	6.0	27.3	**13.1**	9.7	35.7
P-value of trend test	***0.6195***	*0.2025*	*<0.0001*	***0.5261***	*0.8485*	*0.0004*	***0.2468***	*0.0379*	*0.0064*

Note. The complete estimate includes all dyads with complete follow-up (N=3,957). The low and high estimates are a sensitivity analysis (N=4,533).

Abbreviations: CBDHA – Cape Breton District Health Authority; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-6 Three estimates of the percentages of dyads engaged in any breastfeeding at six months by infant's year of birth and District Health Authority

Infant's year of birth	All Mothers			CBDHA			GASHA		
	Complete	Low	High	Complete	Low	High	Complete	Low	High
2006	**22.3**	19.3	33.0	**19.2**	16.4	30.9	**32.7**	29.1	40.0
2007	**21.2**	18.7	30.8	**18.3**	16.0	28.7	**27.6**	24.4	35.8
2008	**22.3**	20.2	29.5	**19.3**	17.9	25.2	**32.8**	28.2	42.3
2009	**17.7**	12.7	40.9	**15.2**	11.0	38.4	**26.8**	18.6	49.2
P-value of trend test	***0.0531***	*0.0004*	*0.0002*	***0.1235***	*0.0094*	*0.0047*	***0.4814***	*0.0276*	*0.0102*

Note. The complete estimate includes all dyads with complete follow-up (N=3,817). The low and high estimates are a sensitivity analysis (N=4,533).

Abbreviations: CBDHA – Cape Breton District Health Authority; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-7 Three estimates of the percentages of dyads exclusively breastfeeding at six weeks by infant's year of birth and District Health Authority

Infant's year of birth	All Mothers			CBDHA			GASHA		
	Complete	Low	High	Complete	Low	High	Complete	Low	High
2006	**35.2**	32.8	39.5	**33.2**	30.5	38.6	**42.2**	40.9	43.9
2007	**34.1**	33.1	36.0	**30.9**	29.9	33.1	**41.4**	40.5	42.8
2008	**33.8**	32.9	35.6	**29.8**	28.9	31.8	**46.2**	45.4	47.2
2009	**31.3**	27.3	40.1	**29.3**	25.6	38.1	**37.8**	32.6	46.5
P-value of trend test	***0.0826***	*0.0065*	*0.7253*	***0.097***	*0.0247*	*0.8703*	***0.6478***	*0.1511*	*0.3634*

Note. The complete estimate includes all dyads with complete follow-up (N=4,251). The low and high estimates are a sensitivity analysis (N=4,533).

Abbreviations: CBDHA – Cape Breton District Health Authority; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-8 Three estimates of the percentages of dyads engaged in any breastfeeding at six weeks by infant's year of birth and District Health Authority

Infant's year of birth	All Mothers			CBDHA			GASHA		
	Complete	Low	High	Complete	Low	High	Complete	Low	High
2006	**41.4**	38.4	45.6	**37.6**	34.5	42.7	**53.4**	51.3	55.2
2007	**42.6**	41.0	44.7	**39.4**	37.7	41.9	**50.5**	49.2	51.8
2008	**43.0**	41.5	45.0	**37.7**	36.4	39.8	**59.8**	58.1	60.9
2009	**42.0**	35.4	51.2	**38.5**	32.5	48.1	**53.5**	44.6	61.2
P-value of trend test	***0.7553***	*0.1519*	*0.0093*	***0.9433***	*0.2649*	*0.0569*	***0.4197***	*0.4588*	*0.0404*

Note. The complete estimate includes all dyads with complete follow-up (N=4,195). The low and high estimates are a sensitivity analysis (N=4,533).

Abbreviations: CBDHA – Cape Breton District Health Authority; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-9 Independent determinants of breastfeeding intention and early cessation of exclusive and any breastfeeding at six weeks and at six months

Risk Factor	Intention to BF	EBF 6 months	ABF 6 months	EBF 6 weeks	ABF 6 weeks
Later Year of Infant's Birth	Yes*	Yes	Yes	+	+
Younger Maternal Age	Yes	+	Yes	Yes	Yes
Lower Level of Maternal Education	Yes	Yes	Yes	Yes	Yes
Lower Neighbourhood Income Quintile	+	Yes	+	Yes	Yes
Urban Residence	+	+	+	+	+
District Health Authority (Living in CBDHA)	+	+	Yes	+	Yes
County of Residence (Living in Cape Breton)	Yes	Yes	+	+	+
No Partner	Yes	Yes	Yes	Yes	Yes
Higher Pre-Pregnancy Body Mass Index	+	Yes	Yes	Yes	Yes
Extreme Gestational Weight Gain Category	N/A	—	—	+	+
Smoker	Yes	Yes	Yes	Yes	Yes
No Folic Acid Supplementation	+	+	+	Yes	+
No Prenatal Education	Yes	+	+	+	+
Primiparous mothers	Yes*	Yes	—	—	—
Health Condition During Pregnancy	—	—	—	—	—
Epidural Analgesia in Labour	N/A	+	+	Yes	+
Non-Spontaneous Labour	N/A	—	—	—	—
Cesarean Section	N/A	—	—	+	—
3rd or 4th Degree Laceration	N/A	—	—	—	—
Premature Birth	N/A	—	+	—	—
Low Birth Weight	N/A	+	+	+	—
Major Anomaly in Infant	N/A	—	+	—	—
Admission to Special Care Nursery	N/A	—	+	+	—
No Intention to Breastfeed	N/A	Yes	Yes	Yes	Yes
No Breast Contact within One Hour of Birth	N/A	Yes	Yes	Yes	Yes

Note. *Abbreviations:* ABF – any breastfeeding; BF – breastfeeding; CBDHA – Cape Breton District Health Authority; EBF – exclusive breastfeeding.

Symbols: '+' – Significant at the univariate $p<0.05$ level; '—' – not significant either in univariate or multivariate analysis; ***** – Risk factor effected in opposite direction (*i.e.* earlier year of birth rather than later year of birth; multiparous mother instead of primiparous mother); N/A – not applicable: intention to breastfeed only includes predictors that could influence a mother's intention to breastfeed (*e.g.* since intention to breastfeed is collected before or at admission for delivery, labour factors are not relevant for intention); Yes – Significant at the multivariate $p<0.05$ level.

Table 5-10 Frequencies and unadjusted relative risk of mother-infant pairs with complete follow-up for ceasing any and exclusive breastfeeding before six weeks

	Missing	**Exclusive Breastfeeding at Six Weeks** (N=4,251)						Missing	**Any Breastfeeding at Six Weeks** (N=4,195)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
All Mothers														
All Mothers	0	4,251	33.6	1	-	-	-	-	4,195	42.3	1	-	-	-
Infant's Year of Birth														
2006		315	35.2	1	-	-			369	41.4	1	-	-	
2007	0	392	34.1	1.03	0.91	1.16	0.3239	0	486	42.6	0.97	0.88	1.08	0.8889
2008		406	33.8	1.04	0.92	1.17			513	43.0	0.96	0.87	1.07	
2009		314	31.3	1.12	0.99	1.28			407	42.0	0.98	0.88	1.10	
Maternal Age														
< 20 years		33	10.5	3.73	2.66	5.23			52	16.7	3.17	2.45	4.11	
20-24 years		211	23.5	1.66	1.42	1.94			263	29.7	1.78	1.57	2.02	
25-29 years	0	445	35.6	1.10	0.97	1.24	<0.0001	0	544	43.9	1.20	1.09	1.33	<0.0001
30-34 years		506	42.4	0.92	0.82	1.04			609	51.7	1.02	0.93	1.12	
35+ years		232	39.1	1	-	-			307	52.8	1	-	-	
Highest Level of Maternal Education														
Less than High School		46	10.1	5.28	3.99	6.98			77	17.0	3.81	3.09	4.68	
High School Graduate	632	297	25.4	2.10	1.88	2.35	<0.0001	614	379	32.8	1.97	1.80	2.17	<0.0001
College Diploma		277	35.2	1.52	1.35	1.69			342	43.8	1.48	1.35	1.62	
University Degree		647	53.5	1	-	-			774	64.8	1	-	-	
Neighbourhood Income Quintiles														
Highest		406	46.8	1	-	-			489	57.3	1	-	-	
Upper-Middle		284	35.4	1.32	1.18	1.49			342	43.4	1.32	1.20	1.46	
Middle	33	306	31.9	1.47	1.31	1.65	<0.0001	30	402	45.1	1.36	1.24	1.50	<0.0001
Lower-Middle		265	28.0	1.67	1.48	1.89			327	34.7	1.65	1.49	1.83	
Lowest		158	24.7	1.89	1.63	2.21			204	32.6	1.75	1.55	1.99	

	Missing	Exclusive Breastfeeding at Six Weeks (N=4,251)						Missing	Any Breastfeeding at Six Weeks (N=4,195)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
Area of Residence														
Rural	0	362	38.2	1	-	-	0.0007	0	447	47.5	1	-	-	0.0003
Urban		1,065	32.3	1.18	1.08	1.30			1,328	40.8	1.16	1.08	1.26	
District Health Authority														
CBDHA	52	976	30.7	1.37	1.26	1.50	<0.0001	50	1,204	38.3	1.42	1.32	1.52	<0.0001
GASHA		428	42.1	1	-	-			545	54.3	1	-	-	
County of Residence														
Antigonish	30	273	48.2	1	-	-	<0.0001	30	333	59.7	1	-	-	<0.0001
Cape Breton		805	29.2	1.65	1.49	1.83			1,003	36.9	1.62	1.49	1.76	
Guysborough		55	33.1	1.45	1.15	1.83			82	50.0	1.19	1.01	1.41	
Inverness		156	39.3	1.21	1.04	1.40			195	50.4	1.18	1.05	1.34	
Richmond		52	32.1	1.50	1.18	1.91			66	40.7	1.46	1.20	1.79	
Victoria		69	38.9	1.26	1.02	1.54			78	43.6	1.37	1.14	1.64	
Marital Status														
Partner	798	971	44.5	1	-	-	<0.0001	786	1,186	55.1	1	-	-	<0.0001
No Partner		270	21.2	2.10	1.87	2.35			360	28.7	1.92	1.75	2.11	
Pre-Conception Folic Acid Supplementation														
Yes	1,629	417	46.2	1	-	-	<0.0001	1,613	499	56.4	1	-	-	<0.0001
No		443	25.8	1.80	1.61	2.00			583	34.4	1.64	1.50	1.79	
Prenatal Education														
Yes	470	1,020	37.0	1	-	-	<0.0001	452	1,266	46.3	1	-	-	<0.0001
No		287	28.0	1.32	1.18	1.47			348	34.5	1.34	1.22	1.48	
Pre-Pregnancy Body Mass Index														
Underweight	1,610	31	25.4	1.46	1.07	2.00	<0.0001	1,592	40	33.1	1.36	1.05	1.77	0.0012
Normal		461	37.1	1	-	-			554	45.0	1	-	-	
Overweight		223	35.2	1.05	0.93	1.20			289	46.2	0.98	0.88	1.08	
Obese		180	28.0	1.32	1.15	1.53			238	38.0	1.18	1.05	1.33	

	Missing	Exclusive Breastfeeding at Six Weeks (N=4,251)						Missing	Any Breastfeeding at Six Weeks (N=4,195)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
Gestational Weight Gain Category														
Sub-Optimal		118	30.0	1.25	1.04	1.50			157	40.4	1.12	0.97	0.31	
Optimal	1,820	230	37.4	1	-	-	0.0406	1,797	276	45.4	1	-	-	0.2865
Excessive		472	33.2	1.13	0.99	1.28			602	43.0	1.06	0.95	1.17	
Smoker During Pregnancy														
Non-Smoker		1,103	41.7	1	-	-			1,342	51.4	1	-	-	
Quit During Pregnancy	292	86	26.5	1.57	1.30	1.89	<0.0001	288	113	35.7	1.44	1.24	1.68	<0.0001
Smoker Throughout		135	13.6	3.06	2.60	3.60			194	19.8	2.60	2.28	2.96	
Parity														
Primiparous	0	578	32.5	1	-	-	0.2229	0	748	42.7	1	-	-	0.6717
Multiparous		849	34.3	0.95	0.87	1.03			1,027	42.0	1.02	0.95	1.09	
Health Condition During Pregnancy														
No	0	1,256	33.8	1	-	-	0.4185	0	1,556	42.4	1	-	-	0.7974
Yes		171	32.0	1.06	0.93	1.20			219	41.8	1.01	0.91	1.13	
Type of Labour														
Spontaneous		875	34.2	1	-	-			1,073	42.3	1	-	-	
Induction	0	354	32.4	1.05	0.95	1.17	0.5749	0	449	41.9	1.01	0.93	1.10	0.8645
No-Labour		198	33.2	1.03	0.91	1.17			253	43.3	0.98	0.88	1.08	
Type of Delivery														
Vaginal	0	1,063	34.6	1	-	-	0.0225	0	1,294	42.6	1	-	-	0.6103
Cesarean		364	30.9	1.12	1.01	1.24			481	41.7	1.02	0.94	1.11	
Epidural Anesthesia in Labour														
No	0	971	35.2	1	-	-	0.0021	0	1,193	43.8	1	-	-	0.0088
Yes		456	30.5	1.15	1.05	1.26			582	39.6	1.11	1.02	1.19	
3rd or 4th Degree Laceration														
No	0	1,383	33.5	1	-	-	0.3856	0	1,724	42.3	1	-	-	0.7148
Yes		44	37.3	0.90	0.71	1.14			51	44.0	0.96	0.78	1.18	

	Missing	Exclusive Breastfeeding at Six Weeks (N=4,251)						Missing	Any Breastfeeding at Six Weeks (N=4,195)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
Gestational Age at Delivery														
< 37 weeks	28	72	31.6	1.07	0.88	1.30	0.4916	27	94	41.8	1.02	0.87	1.19	0.8416
≥ 37 weeks		1,350	33.8	1	-	-			1,674	42.5	1	-	-	
Low Infant Birth Weight														
< 2,500 grams	0	43	23.8	1.43	1.10	1.86	0.0043	0	66	36.7	1.16	0.95	1.41	0.2018
≥ 2,500 grams		1,384	34.0	1	-	-			1,709	42.6	1	-	-	
Major Anomaly in Infant														
No	0	1,410	33.7	1	-	-	0.0973	0	1,751	42.4	1	-	-	0.2018
Yes		17	24.3	1.39	0.92	2.10			24	34.8	1.22	0.88	1.69	
Admission to Special Care Nursery														
No	0	1,240	34.4	1	-	-	0.0063	0	1,527	42.9	1	-	-	0.0714
Yes		187	28.9	1.19	1.05	1.35			248	39.1	1.10	0.99	1.22	
Intention to Breastfeed														
Yes	460	1,307	51.1	1	-	-	<0.0001	456	1,612	64.2	1	-	-	<0.0001
No		41	3.3	15.37	11.35	20.81			53	4.3	14.89	11.43	19.41	
Breast Contact within One Hour														
Yes	1,602	583	57.6	1	-	-	<0.0001	1,595	700	70.4	1	-	-	<0.0001
No		425	26.0	2.22	2.01	2.44			584	36.4	1.93	1.79	2.09	

Note. *Abbreviations:* CBDHA – Cape Breton District Health Authority; CI – confidence interval; GASHA – Guysborough Antigonish Straight Health Authority; URR – unadjusted relative risk.

Table 5-11 Multivariate logistic regression analysis of 3,928 mother-infant pairs for cessation of exclusive breastfeeding before six weeks

Predictor	ARR	95% Confidence Interval		*p*-value
Maternal Education				
Less than High School	2.59	1.68	3.99	<0.0001
High School Graduate	1.43	1.14	1.79	
College Diploma	1.34	1.07	1.68	
University Degree	1	-	-	
Maternal Age				
< 20 years	1.80	1.08	3.02	0.0043
20-24 years	1.10	0.81	1.49	
25-29 years	0.87	0.67	1.13	
30-34 years	0.84	0.65	1.08	
≥ 35 years	1	-	-	
Neighbourhood Income Quintile				
Highest	1	-	-	0.02154
Upper-Middle	1.27	0.99	1.63	
Middle	1.37	1.08	1.75	
Lower-Middle	1.38	1.07	1.77	
Lower	1.47	1.10	1.95	
Marital Status				
Partner	1	-	-	<0.0001
No Partner	1.32	1.06	1.63	
Pre-Pregnancy BMI				
Underweight	0.97	0.58	1.64	<0.0001
Normal	1	-	-	
Overweight	1.23	0.97	1.57	
Obese	1.78	1.37	2.31	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit Smoking During Pregnancy	1.33	0.98	1.81	
Smoker Throughout Pregnancy	2.15	1.69	2.74	
Pre-Conception Folic Acid Supplementation				
Yes	1	-	-	<0.0001
No	1.29	1.05	1.58	
Epidural Anesthesia in Labour				
No	1	-	-	<0.0001
Yes	1.23	1.03	1.46	
Breast Contact within One Hour				
Yes	1	-	-	0.0206
No	2.61	2.14	3.20	
Intention to Breastfeed				
Yes	1	-	-	<0.0001
No	17.60	12.62	24.55	

Test	χ^2	*df*	*p*-value
Overall model evaluation			
Likelihood ratio test	1432.1913	27	<0.0001
Goodness-of-fit test			
Hosmer & Lemeshow	9.4684	8	0.30

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, pre-pregnancy folic acid supplementation, breast contact within 1 hour, and intention to breastfeed were included in model to maximize sample size, but adjusted relative risks are not shown.

Abbreviations: ARR – adjusted relative risk; *df* – degrees of freedom.

Table 5-12 Multivariate logistic regression analysis of 3,832 mother-infant pairs for cessation of any breastfeeding before six weeks

Predictor	ARR	95% Confidence Interval		*p*-value
Maternal Education				
Less than High School Diploma	2.20	1.48	3.26	<0.0001
High School Graduate	1.59	1.26	2.02	
College Diploma	1.63	1.29	2.07	
University Degree	1	-	-	
Maternal Age				
< 20 years	2.53	1.55	4.13	<0.0001
20-24 years	1.74	1.29	2.34	
25-29 years	1.22	0.90	1.59	
30-34 years	1.12	0.87	1.44	
≥ 35 years	1	-	-	
Neighbourhood Income Quintile				
Highest	1	-	-	0.0119
Upper-Middle	1.38	1.06	1.82	
Middle	1.36	1.06	1.74	
Lower-Middle	1.56	1.20	2.02	
Lower	1.51	1.13	2.03	
District Health Authority				
CBDHA	1.35	1.10	1.65	0.0003
GASHA	1	-	-	
Marital Status				
Partner	1	-	-	<0.0001
No Partner	1.44	1.16	1.79	
Pre-Pregnancy BMI				
Underweight	0.92	0.53	1.62	0.0009
Normal	1	-	-	
Overweight	1.12	0.88	1.43	
Obese	1.60	1.23	2.09	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit Smoking During Pregnancy	1.28	0.94	1.74	
Smoker Throughout Pregnancy	1.96	1.56	2.46	
Breast Contact within One Hour				
Yes	1	-	-	<0.0001
No	2.70	2.17	3.36	
Intention to Breastfeed				
Yes	1	-	-	<0.0001
No	22.23	16.46	30.02	

Test	χ^2	*df*	*p*-value
Overall model evaluation			
Likelihood ratio test	1802.121	25	<0.0001
Goodness-of-fit test			
Hosmer & Lemeshow	5.4775	8	0.71

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, breast contact within 1 hour, and intention to breastfeed were included in model to maximize sample size, but adjusted relative risks are not shown.

Abbreviations: ARR – adjusted relative risk; CBDHA – Cape Breton District Health Authority; *df* – degrees of freedom; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-13 Frequencies and unadjusted relative risk of mother-infant pairs with complete follow-up for ceasing exclusive and any breastfeeding before six months

	Missing	**Exclusive Breastfeeding at Six Months** (N=3,957)						Missing	**Any Breastfeeding at Six Months** (N=3,817)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
All Mothers														
All Mothers	0	3,957	10.4	1	-	-	-	-	3,817	21.0	1	-	-	-
Infant's Year of Birth														
2006		90	10.7	1	-	-			185	22.3	1	-	-	
2007	0	104	9.7	1.10	0.84	1.44	0.0732	0	221	2.2	1.05	0.88	1.25	0.0565
2008		140	12.2	0.87	0.68	1.12			250	22.3	1.01	0.85	1.18	
2009		79	8.9	1.21	0.91	1.61			146	17.7	1.26	1.04	1.53	
Maternal Age														
< 20 years		8	2.6	5.20	2.54	10.65			17	4.6	6.30	3.71	10.70	
20-24 years		41	4.8	2.81	1.95	4.06			90	10.9	2.68	2.12	3.40	
25-29 years	0	130	11.0	1.23	0.94	1.60	<0.0001	0	250	22.1	1.33	1.11	1.58	<0.0001
30-34 years		161	14.9	0.91	0.70	1.17			299	28.6	1.02	0.86	1.20	
35+ years		73	13.5	1	-	-			149	29.2	1	-	-	
Highest Level of Maternal Education														
Less than High School		11	2.4	8.55	4.72	15.51			30	6.8	5.69	3.99	8.11	
High School Graduate	600	65	5.8	3.58	2.75	4.66	<0.0001	569	142	13.2	2.93	2.47	3.48	<0.0001
College Diploma		75	10.25	2.04	1.60	2.60			150	21.1	1.83	1.56	2.16	
University Degree		222	20.9	1	-	-			392	38.6	1	-	-	
Neighbourhood Income Quintiles														
Highest		149	19.4	1	-	-			235	32.5	1	-	-	
Upper-Middle		68	9.1	2.13	1.63	2.79			149	20.9	1.56	1.30	1.86	
Middle	32	75	8.3	2.34	1.81	3.04	<0.0001	29	178	20.1	1.62	1.37	1.91	<0.0001
Lower-Middle		72	8.0	2.43	1.87	3.17			155	17.5	1.85	1.55	2.21	
Lowest		45	7.4	2.61	1.90	3.58			80	13.8	2.35	1.87	2.95	

	Missing	Exclusive Breastfeeding at Six Months (N=3,957)						Missing	Any Breastfeeding at Six Months (N=3,817)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
Area of Residence														
Rural	0	117	12.8	1	-	-	0.0068	0	233	26.2	1	-	-	<0.0001
Urban		296	9.7	1.32	1.08	1.62			569	19.7	1.35	1.18	1.54	
District Health Authority														
CBDHA	48	241	8.1	2.15	1.79	2.59	<0.0001	43	521	18.1	1.66	1.46	1.88	<0.0001
GASHA		162	17.4	1	-	-			268	30.0	1	-	-	
County of Residence														
Antigonish	28	118	23.2	1	-	-	<0.0001	26	166	34.6	1	-	-	<0.0001
Cape Breton		196	7.7	3.03	2.46	3.73			414	16.7	2.07	1.78	2.40	
Guysborough		27	17.2	1.35	0.92	1.97			36	23.7	1.46	1.07	1.99	
Inverness		31	8.4	2.76	1.90	4.00			39	24.8	1.39	1.03	1.88	
Richmond		10	6.4	3.64	1.96	6.77			47	27.7	1.25	0.95	1.64	
Victoria		22	12.6	1.83	1.20	2.79			239	15.2	2.09	1.79	2.44	
Marital Status														
Partner	747	314	15.8	1	-	-	<0.0001	715	577	30.3	1	-	-	<0.0001
No Partner		59	4.8	3.29	2.52	4.31			135	11.3	2.70	2.27	3.21	
Pre-Conception Folic Acid Supplementation														
Yes	1,510	143	17.3	1	-	-	<0.0001	1,461	248	31.7	1	-	-	<0.0001
No		118	7.3	2.38	1.90	3.00			239	15.2	2.09	1.79	2.44	
Prenatal Education														
Yes	428	312	12.1	1	-	-	0.0002	396	599	24.1	1	-	-	<0.0001
No		74	7.73	1.5688	1.23	2.00			146	15.7	1.54	1.31	1.81	
Pre-Pregnancy Body Mass Index														
Underweight	1,500	10	8.6	1.43	0.78	2.64	0.0073	1,449	14	12.3	1.91	1.16	3.16	0.0018
Normal		139	12.2	1	-	-			258	23.5	1	-	-	
Overweight		72	12.2	1.00	0.77	1.31			124	21.8	1.07	0.89	1.30	
Obese		45	7.3	1.67	1.21	2.31			100	17.1	1.37	1.12	1.69	

	Missing	Exclusive Breastfeeding at Six Months (N=3,957)						Missing	Any Breastfeeding at Six Months (N=3,817)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
Gestational Weight Gain Category														
Sub-Optimal		36	9.8	1.27	0.87	1.86			60	17.1	1.34	1.02	1.77	
Optimal	1,696	70	12.5	1	-	-	0.2372	1,639	125	23.0	1	-	-	0.1018
Excessive		133	10.0	1.25	0.95	1.64			261	20.3	1.13	0.94	1.36	
Smoking during Pregnancy														
Non-Smoker		342	14.2	1	-	-			635	27.5	1	-	-	
Quit During Pregnancy	267	20	6.4	2.22	1.44	3.43	<0.0001	258	43	14.3	1.92	1.45	2.55	<0.0001
Smoker Throughout		23	2.4	5.98	3.94	9.05			65	6.8	4.03	3.16	5.14	
Parity														
Primiparous	0	145	8.7	1	-	-	0.0018	0	317	19.8	1	-	-	0.1071
Multiparous		268	11.7	0.74	0.61	0.90			485	21.9	0.90	0.79	1.02	
Health Condition During Pregnancy														
No	0	358	10.4	1	-	-	0.721	0	699	21.0	1	-	-	0.916
Yes		55	10.9	0.95	0.73	1.25			103	21.2	0.99	0.82	1.19	
Type of Labour														
Spontaneous		254	10.7	1	-	-			486	21.0	1	-	-	
Induction	0	100	9.8	1.09	0.88	1.36	0.7096	0	197	20.3	1.04	0.90	1.20	0.6161
No Labour		59	10.7	1.00	0.76	1.31			119	22.4	0.94	0.79	1.12	
Type of Delivery														
Vaginal	0	306	10.7	1	-	-	0.384	0	580	21.0	1	-	-	0.9022
Cesarean		107	9.8	1.10	0.89	1.35			222	21.1	0.99	0.86	1.14	
Epidural Anesthesia in Labour														
No	0	296	11.6	1	-	-	0.0015	0	563	22.7	1	-	-	0.0005
Yes		117	8.4	1.39	1.13	1.70			239	17.9	1.27	1.11	1.45	
3rd or 4th Degree Laceration														
No	0	398	10.4	1	-	-	0.2658	0	779	21.0	1	-	-	0.8198
Yes		15	13.6	0.76	0.47	1.23			23	21.9	0.96	0.66	1.38	

	Missing	Exclusive Breastfeeding at Six Months (N=3,957)						Missing	Any Breastfeeding at Six Months (N=3,817)					
		N	%	URR	95% CI		*P*-value		N	%	URR	95% CI		*P*-value
Gestational Age at Delivery														
< 37 weeks	26	15	7.1	1.51	0.92	2.48	0.0961	24	30	14.5	1.48	1.06	2.07	0.0171
≥ 37 weeks		397	10.7	1	-	-			769	21.4	1	-	-	
Low Infant Birth Weight														
< 2,500 grams	0	8	4.7	2.27	1.15	4.50	0.0125	0	20	12.0	1.79	1.18	2.71	0.0034
≥ 2,500 grams		405	10.7	1	-	-			782	21.4	1	-	-	
Any Major Anomaly in Infant														
No	0	408	10.5	1	-	-	0.4433	0	795	21.2	1	-	-	0.0461
Yes		5	7.6	1.38	0.59	3.23			7	10.9	1.94	0.96	3.91	
Admission to Special Care Nursery														
No	0	363	10.8	1	-	-	0.0558	0	698	21.6	1	-	-	0.0411
Yes		50	8.3	1.31	0.99	1.74			104	17.8	1.21	1.00	1.46	
Intention to Breastfeed														
Yes	444	393	17.2	1	-	-	<0.0001	437	744	34.4	1	-	-	<0.0001
No		5	0.4	41.87	17.38	100.88			15	1.2	27.80	16.76	46.12	
Breast Contact within One Hour														
Yes	1,544	169	19.5	1	-	-	<0.0001	1,525	309	38.2	1	-	-	<0.0001
No		123	8.0	2.45	1.98	3.05			236	15.9	2.40	2.07	2.77	

Note. *Abbreviations:* CBDHA – Cape Breton District Health Authority; CI – confidence interval; GASHA – Guysborough Antigonish Straight Health Authority; URR – unadjusted relative risk.

Table 5-14 Multivariate logistic regression analysis of 3,634 mother-infant pairs for cessation of exclusive breastfeeding before six months

Predictor	ARR	95% Confidence Interval		*p*-value
Infant's Birth Year				
2006	1	-	-	0.0025
2007	1.70	1.05	2.74	
2008	1.38	0.83	2.29	
2009	1.96	1.15	3.35	
Maternal Education				
Less than High School	2.47	1.22	5.00	<0.0001
High School Graduate	1.98	1.41	2.80	
College Diploma	1.70	1.22	2.37	
University Degree	1	-	-	
Neighbourhood Income Quintile				
Highest	1	-	-	0.003
Upper-Middle	1.66	1.13	2.42	
Middle	1.68	1.16	2.44	
Lower-Middle	1.49	1.04	2.14	
Lower	1.24	0.79	1.95	
County				
Antigonish	1	-	-	<0.0001
Cape Breton	2.20	1.59	3.06	
Guysborough	0.98	0.57	1.71	
Inverness	3.10	1.86	5.16	
Richmond	2.81	1.27	6.22	
Victoria	1.61	0.86	3.02	
Marital Status				
Partner	1	-	-	0.011
No Partner	1.65	1.17	2.32	
Pre-Pregnancy Body Mass Index				
Underweight	0.76	0.35	1.65	0.009
Normal	1	-	-	
Overweight	1.13	0.80	1.61	
Obese	1.94	1.29	2.92	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit Smoking During Pregnancy	1.39	0.83	2.34	
Smoker Throughout Pregnancy	2.68	1.63	4.42	
Parity				
Primiparous	1	-	-	<0.0001
Multiparous	0.63	0.49	0.80	
Breast Contact within One Hour				
Yes	1	-	-	<0.0001
No	2.11	1.56	2.87	

Predictor	ARR	95% Confidence Interval		*p*-value
Intention to Breastfeed				
Yes	1	-	-	<0.0001
No	22.42	9.47	53.06	
Test	χ^2	***df***	***p*-value**	
Overall model evaluation				
Likelihood ratio test	565.9858	29	<0.0001	
Goodness-of-fit test				
Hosmer & Lemeshow	4.5172	8	0.81	

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, breast contact within 1 hour, and intention to breastfeed were included in model to maximize sample size, but adjusted relative risks are not shown.

Abbreviations: ARR – adjusted relative risk; *df* – degrees of freedom.

Table 5-15 Multivariate logistic regression analysis of 3,518 mother-infant pairs for cessation of any breastfeeding before six months

Predictor	ARR	95% Confidence Interval		*p*-value
Infant's Birth Year				
2006	1	-	-	0.0018
2007	1.58	1.13	2.23	
2008	1.48	1.00	2.18	
2009	2.02	1.36	2.99	
Maternal Education				
Less than High School	1.53	0.92	2.55	<0.0001
High School Graduate	1.66	1.28	2.16	
College Diploma	1.56	1.20	2.03	
University Degree	1	-	-	
Maternal Age				
< 20 years	4.36	2.19	8.70	<0.0001
20-24 years	2.33	1.62	3.33	
25-29 years	1.34	1.00	1.79	
30-34 years	1.16	0.87	1.53	
≥ 35 years	1	-	-	
District Health Authority				
CBDHA	1.60	1.28	2.00	<0.0001
GASHA	1	-	-	
Marital Status				
Partner	1	-	-	0.0062
No Partner	1.46	1.13	1.89	
Pre-Pregnancy BMI				
Underweight	1.40	0.73	2.70	0.008
Normal	1	-	-	
Overweight	1.26	0.94	1.68	
Obese	1.67	1.23	2.27	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit Smoking During Pregnancy	1.37	0.93	2.00	
Smoker Throughout Pregnancy	2.26	1.64	3.12	
Breast Contact within One Hour				
Yes	1	-	-	<0.0001
No	2.22	1.75	2.80	
Intention to Breastfeed				
Yes	1	-	-	<0.0001
No	23.14	13.67	39.17	

Test	χ^2	*df*	*p*-value
Overall model evaluation			
Likelihood ratio test	955.7205	24	<0.0001
Goodness-of-fit test			
Hosmer & Lemeshow	7.8913	8	0.44

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, breast contact within 1 hour, and intention to breastfeed were included in model to maximize sample size, but adjusted relative risks are not shown.

Abbreviations: ARR – adjusted relative risk; *df* – degrees of freedom.

Table 5-16 *P*-values for the log-rank test of equality across strata in Kaplan-Meier analyses of exclusive and any breastfeeding duration

Predictor	Log-Rank *P*-value		*df*
	Exclusive BF	Any BF	
Infant's Year of Birth	0.0988	0.02569	3
Maternal Age	<0.0001	<0.0001	4
Highest Maternal Level of Education	<0.0001	<0.0001	4
Neighbourhood Income Quintile	<0.0001	<0.0001	4
Area of Residence	0.2542	0.3435	1
District Health Authority	<0.0001	<0.0001	1
County of Residence	<0.0001	<0.0001	5
Marital Status	<0.0001	<0.0001	2
Pre-Pregnancy Body Mass Index	<0.0001	0.0027	4
Gestational Weight Gain Category	0.0166	0.0254	3
Smoking During Pregnancy	<0.0001	<0.0001	2
Pre-Conception Folic Acid Supplementation	<0.0001	<0.0001	2
Prenatal Education	0.2191	0.4044	2
Parity	<0.0001	<0.0001	1
Health Condition During Pregnancy	0.0317	0.0466	1
Type of Labour	0.1066	0.3988	2
Type of Delivery	0.0014	0.1299	1
Epidural Anesthesia in Labour	<0.0001	<0.0001	1
3rd or 4th Degree Laceration	0.7394	0.9657	1
Gestational Age at Delivery	0.0061	0.0011	1
Low Birth Weight	<0.0001	<0.0001	1
Major Anomaly in Infant	0.0998	0.2111	1
Admission to Special Care Nursery	0.0003	0.0041	1
Intention to Breastfeed	<0.0001	<0.0001	2
Breast Contact within One Hour of Birth	<0.0001	<0.0001	2

Note. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, gestational weight gain category, pre-conception folic acid supplementation, prenatal education, intention to breastfeed, breast contact within one hour of birth are included in model to maximize sample size, inflating the degrees of freedom for these variables.

Abbreviations: BF – breastfeeding; *df* – degree of freedom.

Table 5-17 Cox proportional hazard analysis of 2,639 mother-infant dyads for exclusive breastfeeding duration

Predictor	Hazard Ratio	95% Confidence Interval		*p*-value
Maternal Education				
Less than High School	1.66	1.35	2.04	<0.0001
High School Graduate	1.35	1.18	1.54	
College Diploma	1.25	1.08	1.43	
University Degree	1	-	-	
Neighbourhood Income Quintile				
Highest	1	-	-	<0.0001
Upper-Middle	1.33	1.14	1.55	
Middle	1.38	1.19	1.59	
Lower-Middle	1.27	1.10	1.48	
Lower	1.35	1.13	1.60	
District Health Authority				
CBDHA	1.21	1.08	1.37	0.0007
GASHA	1	-	-	
Marital Status				
Partner	1	-	-	0.0013
No Partner	1.24	1.10	1.41	
Pre-Pregnancy Body Mass Index				
Underweight	0.91	0.66	1.23	0.001
Normal	1	-	-	
Overweight	1.12	0.97	1.30	
Obese	1.43	1.23	1.65	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit During Pregnancy	1.09	0.92	1.29	
Smoker Throughout Pregnancy	1.39	1.21	1.60	
Pre-Conception Folic Acid Supplementation				
Yes	1	-	-	0.0424
No	1.15	1.01	1.30	
Parity				
Primiparous	1	-	-	<0.0001
Multiparous	0.76	0.69	0.84	
Breast Contact within One Hour				
Yes	1	-	-	<0.0001
No	1.44	1.29	1.62	
Intention to Breastfeed				
Yes	1	-	-	<0.0001
No	1.78	1.44	2.16	

Test	χ^2	*df*	*p*-value
Overall model evaluation			
Likelihood ratio test	390.9358	24	<0.0001

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, pre-pregnancy folic acid supplementation, breast contact within 1 hour, and intention to breastfeed were included in model to maximize sample size, but hazard ratios are not shown.

Abbreviations: CBDHA – Cape Breton District Health Authority; *df* – degrees of freedom; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-18 Cox proportional hazard analysis of 2,639 mother-infant dyads for any breastfeeding duration

Predictor	Hazard Ratio	95% Confidence Interval		*p*-value
Maternal Education				
Less than High School	1.41	1.10	1.78	<0.0001
High School Graduate	1.29	1.11	1.49	
College Diploma	1.32	1.14	1.53	
University Degree	1	-	-	
Maternal Age				
< 20 years	1.61	1.20	2.14	<0.0001
20-24 years	1.27	1.05	1.53	
25-29 years	1.04	0.88	1.22	
30-34 years	1.01	0.86	1.19	
35+ years	1	-	-	
Neighbourhood Income Quintile				
Highest	1	-	-	<0.0001
Upper-Middle	1.35	1.15	1.59	
Middle	1.44	1.24	1.68	
Lower-Middle	1.35	1.15	1.58	
Lower	1.35	1.12	1.61	
District Health Authority				
CBDHA	1.32	1.17	1.50	<0.0001
GASHA	1	-	-	
Marital Status				
Partner	1	-	-	0.0043
No Partner	1.26	1.10	1.44	
Pre-Pregnancy Body Mass Index				
Underweight	0.95	0.68	1.30	0.0074
Normal	1	-	-	
Overweight	1.13	0.97	1.32	
Obese	1.33	1.14	1.55	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit During Pregnancy	1.14	0.95	1.36	
Smoker Throughout Pregnancy	1.46	1.27	1.68	
Parity				
Primiparous	1	-	-	0.0003
Multiparous	0.82	0.74	0.92	
Breast Contact within One Hour				
Yes	1	-	-	<0.0001
No	1.39	1.23	1.56	

Predictor	Hazard Ratio	95% Confidence Interval		*p*-value
Intention to Breastfeed				
Yes	1	-	-	<0.0001
No	1.93	1.56	2.36	
Test	χ^2	***df***	***p*-value**	
Overall model evaluation				
Likelihood ratio test	408.7354	26	<0.0001	

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, breast contact within 1 hour, and intention to breastfeed were included in model to maximize sample size, but hazard ratios are not shown.

Abbreviations: CBDHA – Cape Breton District Health Authority; *df* – degrees of freedom; GASHA – Guysborough Antigonish Straight Health Authority.

Table 5-19 Frequencies and unadjusted relative risk of 4,043 mother-infant pairs for intention to breastfeed

	No Intention to BF			URR	95% Confidence Interval		*P*-value
	N	%	Missing				
All Mothers							
All Mothers	1,243	30.7	0	1	-	-	-
Infant's Year of Birth							
2006	282	33.7		1	-	-	
2007	340	32.6	0	0.98	0.92	1.05	0.0101
2008	334	30.1		0.95	0.89	1.01	
2009	287	27.3		0.91	0.86	0.97	
Maternal Age							
< 20 years	141	52.2		1.59	1.39	1.82	
20-24 years	289	35.0		1.17	1.09	1.25	
25-29 years	372	30.7	0	1.10	1.04	1.17	<0.0001
30-35 years	305	26.1		1.03	0.97	1.09	
35+ years	136	24.0		1	-	-	
Mother's Highest Level of Education							
Less than High School	220	56.0		1.93	1.72	2.16	
High School Graduate	421	39.0	614	1.39	1.32	1.47	<0.0001
College Diploma	194	25.9		1.15	1.09	1.20	
University Degree	182	15.1		1	-	-	
Neighbourhood Income Quintiles							
Highest	178	20.4		1	-	-	
Upper-Middle	236	30.7		1.15	1.08	1.22	
Middle	266	30.1	38	1.14	1.08	1.20	<0.0001
Lower-Middle	315	36.1		1.25	1.17	1.32	
Lowest	238	39.3		1.31	1.22	1.41	
Area of Residence							
Rural	234	25.9	0	1	-	-	0.0004
Urban	1,009	32.1		1.09	1.04	1.14	
District Health Authority							
CBDHA	1,024	34.3	51	1.21	1.16	1.26	<0.0001
GASHA	205	20.4		1	-	-	
County of Residence							
Antigonish	92	16.1		1	-	-	
Cape Breton	919	35.5		1.30	1.24	1.36	
Guysborough	36	22.5	28	1.08	0.99	1.19	<0.0001
Inverness	87	23.0		1.09	1.02	1.16	
Richmond	51	33.6		1.26	1.12	1.42	
Victoria	51	31.6		1.23	1.10	1.37	

Marital Status							
Partner	469	21.8	750	1	-	-	<0.0001
No Partner	465	40.7		1.32	1.25	1.39	
Pre-Pregnancy Body Mass Index							
Underweight	46	42.2	1,487	1.24	1.06	1.47	0.0039
Normal	336	28.1		1	-	-	
Overweight	162	26.0		0.97	0.92	1.03	
Obese	193	30.7		1.04	0.97	1.11	
Smoking During Pregnancy							
Non-Smoker	620	23.9	260	1	-	-	<0.0001
Quit During Pregnancy	92	29.6		1.08	1.00	1.16	
Smoker Throughout	443	50.2		1.53	1.43	1.64	
Pre-Conception Folic Acid Supplementation							
Yes	577	35.8	1,544	1	-	-	<0.0001
No	149	16.8		1.30	1.24	1.36	
Prenatal Education							
Yes	697	26.9	492	1	-	-	-
No	384	40.1		1.22	1.15	1.29	<0.0001
Parity							
Primiparous	423	25.4	0	1	-	-	-
Multiparous	820	34.5		1.14	1.09	1.19	<0.0001
Health Condition During Pregnancy							
No	1,105	31.2	0	1	-	-	-
Yes	138	27.7		0.95	0.90	1.01	0.1172

Note. *Abbreviations:* BF – breastfeed; CBDHA – Cape Breton District Health Authority; GASHA – Guysborough Antigonish Straight Health Authority; URR – unadjusted relative risk.

Table 5-20 Multivariate logistic regression analysis of 3,756 mother-infant pairs for no intention to breastfeed

Predictor	ARR	95% Confidence Interval		*p*-value
Infant's Birth Year				
2006	1	-	-	0.0036
2007	1.06	1.86	1.31	
2008	0.84	0.67	1.04	
2009	0.78	0.62	0.97	
County				
Antigonish	1	-	-	<0.0001
Cape Breton	2.28	1.74	3.00	
Guysborough	1.36	0.86	2.14	
Inverness	1.41	0.98	2.04	
Richmond	2.31	1.45	3.68	
Victoria	1.88	1.20	2.94	
Maternal Education				
Less than High School	3.03	2.21	4.17	<0.0001
High School Graduate	2.17	1.72	2.73	
College Diploma	1.69	1.32	2.17	
University Degree	1	-	-	
Maternal Age				
< 20 years	1.86	1.24	2.81	0.0152
20-24 years	1.03	0.77	1.39	
25-29 years	1.17	0.90	1.52	
30-34 uears	1.11	0.86	1.43	
≥ 35 years	1	-	-	
Marital Status				
Partner	1	-	-	<0.0001
No Partner	1.71	1.41	2.08	
Smoker During Pregnancy				
Non-Smoker	1	-	-	<0.0001
Quit Smoking During Pregnancy	0.95	0.71	1.25	
Smoker Throughout Pregnancy	1.61	1.34	1.94	
Pre-Conception Folic Acid Supplementation				
Yes	1	-	-	<0.0001
No	1.66	1.33	2.08	
Prenatal Education				
Yes	1	-	-	0.005
No	1.32	1.11	1.57	
Parity				
Primiparous	1	-	-	<0.0001
Multiparous	1.32	1.11	1.57	

Test	χ^2	*df*	*p*-value
Overall model evaluation			
Likelihood ratio test	568.5997	25	<0.0001
Goodness-of-fit test			
Hosmer & Lemeshow	7.2325	8	0.51

Note. Model includes all variables significant at α=0.1 level of significance in unadjusted analysis. "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, pre-conception folic acid supplementation are included in model to maximize sample size, but adjusted relative risks are not shown.

Abbreviations: CBDHA – Cape Breton District Health Authority; GASHA – Guysborough Antigonish Straight Health Authority.

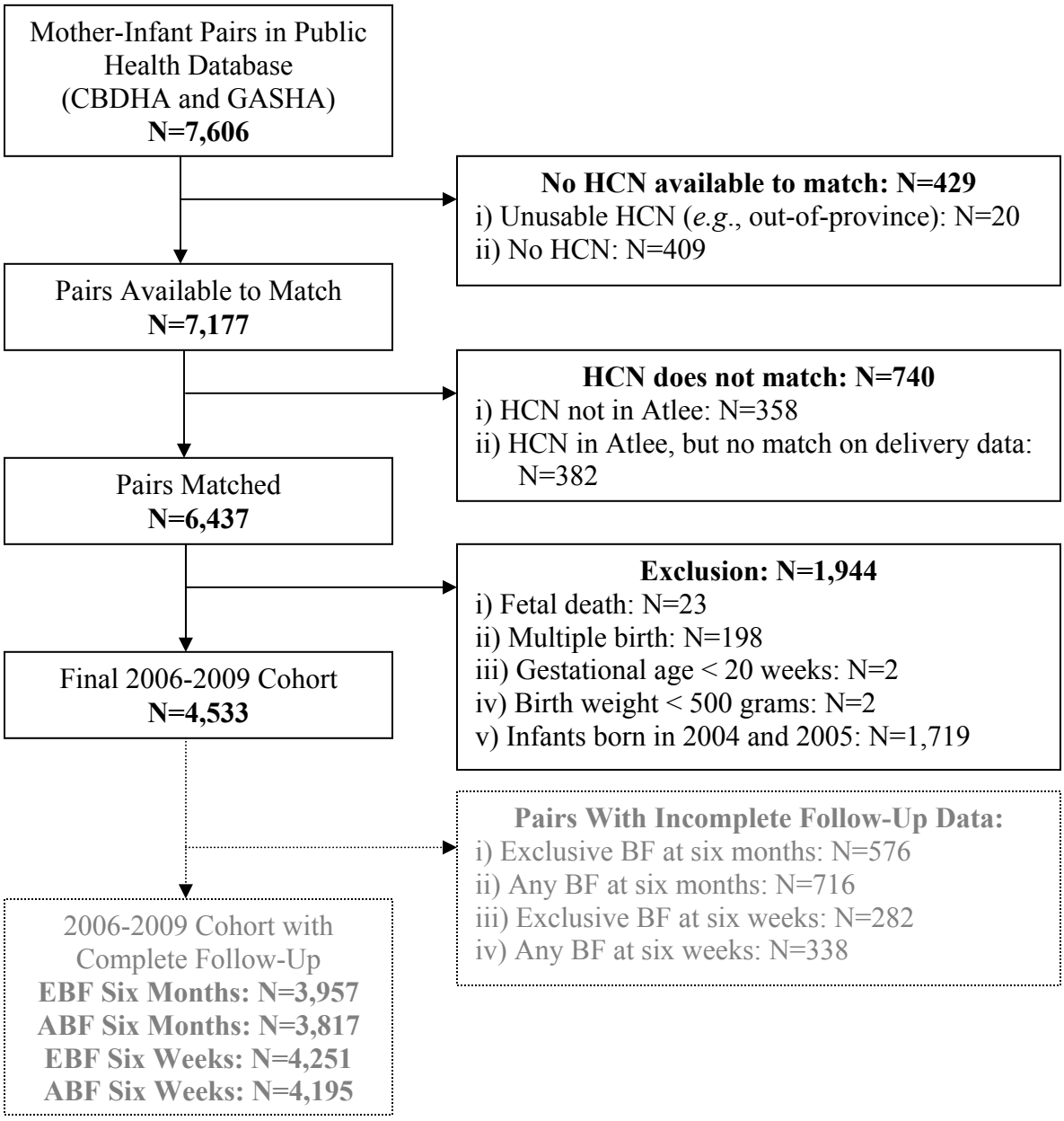

Figure 5-1 Flow linkage diagram of mother-infant pairs available in Public Health Database between 2006 and 2009

Note. *Abbreviations:* ABF – any breastfeeding; Atlee – Nova Scotia Atlee Perinatal Database; BF – breastfeeding; CBDHA – Cape Breton District Health Authority; EBF – exclusive breastfeeding; GASHA – Guysborough Antigonish Straight Health Authority; HCN – health card number.

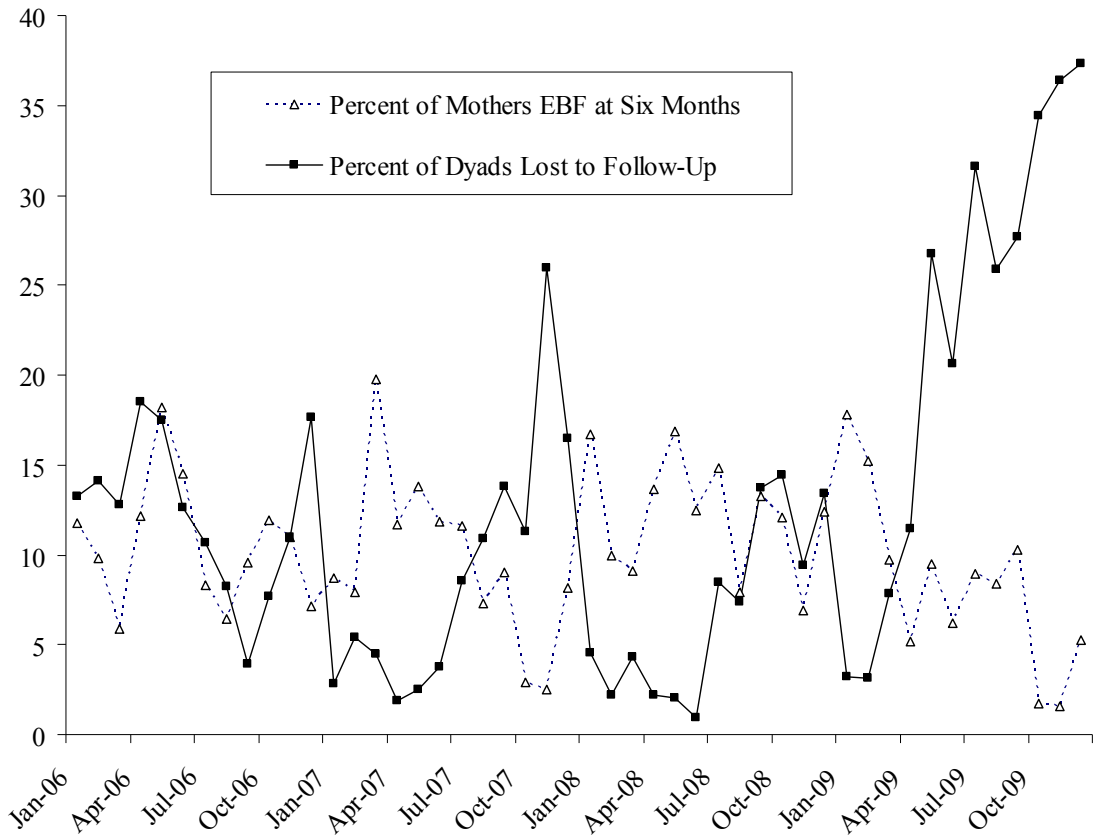

Figure 5-2 Comparison of trends in the proportion of dyads exclusive breastfeeding with complete follow-up at six months and the proportion of dyads lost to follow-up between 2006 and 2009 by month and year of birth

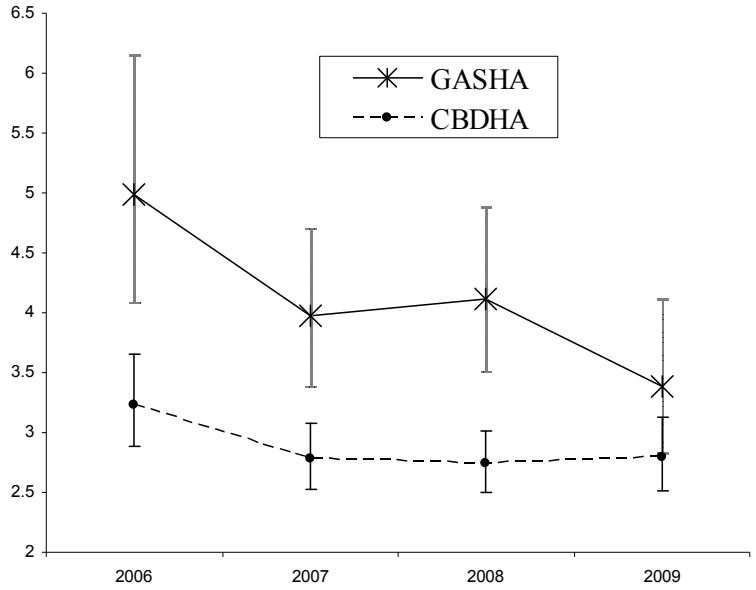

Figure 5-3 Mean exclusive breastfeeding duration between 2006 and 2009 by infant's year of birth and District Health Authority

Note. Error bars represent 95% confidence intervals.

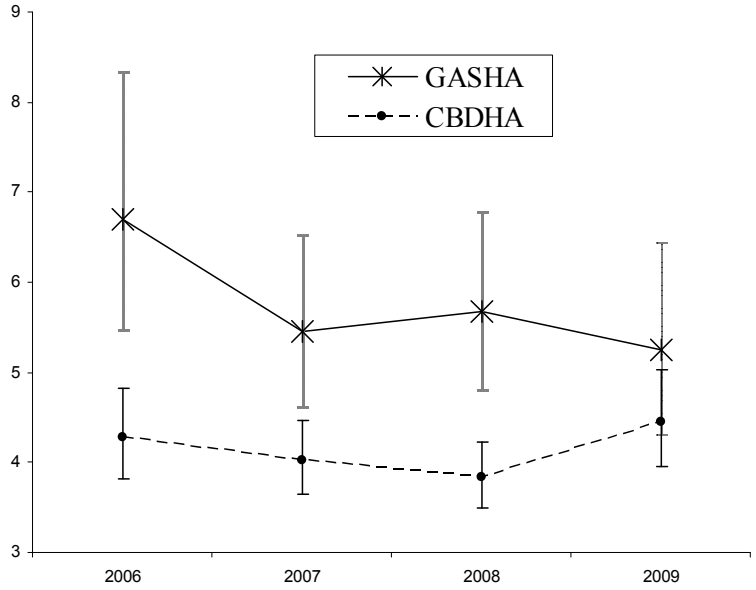

Figure 5-4 Mean any breastfeeding duration between 2006 and 2009 by infant's year of birth and District Health Authority

Note. Error bars represent 95% confidence intervals.

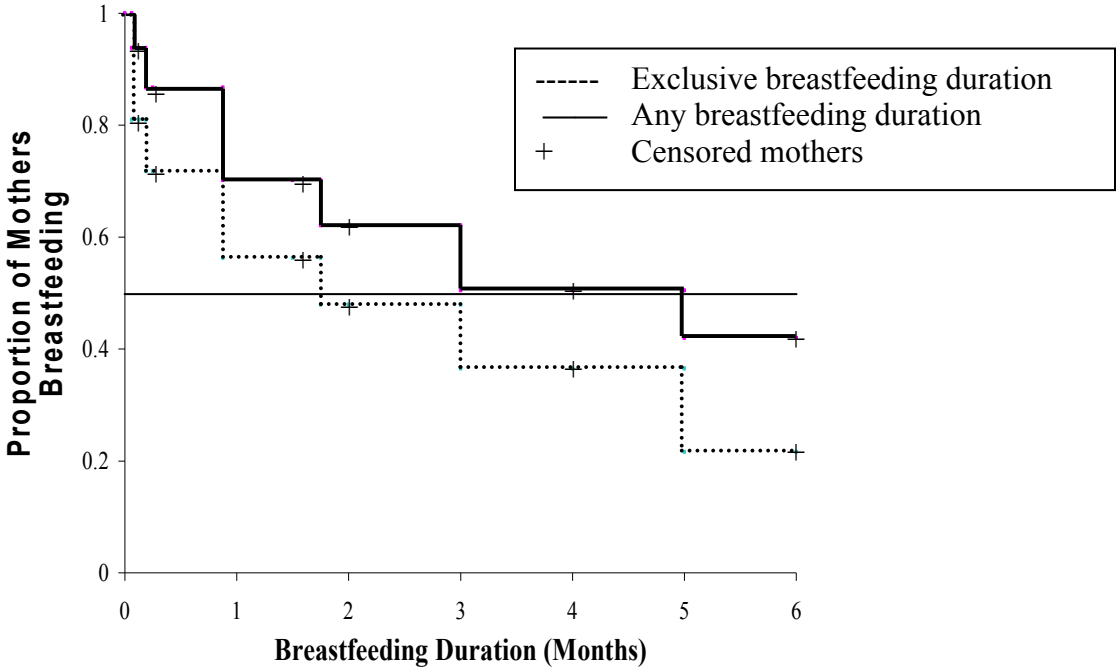

Figure 5-5 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive and any breastfeeding duration to six months

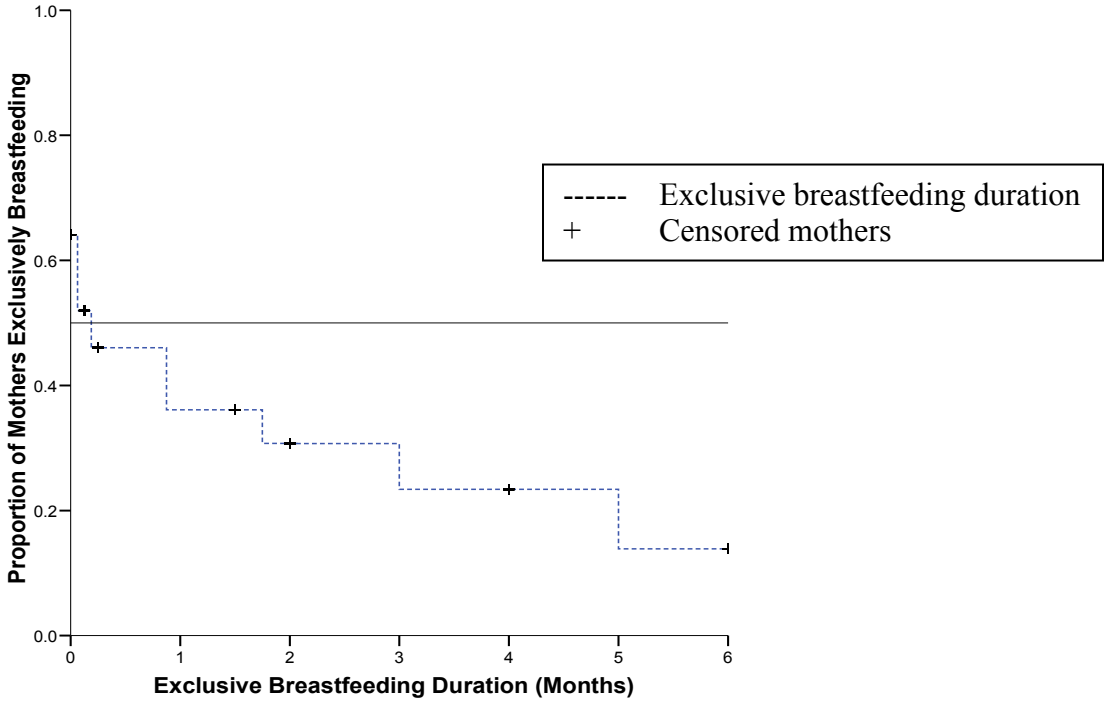

Figure 5-6 Among all 4,533 mothers, Kaplan-Meier curve of exclusive breastfeeding duration to six months

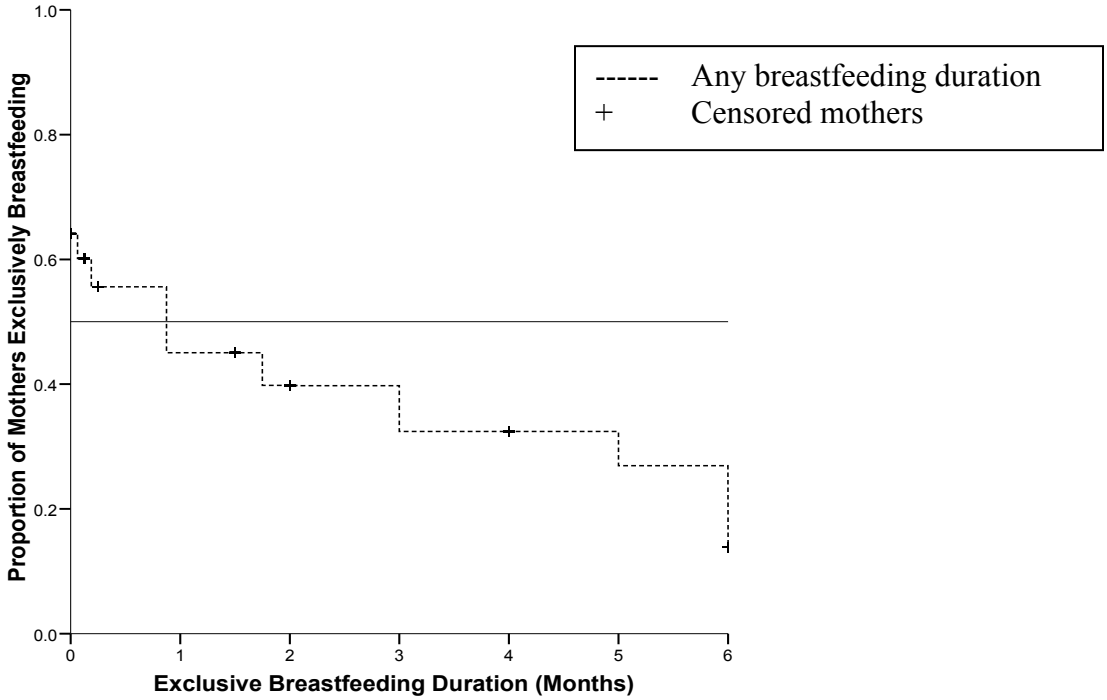

Figure 5-7 Among all 4,533 mothers, Kaplan-Meier curve of any breastfeeding duration to six months

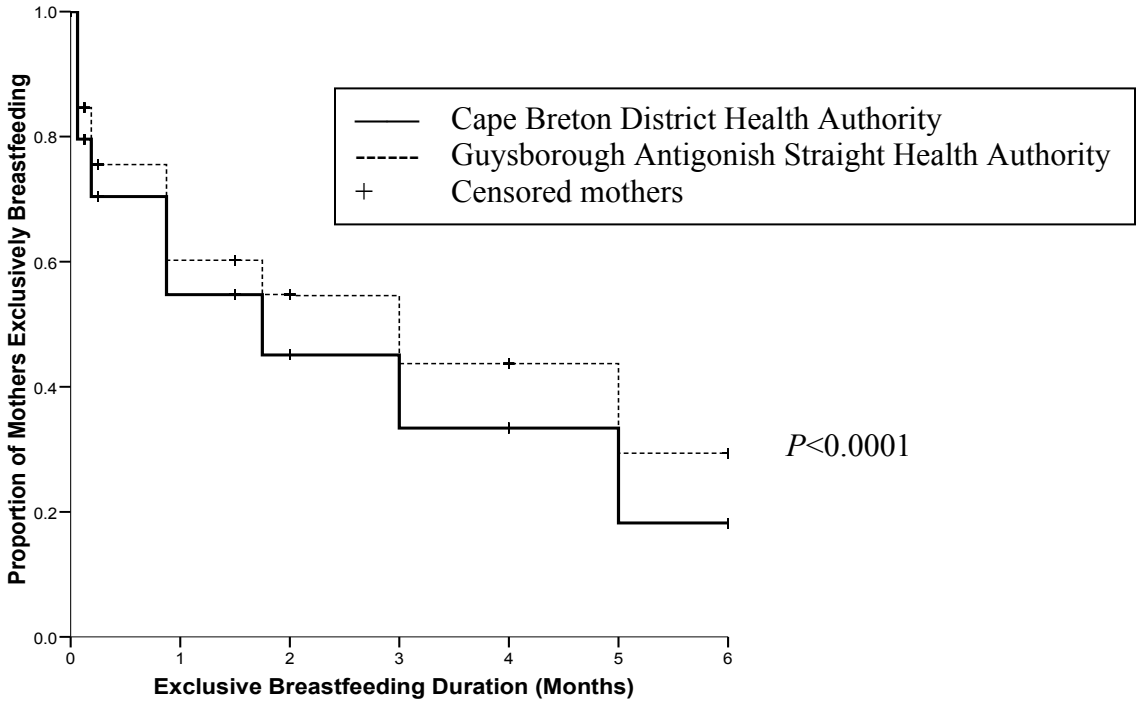

Figure 5-8 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeed duration to six months stratified by District Health Authority in which the mother resided

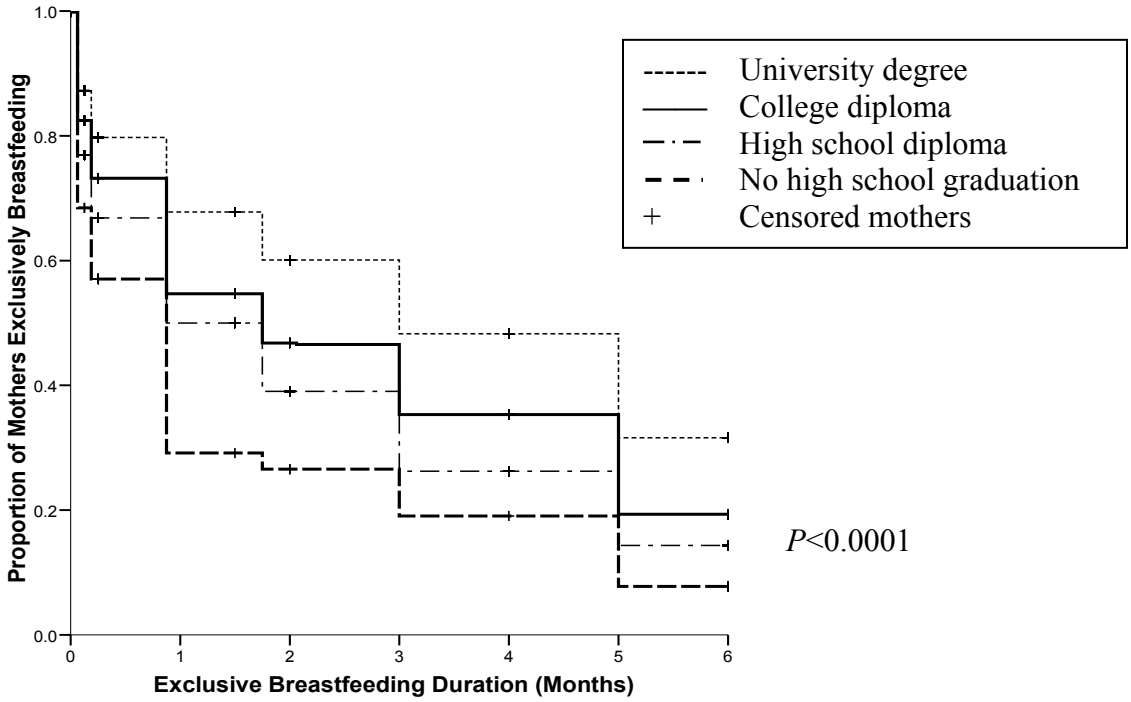

Figure 5-9 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by highest level of maternal education

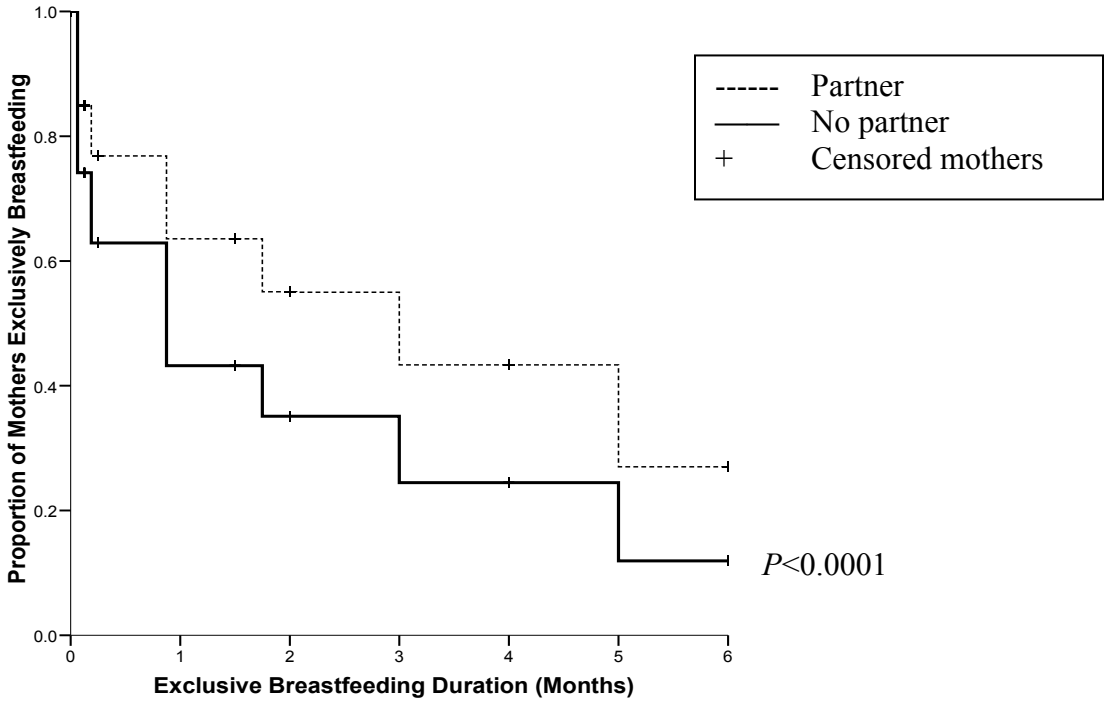

Figure 5-10 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by marital status

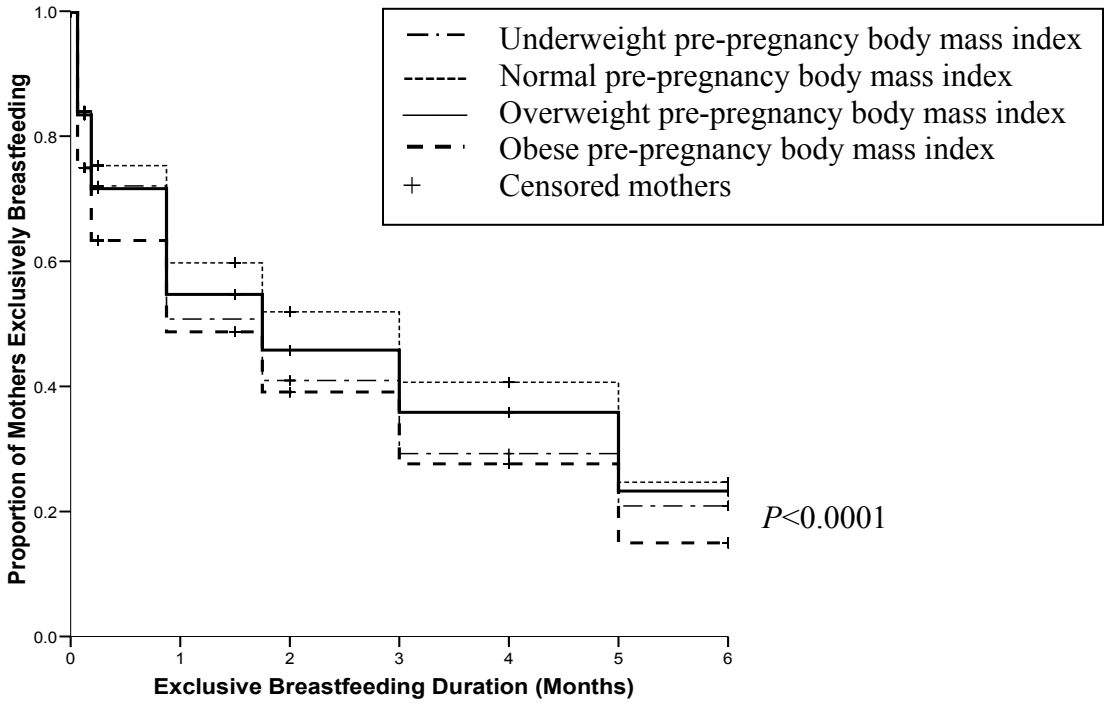

Figure 5-11 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by maternal pre-pregnancy body mass index category

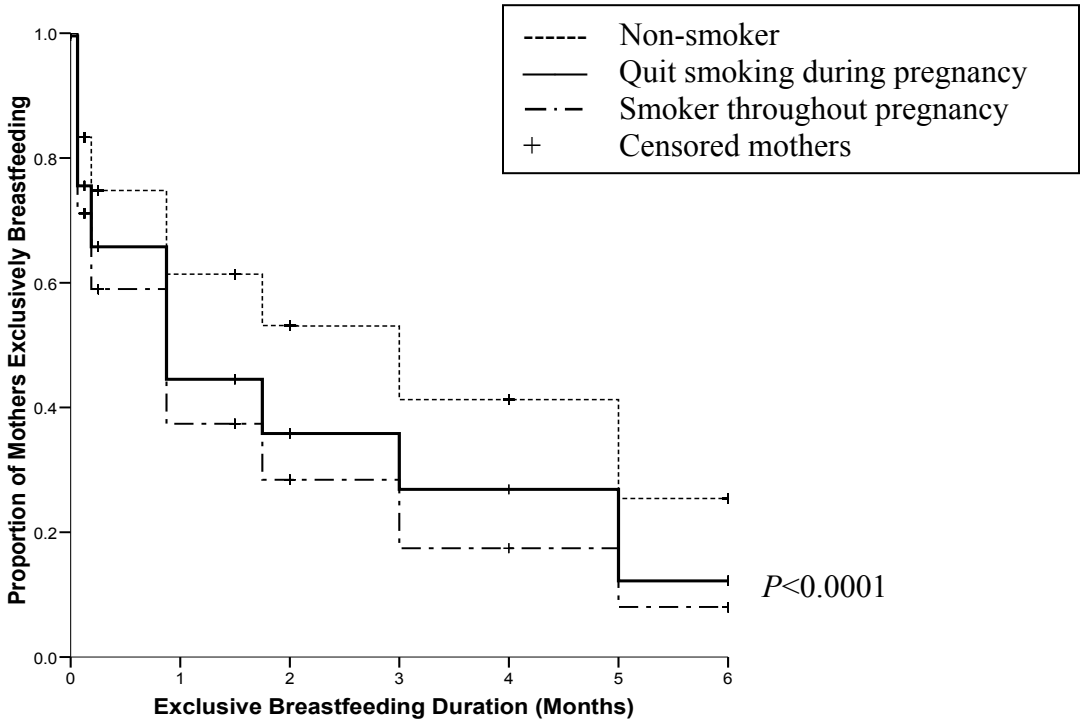

Figure 5-12 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by maternal smoking status

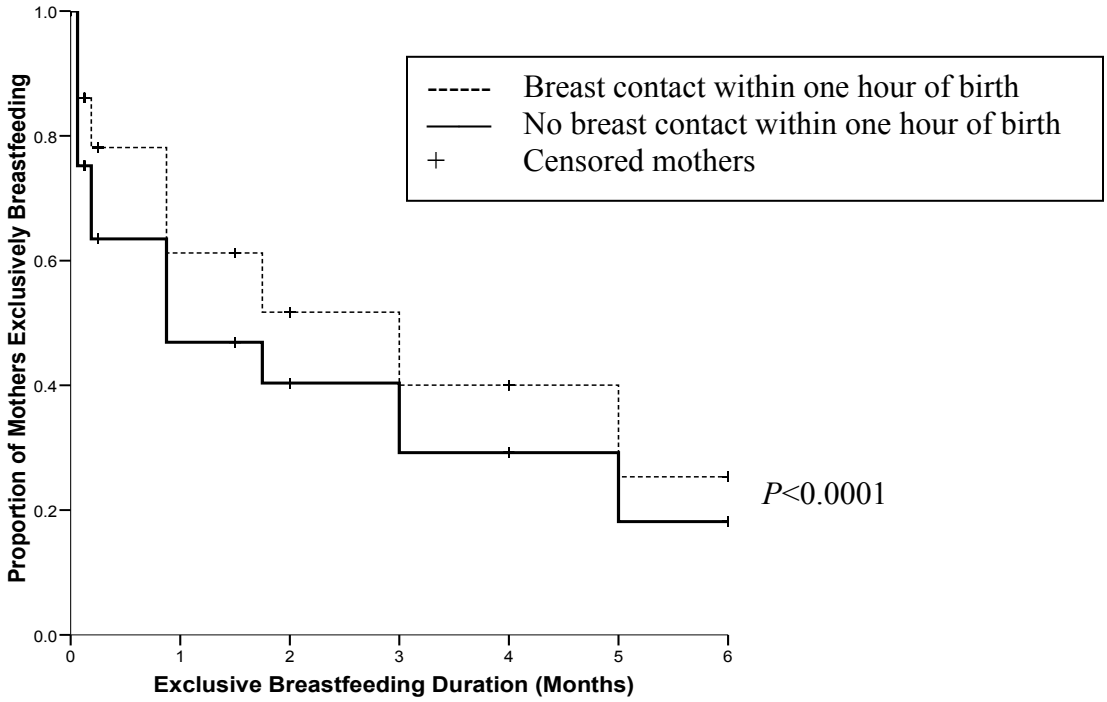

Figure 5-13 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by whether mother and neonates had breast contact within one hour of birth

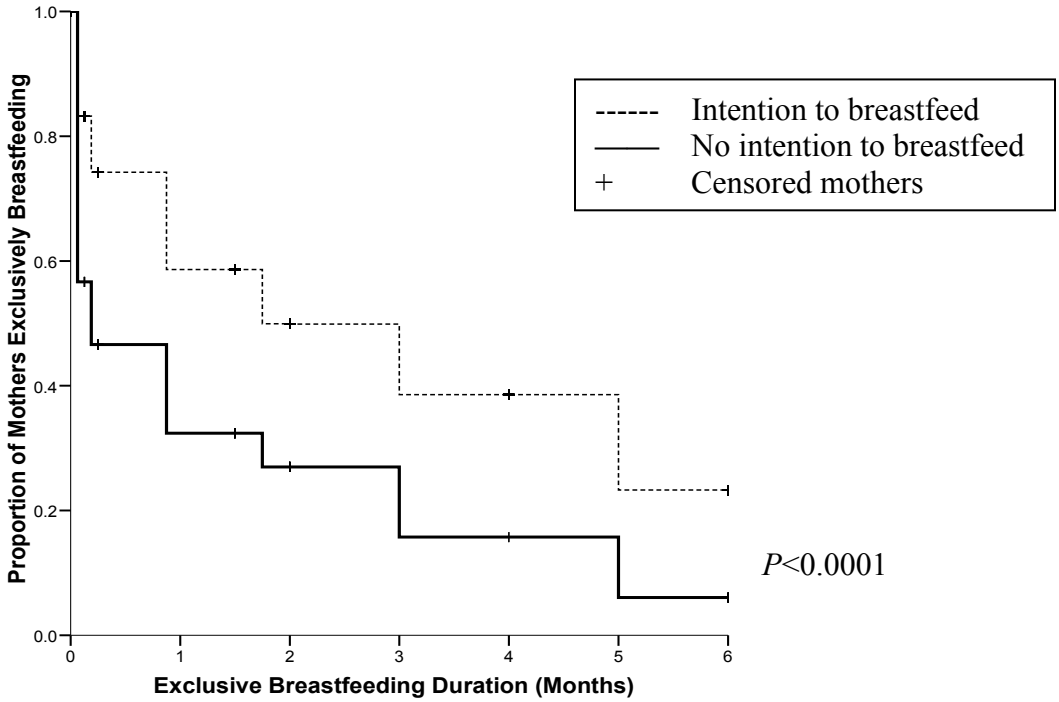

Figure 5-14 Among the 2,907 mothers who initiated breastfeeding, Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by intention to breastfeed

CHAPTER 6 DISCUSSION

This thesis aimed to investigate the prevalence and predictors of exclusive and any breastfeeding to six months among mothers living in Eastern Nova Scotia. Although 64.1% of mothers initiated breastfeeding in this region, only 10.4% exclusively breastfed their infant for the recommended six months. The rates of breastfeeding initiation and exclusive breastfeeding duration among the cohort are consistent with reported rates across Nova Scotia from cross-sectional surveys conducted between 2005 and 2007.[23,28] In contrast and compared to provincial data from the Maternity Experience Survey, intention to breastfeed among mothers in the cohort at 69.3% is more than 10% lower than the rate reported among Nova Scotia mothers, and the rate of any breastfeeding at six month among dyads in the cohort at 21.0% is half the reported rate of any breastfeeding at six months among Nova Scotia mothers.[23] While these breastfeeding patterns are similar to other Atlantic provinces, compared with the Canadian average, Nova Scotia mothers are clearly struggling to meet the WHO breastfeeding recommendation. Nationally, 90.0% of mothers intend to breastfeed, 90.3% initiate breastfeeding, 53.9% are any breastfeeding at six months, and 14.4% are exclusively breastfeeding at six months.[23]

Rates of exclusive breastfeeding decreased considerably from hospital discharge to six months. As evident in Figure 5-5 (p96), the proportion of mothers who were exclusive breastfeeding or any breastfeeding fell more quickly within the first six weeks after birth than between six weeks and six months. The Nova Scotia provincial government has already identified the first six weeks as a critical intervention window to help mothers breastfeed longer. Indeed, Nova Scotia launched its $500,000 "Breastfeeding: Learning Makes it Natural" social marketing campaign in spring 2009, which targeted the first six weeks after birth.[97] Results from the present study suggest that continued efforts should be focused on supporting mothers and their infants during this critical intervention window. Moreover, breastfeeding initiation rates in CBDHA and GASHA remain 15 to 25% lower than the Canadian average. Even before support is offered during the first six weeks of life, support from lactation consultants in-hospital

and from public health nurses to mothers and infants immediately after discharge from hospital is vital to help mothers initiate breastfeeding.

This study found a non-significant decrease in the rate of exclusive breastfeeding at six months between 2006 and 2009. This trend could be worrisome because, as previously mentioned, breastfeeding rates in Nova Scotia are already well below the Canadian average. Following hospital discharge, breastfeeding support services to mothers in GASHA And CBDHA are largely provided by public health nurses through the Healthy Beginnings Program. In 2009, the H1N1 flu epidemic disrupted the Healthy Beginnings Program. Two waves of the H1N1 outbreak affected Nova Scotia in 2009: the first wave peaked in July 2009 and the second wave in November 2009.[100] During the epidemic, Public Health Services implemented their Business Continuity Plan, which consisted of offering only essential services such as delivering H1N1 flu vaccines and communicable disease follow-up.[74] While PHN did not offer usual follow-up for prenatal and postpartum services including breastfeeding, they were contacting all referred postpartum mothers post-discharge and did complete a small number of home visits.[74] The disruption of regular services may explain some of the apparent decrease in breastfeeding rates in 2009 compared with 2006 to 2008. Conversely, the sensitivity estimate on rates of exclusive breastfeeding at six months (Table 5-5, p65) suggests that the rate of exclusive breastfeeding between 2006 and 2009 is unlikely to have decreased, and may even have increased over the four year period. The high level of uncertainty around a trend over time is directly related to the high percent of infants lost to follow-up between July and December 2009, about 32%. Unfortunately, breastfeeding data from CBDHA and GASHA for 2010 is unavailable to this thesis project, so we cannot test whether breastfeeding rates returned to more usual levels in 2010.

This study identified six risk factors consistently and independently associated with early cessation of exclusive and any breastfeeding before six weeks and at six months, as well as shorter duration of exclusive and any breastfeeding. These include lower maternal education, no partner, obese pre-pregnancy body mass index, smoking during pregnancy, no breast contact between mother and infant within the first hour after birth, and no intention to breastfeed. The first four risk factors are consistent with existing Canadian literature.[16,18,32,33,36,77] The fifth factor, no breast contact between

mother and infant within the first hour after birth, has, to the author's knowledge, never been studied before in the Canadian literature. Finally, the sixth factor, no intention to breastfeed, has been less extensively studied within the Canadian context; however, international evidence supports the importance of this risk factor.[51,101]

Compared to mothers with a university degree, mothers with fewer years of education are at higher risk of shorter exclusive breastfeeding duration. This social determinant of health is the most important risk factor after breastfeeding intention. Indeed, a clear gradient among education levels exists: mothers with a college diploma are 70% more likely, mothers with a high school diploma are 98% more likely, and mothers who never graduated from high school are 147% more likely to cease exclusive breastfeeding before six months compared to university-educated mothers. Most Canadian studies on the determinants of exclusive breastfeeding corroborate this finding.[16,18,33,36,77] While this is not a factor that governments can change in the short term, it is something that they should be considering over the medium and longer term, especially since lack of high school graduation often tracks other socio-economic indicators around various types of poverty.

Curiously, among Canadian studies on the predictors of breastfeeding exclusivity and duration, only one found a significant multivariate association between mothers who had a partner and a higher rate of exclusive breastfeeding at six months.[16] Other Canadian studies failed to demonstrate an association[18,32-34,36,77]; however, international studies from high-income nations have consistently demonstrated that married women have a higher rate of breastfeeding initiation and longer breastfeeding duration.[30,31,102,103] In the present study, marital status was the next most important social determinant of health related to better breastfeeding practices after education. Indeed, no partner was the most important predictor of cessation of exclusive breastfeeding before six months in the social ecological model for the interpersonal level. Living with a partner likely provides the mother with important social support, increasing her ability to choose to breastfeed. Further, women without partners may also reflect mothers who are younger and less educated.

In the present study, an obese pre-pregnancy BMI was consistently associated with shorter breastfeeding duration and a lower proportion of mothers who breastfeed

exclusively. No association, however, existed with a reduced intention to breastfeed. Indeed, comparing only mothers with an intention to breastfeed in this cohort, obese mothers were no less likely to initiate breastfeeding than normal weight mothers, but they were 22% (URR=1.22, 95% CI=1.06-1.43) more likely to cease exclusive breastfeeding before six weeks and 64% (1.64, 1.20-2.25) more likely to cease exclusive breastfeeding before six months. This implies that despite a similar intention to breastfeed among obese mothers, they have greater difficulty in achieving longer and more exclusive breastfeeding practices compared with normal weight mothers, which suggests is an opportunity to better support these mothers.

Few Canadians studies have examined maternal pre-pregnancy BMI as a risk factor for breastfeeding, but both demonstrated a significant multivariate association.[16,36] This study's suggested effect size of a 94% increase risk of cessation of exclusive breastfeeding before six months is consistent with Amir and Donath's systematic review of maternal obesity and breastfeeding duration,[43] and it underlines the importance of conceiving at a healthy weight. Conversely, this study does not support Hilson and Rasmussen's finding that women who exceeded the gestational weight gain recommendations have a higher risk of early breastfeeding cessation.[47] This may be related, in part, to potential misclassification of gestational weight gain category in the present study due to self-reported pre-pregnancy weight and height.

Consistent evidence in Canada[16,32,34] and internationally[42,45,48,50,51] has demonstrated a strong association between smoking and poorer breastfeeding patterns. In the present study, the hazard ratio (*i.e.* instantaneous relative risk) among mothers who smoked throughout pregnancy compared to non-smokers mothers was 1.39 (95% CI= 1.21-1.60). This is consistent with a meta-analysis that suggested smoking increases the odds of shorter breastfeeding by 50%.[48] An interesting non-significant tendency noted in the present study was that mothers who quit smoking had better breastfeeding outcomes than mothers who smoked throughout pregnancy. This finding is consistent with other studies in the United States[50], Sweden[42], and Australia[45] that demonstrated mothers who quit smoking during pregnancy have significantly better breastfeeding practices compared with smoking mothers.

To the author's knowledge, this is the first Canadian study on breastfeeding determinants to consider breast contact between mothers and their infant within one hour after birth. This association may be quite important for improving breastfeeding practices: no early breast contact between dyads had a similar hazard ratio as smoking (1.44, 1.29-1.62). A prospective study in Poland noted that skin-to-skin contact increased mean duration of exclusive breastfeeding by 0.39 months and any breastfeeding duration by 1.4 months, as well as significantly coexisting with other hospital practices supportive of breastfeeding such as infants rooming-in with mothers and breastfeeding initiation within two hours of birth.[41] Indeed, placing infants in uninterrupted skin-to-skin contact with their mother immediately following birth is one of the 10 steps of the WHO/UNICEF Baby-Friendly Initiative (Appendix A).[104]

Unsurprisingly, no intention to breastfeed was the most important risk factor for early cessation of breastfeeding in the present study, and it was the strongest predictor in the social ecological model at the individual level. In their study on predictors of breastfeeding intention, Stuebe and Bonuck suggest that the two most important predictors of intention to breastfeed are stronger maternal knowledge about the infant health benefits associated with exclusive breastfeeding and higher comfort with breastfeeding in social settings.[105] These predictors are consistent with the theory of planned behaviour, which suggests that a person's attitude, subjective norms, and perceived behaviour control predict intention.[71] Future studies, however, may benefit from qualifying the strength of intention. Semenic and colleagues, one of the few Canadian studies to examine breastfeeding intention, found in their study on predictors of exclusive breastfeeding that intention to exclusively breastfeeding to six months compared with less than six months was not significantly associated with the practice of exclusive breastfeeding to six months (p=0.06).[35] This study followed 189 primiparous mothers who intended to exclusively breastfeed for at least six weeks, so given the strong, preexisting intention to breastfeed for at least six weeks, it may have been insufficiently powered to find an association with breastfeeding at six months.

A further five risk factors were independently associated with at least one poorer breastfeeding pattern. This included lower maternal age, lower neighborhood income quintile, mothers living in CBDHA, no pre-conception folic acid supplementation, and

epidural analgesia. Two other predictors were also independently associated with poorer breastfeeding practices, infant's year of birth and parity, but the direction of the association was opposite for intention to breastfeed versus early cessation of breastfeeding.

Lower maternal age was associated with lower intention to breastfeed and shorter any breastfeeding duration. Moreover, the present study demonstrated a clear gradient: the poorest breastfeeding practices were associated with teenaged mothers while the best breastfeeding practices were associated with mothers older than 30 years of age. Many Canadian studies have similarly noted a significant multivariate association between age and breastfeeding.[18,32,33] Conversely, to the authors knowledge, no Canadian studies conducted after 1995 examining predictors of breastfeeding have found an association between lower income level and poorer breastfeeding practices[16,18,32-34,36,77], although an international review of factors associated with breastfeeding duration suggests that socioeconomic status is associated with breastfeeding.[30] Unlike other social determinants of health associated with breastfeeding in the present study such as maternal education or age, no clear dose-response relationship between neighbourhood income quintile and breastfeeding practices exists. Indeed, in the multivariate logistic regression analysis of cessation of exclusive breastfeeding before six months, while the three middle neighbourhood income quintiles were associated with early cessation of exclusive breastfeeding compared to the highest neighbourhood income quintile, no such association existed for the lowest neighbourhood income quintile. It is possible that the poorest mothers cannot afford formula, but this possibility merits future research.

The disparities in breastfeeding rates between CBDHA and GASHA are worrisome. Indeed, disparities likely exist across other DHAs in Nova Scotia, and these disparities may even be larger than the ones seen in this study because other DHAs have breastfeeding initiation rates 10% higher than GASHA.[81] County of residence was the strongest predictor in the social ecological model at the organizational level. It likely served as a proxy for breastfeeding culture in different hospitals and communities in the two DHAs. Some high-risk births are born at the IWK Hospital in Halifax. Otherwise, mothers in CBDHA generally give birth at Glace Bay Healthcare Complex, and mothers in GASHA generally give birth at St. Matha's Regional Hospital. Different hospitals

have different cultures and availability of breastfeeding support, and these differences may contribute to the disparities.[72] Lower rates of breastfeeding initiation may also be related to community habits, practices and attitudes that go back over decades of breastfeeding in Nova Scotia.[73] Unfortunately, birth hospital or a proxy for community attitudes towards breastfeeding is unavailable to better understand the geographic disparities in this analysis.

A later year of infant's birth was associated with increased intention to breastfeed on the one hand, yet an increased risk of cessation of exclusive and any breastfeeding before six months on the other. This counterintuitive finding may be related to the high proportion of mothers censored in 2009 compared with 2006 to 2008. Ideally, a later year of infant's birth should be associated with increased duration and exclusivity of breastfeeding. Notably, breastfeeding habits among Nova Scotia mothers are generally improving. Data from CCHS 2.1 (2003), before Health Canada changed its breastfeeding recommendations that mothers should exclusively breastfeeding for the first six months, found that the rate of exclusive breastfeeding at six months was 4.83% (a weighted 17 of 261 mothers sampled).[106] Infant's year of birth was the only predictor in the social ecological model at the community level. Some community influences such as Nova Scotia's social marketing campaign to promote exclusive breastfeeding or the widespread disruption in public health services may have been captured through this variable. It likely, however, does not capture other important community influences.

To the author's best knowledge, this is the first Canadian study to look at pre-conception folic acid supplementation. Pre-conception folic acid supplementation may be a proxy for adherence to a healthy lifestyle, including pre- and postpartum behaviours rather than an independent influence. Poorer health behaviours along with poorer sociodemographic factors tend to be clustered. In Canada, women who do not take pre-conception folic acid supplements are also more likely to smoke, to be obese, to be unemployed, and to be poorly educated.[107]

In the present study, primiparous mothers were more likely to intend to breastfeed, yet less likely to exclusively breastfeed to six months compared with multiparous mothers. This counterintuitive finding was also noted in the Maternity Experiences Survey and a large American cross-sectional survey.[19,38] Multiparous

mothers may benefit from a higher level of breastfeeding self-efficacy from earlier breastfeeding experiences. Indeed, a Canadian study of primiparous mothers demonstrated that higher breastfeeding confidence and self-efficacy is associated with the duration of exclusive breastfeeding to six months.[35]

Of all the delivery-related various included in the model, only epidural analgesia was associated with breastfeeding in the multivariate regression and proportional hazard models. Early cessation of exclusive breastfeeding at six weeks was associated with epidural analgesia during birth. This finding suggests that delivery-related variables are far less influential in predicting breastfeeding behaviour than other risk factors such as poorer social determinants of health and practicing health-compromising behaviours. Indeed, induction of labour with oxycotin, 3rd and 4th degree lacerations, and type of birth were not associated with breastfeeding practices.

Neither infant-related factors, including low birthweight, admission to special care nursery, prematurity, or presence of a major anomaly, nor the presence of a health condition in the mother was associated with breastfeeding practices. This is an encouraging finding as poor health in either mother or newborn rarely contraindicates breastfeeding.[17] The finding that infant health factors are not associated with breastfeeding is consistent with other Canadian studies.[34-36,77] Conversely, the relationship between maternal health and breastfeeding practices is less clear. While two Canadian cohort studies found an association between higher anxiety in the mother and cessation of exclusive breastfeeding before six months,[34,36] Al-Sahab's *et al*.'s analysis of the Maternity Experiences Survey found no association between poorer breastfeeding practices with both stressful events during pregnancy and "health problems" during pregnancy. [16] Two American prospective cohort studies found no association between depressive symptoms and breastfeeding initiation,[108,109] although one study did find that serotonin reuptake inhibitor use was associated with decreased breastfeeding duration at three months.[108] The predictor health condition during pregnancy in this analysis may not have been sensitive enough to find an association with breastfeeding practices since it only included hypertension, diabetes, and hyperemesis gravidum: previously noted associations with poorer breastfeeding practices and mother's health involved poorer mental health such as anxiety in the mother.

Interestingly, prenatal education was not associated with breastfeeding practices. The limited available Canadian evidence on this association is conflicting. Two studies similarly found no association between prenatal class attendance and higher rates of exclusive breastfeeding at six months[16,34] while Semenic *et al.* found a strong association.[35] In the present study, prenatal education was collected by public health nurses in the Health Beginnings Database, and the measure used dichotomized all the different types of prenatal education into mothers received some or no prenatal education. As such, perhaps this broad measure was not sensitive enough to find an association with breastfeeding.

There was no difference between the statistical and theoretical model of early cessation of exclusive breastfeeding. As aforementioned, one predictor from each level of influence in the Social Ecological Model was independently associated with exclusive breastfeeding at six months, so no variables were necessarily forced into the theoretical model. This analysis, however, may not have allowed a fair modeling of the Social Ecological Model: given the limits of the linked database, important predictors at various levels of influence were unavailable for analysis. For example, no predictors at the societal/public policy levels were available. Further, predictors available at more proximal levels to the individual were often imperfect. At the community level, no measures of cultural attitudes towards breastfeeding or presence of a breastfeeding advocacy group in the community were available. At the institutional level, we did not have a measure of the proportion of mothers who received in-hospital formula supplementation, maternity benefits of the mother, or support levels of breastfeeding in workplaces. At the interpersonal level, we did not have a measure representing social support or breastfeeding beliefs of the mother's partner, family, and close friends. At the individual level, we did not have a measure of breastfeeding self-efficacy, mother's subjective norms, or mother's breastfeeding attitudes. Future studies that evaluate the utility of theoretical models of planned behaviour would benefit from more specific factors that are generally not captured in administrative databases.

6.1 Policy and Practice Implications

This study highlights the important gap between public health recommendations and breastfeeding practices in the first six months of life. While slowly increasing over time, the low rates of breastfeeding intention and initiation in these DHAs compared to Canadian mothers is particularly worrisome for policy makers in Nova Scotia. Lower rates of breastfeeding intention are likely related to community habits, practices and attitudes that go back over decades of breastfeeding in Nova Scotia, and changing this "ethos" will be a particular challenge for policy makers.[72,73] Moreover, it is unclear from this study whether the sharp drop of exclusive and any breastfeeding within the first few weeks of leaving hospital is due to lack of social support to the mother or simply whether the mother planned to stop breastfeeding at this time. From exhaustion to personal inconvenience, lack of support from her immediate partner and extended family to lack of support for breastfeeding in public, the power of media and easy availability of formula to lack of education on the full benefits of exclusive breastfeeding, many factors from different levels of influence are likely at play (Figure 2-1, p23). A survey that provides information on this critical question would be informative to decision-makers.

Policy interventions to improve breastfeeding practices are difficult to implement, especially given that most of the strongest predictors are likely non-modifiable in the short-term. Continued efforts towards improving the social determinants of health, especially maternal education, income equality, and access to social support, will likely result in improved breastfeeding behaviours. While these are crucial to improve, modifying the social determinants of health is a lengthy process and can be a costly.[110] In the short-term, policy makers are more interested in modifiable risk factors.

A performance outcome from the *2010-2011 [Nova Scotia Department of] Health Promotion and Protection Statement of Mandate* is to "improve the health status of mothers and babies by increasing breastfeeding duration in Nova Scotia".[25] This outcome was to be measured by the rate of exclusive breastfeeding at six months (using CCHS data), with the "ultimate target" of continuing an upward trend between 2003 and 2015 of the proportion of mothers exclusively breastfeeding. The author regrettably notes that this performance outcome has been omitted from the *2011-2012 [Nova Scotia]*

Department of Health and Wellness Statement of Mandate;[111] however, the Nova Scotia Department of Health and Wellness intends to reintroduce this performance outcome in their 2012-2013 Statement of Mandate.[112]

One performance outcome included in the *2011-2012 [Nova Scotia] Department of Health and Wellness Statement of Mandate* is to support the implementation of the Baby-Friendly Hospital Initiative (Appendix A).[111] The largest conducted randomized controlled trial of breastfeeding promotion (N=17,046), Promotion of Breastfeeding Intervention Trial (PROBIT), clearly demonstrated that implementation of the Ten Steps of the WHO/UNICEF Baby-Friendly Hospital Initiative (BFHI) increases the rate of breastfeeding initiation, lengthens breastfeeding duration, and increases the proportion of mothers who breastfeed exclusivity.[4] As the national authority of the WHO/UNICEF Baby-Friendly Initiative, the Breastfeeding Committee of Canada can accredit a hospital as Baby-Friendly. To receive this distinction, practitioners must follow each of the ten principles for at least 80% of all mothers and infants who receive in-hospital care. An evaluation of compliance to the BFHI remarked that if the average experience of mothers in Canada, rather than individual hospitals, was to be compared against the BFHI standards, only three principles out of the eight assessed would meet the standards.[19] As of Spring 2012, no hospitals in Nova Scotia are accredited as Baby-Friendly. Continued support for the implementation of the Baby-Friendly Hospital Initiative in Nova Scotia can only strengthen breastfeeding practices in Nova Scotia.

This study identifies four potentially modifiable behaviours associated with breastfeeding. No intention to breastfeed is the most important risk factor for early cessation to breastfeed, yet over 30% of Nova Scotia mothers have no intention to breastfeed. Intention to breastfeed may be modifiable during – and even prior to – pregnancy. Changing intention will require modifying the three predictors of intention: a mother's attitude, her subjective norms, and her perceived control of breastfeeding.[71,105] Before changing their attitude, mothers will need to believe that the benefits of breastfeeding outweigh the bad outcomes. Ensuring mothers receive adequate prenatal education, including on the benefits of breastfeeding, may help improve their attitude towards breastfeeding. Mother's subjective norms may be more difficult to modify. Indeed, mothers cannot control whether other significant people in her life think she

should or should not breastfeed. Promoting breastfeeding in the general population may shift norms in society, starting with modifying the elementary and secondary school curricula. This is where the Government of Nova Scotia may wish to look at findings of the "Tipping Point" concept, the event of a previously rare phenomenon – like exclusive breastfeeding at six months in Canada – becoming rapidly and strikingly more common in society.[113] Finally, the more the mother perceives she can breastfeed, the stronger her breastfeeding self-efficacy. Increased access to lactation consultants in-hospital and to public health nurses postpartum may help mothers improve their breastfeeding self-efficacy.[114]

The second potentially modifiable behaviour associated with poorer breastfeeding practices is no breast contact between mother and neonate within one hour of birth. There is scope to improve this practice: less than one-third of dyads among the cohort had breast contact within one hour of birth. Early skin-to-skin contact between dyads promotes bonding and breastfeeding initiation. Indeed, it is one of the 10 steps of the Baby-Friendly Initiative (Appendix A).[104] Implementation of the Baby-Friendly Hospital Initiative will encourage health care providers to ensure dyads experience early breast contact. Again, the Government of Nova Scotia should be strongly encouraged to make it government policy to ensure that all hospitals achieve Baby Friendly accreditation over the next few years. This can come with a relatively small investment in public health, but possibly lead to rich dividends in health outcomes.

Finally, two health-compromising health behaviours are associated with poorer breastfeeding practices: maternal smoking and an obese pre-pregnancy weight. For both behaviours, it is unclear whether this negative association is related to physiological mechanisms or lower motivation to breastfeed among these mothers who already exhibit other high-risk behaviours. With respect to smoking, nicotine may diminish milk yield through reduced prolactin levels, and these lower milk output volumes combined with the lower fat concentrations regularly found in milk from smoking mothers may contribute to the need for early supplementation of breastfeeding.[48,67] Similarly, adipose tissue may inhibit the prolactin response, compromising an obese mother's ability to produce milk.[46,66] Should the association be related to physiological mechanisms, continued efforts in smoking reduction as well as encouraging mothers to conceive at a healthy

weight may improve breastfeeding patterns. Should, however, these behaviours be linked to lower motivation or a composite of physiological mechanisms and lower motivation, then the additional support of public health nurses pre and postpartum could be a key factor in aiding these mothers in better managing their health-compromising behavior and in staying the course on breastfeeding duration.

The Healthy Beginnings Public Health Database was primarily designed to be a practical database that public health nurses could use to identify mothers requiring greater postpartum support, and its linkage with the Nova Scotia Atlee Public Health Database has created a unique research opportunity to better understand risk factors of early breastfeeding cessation. CBDHA and GASHA should be commended for spearheading the inclusion of breastfeeding duration and type information in their public health databases. Given the importance of meeting breastfeeding recommendations and the low level of mothers who do so in Nova Scotia, other DHAs should consider expanding their Healthy Beginnings databases to include breastfeeding information. Cost constraints on governments today should not result in "penny foolish" cuts to such databases.

Notwithstanding the richness of breastfeeding information available through the PHD, the uncertainty in the direction of exclusive breastfeeding trends between 2006 and 2009 underscore that administrative databases should attempt to have as complete follow-up as possible. Otherwise, high levels of incomplete or lost to follow-up breastfeeding data limit researchers' ability to generate new knowledge than can be then translated into policy to better support mothers and their newborns. Better data on breastfeeding duration is important not only to determine the determinants of longer exclusive breastfeeding duration, but also to use when conducting evaluations of interventions to better support breastfeeding mothers.

This analysis demonstrates the importance of collecting relevant data at the population level for exclusive breastfeeding. Surveillance of exclusive breastfeeding in Canada is primarily conducted through the Canadian Community Health Survey (CCHS). While this survey provides important national estimates, CCHS is cross-sectional and is likely influenced by recall bias, especially considering all mothers who had given birth within the last five years are included in the Maternal Experiences – Breastfeeding (MEX) module within CCHS. Indeed, the 2007-2008 CCHS estimate of the rate of

exclusive breastfeeding at six months in Nova Scotia is nearly 17%, over 50% higher than the rate estimated in this study. In contrast, the Maternity Experiences Survey, which only included mothers who had given birth within the last five to fourteen months, estimated the rate of exclusive breastfeeding in Nova Scotia at 10%. Unfortunately, the MES is an initiative of the Canadian Perinatal Surveillance System, and they have no current plan to repeat the MES.[115]

Finally, Health Canada recommends not only exclusive breastfeeding for the first six months of life, but also continued breastfeeding for up to two years and beyond.[12] Currently, the CCHS through the MEX module is providing annual national surveillance on the rate of exclusive breastfeeding at six months; however, to the author's knowledge, Canada has no surveillance system to monitor the proportion of dyads who continue breastfeeding for up to two years and beyond. The Nova Scotia government should explore developing surveillance among Nova Scotia mothers of adherence both to exclusive breastfeeding at six months as well as to the second portion of breastfeeding recommendations; that is, breastfeed for up to two years and beyond.

6.2 Strengths and Limitations

To the author's best knowledge, this is the largest cohort study on the rates and determinants of exclusive breastfeeding to six months conducted in Canada to date. In addition, this is the first study on determinants of exclusive breastfeeding conducted in the Maritimes. Previous Canadian cohort studies in Calgary[36], London[34], Montreal[35] and Quebec[77] have been limited to fewer than 900 mothers and generally to one urban centre. More importantly, this study is the first Canadian cohort study on exclusive breastfeeding duration that uses administrative data, thereby capturing all births in a defined geographic region and time. As such, the risk of selection bias found in other studies is limited among this study's cohort to mothers unable to be matched.

While the recent national cross-sectional surveys,[16,18] CCHS and MES, are larger than the current study, retrospective recall is known to systematically overestimate the duration of exclusive breastfeeding at six months, even when the infant is only nine

months old.[116] Further, the Nova Scotia sample of fewer than 350 mothers within both these cross-sectional studies is inadequate to study the determinants of breastfeeding in Nova Scotia.

The richness of the Public Heath Database and Nova Scotia Atlee Perinatal databases allows this study to examine variables associated with breastfeeding that have not been previously studied in Canada, including gestational weight gain category, pre-conception folic acid supplementation, and breast contact between mother and neonate within one hour of birth. Moreover, these databases contain many important socio-demographic, prenatal, delivery-related, and post-partum risk factors known to be associated with poorer breastfeeding practices, allowing this study to control extensively for other predictors in the multivariate modeling.

Despite its strengths, acknowledgement of this study's limitations is important. The largest city in the two DHAs is Cape Breton Regional Municipality, a municipality with just over 100,000 residents and few visible minorities. This reduces the generalizability of this data to large Canadian urban centres, such as Toronto or Vancouver, with high proportions of visible minorities and perhaps with different sets of attitudes, habits, and practices towards breastfeeding.

The rural postal code definition used to classify rural and urban population is imperfect. Du Plessis *et al.* compared alternative definitions for the rural Canadian population and their preferred definition for the rural Canadian population is the rural and small town definition: "the population living in towns and municipalities outside the commuting zone of larger urban centres (*i.e.* outside the commuting zone of centres with population of 10,000 or more)".[87] They note that the degree of overlap of the rural Canadian population using the rural postal code definition and the preferred rural and small town definition is 78%.[87] An analysis of the MEX module of the CCHS found an association between rural location of residence and an increased risk of exclusive breastfeeding cessation before six months,[18] while an analysis of the Maternity Experiences Survey found no such association.[16] Given the imperfect classification of rural and urban residence in this study, future study on the association between location of residence and breastfeeding patterns is warranted.

Since many factors are self-reported by the mother such as smoking status and pre-pregnancy weight, there is an important risk of reporting bias among the predictive variables. Pre-pregnancy weight and height are generally entered into the NSAPD from the Prenatal Record.[80] This information can either be self-reported or measured by the physician at the first prenatal visit. Weight at first prenatal visit is occasionally entered as pre-pregnancy weight if the pre-pregnancy weight field is unknown. Since women do not gain weight at a high rate in the first trimester, this does not introduce a large amount of bias. Should pre-pregnancy weight and height be self-reported, evidence from large Canadian studies have found that Canadians tend to underestimate their weight and overestimate their height, resulting in a misclassification of pre-pregnant BMI.[117] This lower weight, however, will likely underestimate the association between high pre-pregnant BMI and breastfeeding patterns because more overweight and obese women will be placed in the reference group of normal pre-pregnancy BMI.

With respect to GWG category, misclassification of pre-pregnancy BMI may result in subsequent misclassification of GWG category. The delivery weight is either from the maternal admission assessment form or the weight entered for the last date on the prenatal record.[80] When the delivery weight comes from the last prenatal visit, there may be small underestimation of gestational weight gain. Since women are weighed regularly throughout pregnancy, the amount of underestimation is likely to be minimal. Misclassification of GWG category may explain why no association between GWG category and breastfeeding outcomes was found.

More importantly, breastfeeding type at each follow-up is self-reported. Many mothers are aware of the health benefits and desirability of longer exclusive breastfeeding duration, which may have resulted in over-reporting. This bias will likely be no higher than in previous cross-sectional surveys conducted via telephone, such as the CCHS or Maternal Experiences Survey, and it may even be lower since some data is collected in a face-to-face visit with a public health nurse, a data collection method shown to reduce reporting bias compared with telephone surveys.[118]

The scope of the databases is limited by an absence of data on hospital policies or caregiver support. In addition, the available information on socioeconomic status, an important predictor of breastfeeding outcomes, is largely limited to maternal education;

family income was estimated using neighborhood income from census data, and factors related to social status are unavailable. While census data have been used as a proxy for income in other studies, this measure cannot be interpreted as if it were collected at the individual level.[119]

Other sociocultural and perinatal variables known to be associated with breastfeeding practices such as ethnicity, breastfeeding self-efficacy, postpartum employment, maternal support networks, workplace policies, and maternal mental health are also unavailable. Importantly, other Canadian studies have underlined the importance of these predictors for breastfeeding exclusivity and duration. As demonstrated when operationalizing the social ecological model, a limited number of variables fit into the community and the societal/public policy levels of influence. These influences may be some of the most important levels to better understand, but it is difficult to do so without more information on the impact of society and social norms on individual behaviour. While the choice of predictors for this study was restricted to variables available in the PHD and NSAPD, future cohort studies should consider including these broader influences in their study design.

The percent of missing values was high. Indeed, a complete-subject analysis before addressing missing values would have excluded over 80% of dyads. Multiple imputation was considered as a method to deal with the high number of missing values. Unfortunately, PROC MI in SAS 9.2 can only impute missing values for categorical data if the pattern of missing is monotone. Since the pattern of missing is not monotone, multiple imputation techniques for the missing data were not able to be used.

The creation of a "dummy missing category" is not ideal to treat missing values: it tends to underestimate uncertainty in some analyses because sample size is inflated, thereby creating potential for type I errors, while overestimating uncertainty in other analyses because the degrees of freedom is increased.[120,121] Further, since individuals who are missing data tend to be clustered, this can create a multicollinearity problem.[122] Notwithstanding these limitations, the "dummy category" is preferred over other *ad hoc* alternatives such as using the mean as the imputed value.[123] Other options such as a complete-case analysis would have resulted in a high risk of selection bias since over 80% of mothers had missing covariates. A complete-case analysis would also have

resulted in a large decrease in power, which would have inflated the standard errors and increased the risk of a type II error.

Finally, mid-point imputation offers a good approximation when the time-period between follow-up observations is short.[124,125] When follow-up occurs less frequently, mid-point imputation may underestimate both the standard error and the point estimate.[124] While follow-up in this study is frequent during the first two months (four times), it is less frequent during the last four months (two times). As relatively few mothers breastfed for longer than two months, this bias is likely less important than other aforementioned limitations.

6.3 Future Directions

Given the limited Canadian literature on determinants of breastfeeding – eight studies since 1995 to the author's knowledge – future research should continue to study the determinants of breastfeeding duration and exclusivity. Of particular interest, these studies may wish to evaluate whether breastfeeding rates are improving over time, and more importantly, whether disparities in breastfeeding patterns among different sub-populations are changing over time. The present study identified numerous vulnerable sub-populations, such as poorly educated mothers, poorer women, and women without partners, as well as mothers who practice health-compromising behaviours, such as being obese and smoking, that are associated with inferior breastfeeding practices. This in turn may place their newborn at heightened risk for poorer health. Ensuring mothers who are vulnerable and who practice health-compromising behaviours receive adequate breastfeeding support will be critical to closing disparities in breastfeeding patterns.

Second, it is important to understand more clearly breastfeeding decisions among women who choose not to breastfeed and who choose to cease breastfeeding earlier than recommended. A better understanding of why women do not initiate breastfeeding or stop breastfeeding their newborn can help inform policy makers and health care providers when and how breastfeeding interventions are effective.

Large comprehensive studies that go beyond data available in administrative databases are also important. Other Canadian studies have underlined mother's

employment postpartum as an important predictor of breastfeeding.[16,34,36] Indeed many mothers are ineligible for maternity benefits, including women who are self-employed and who work shift work or part-time. Further, with the exception of Quebec which has higher benefits, Canadian employers are required to pay mothers 55% of their average insurable earnings. As of January 1st, 2012, this amounts to a maximum of $485/week.[126] These replacement maternity wages may be insufficient to support families, especially if mothers are the main income earner for their family. Indeed, 144 countries around the world provide higher wage replacements for maternity leave than Canada.[127] Poor maternity benefits may entice a woman to return to work early, which, in turn, may lead to poorer breastfeeding practices. Moreover, once the mother has returned to work, the employer should ensure she has an opportunity to continue breastfeeding. Nearly 90 countries have guaranteed nursing breaks for at least one year or more. In Canada, however, only four provincial/territorial jurisdictions – including Nova Scotia – require employers to accommodate nursing mothers with breastfeeding breaks.[127] Studies examining the impact of maternity benefit eligibility and nursing breaks availability on breastfeeding practices in Canada will be important to understand better these influential postpartum factors of breastfeeding.

Finally, many mothers are unable to meet current breastfeeding recommendations. Some evidence suggests that the pressure to breastfeed for six months exclusively can undermine a women's confidence as a mother, exacerbate postpartum depression, or lead to guilt in the mother, and this stress in not helpful for the mother's psychosocial wellbeing.[128-132] It is therefore important to ask: is adopting a global policy goal at the individual level helpful to all mothers and infants? Some academics argue that more intermediate breastfeeding targets, such as critical milestones, alongside the six months exclusively breastfeeding goal would be helpful to mothers.[133] Future studies may wish to consider how to reconcile this dilemma between the psychosocial needs of the mother and the optimal nutritional and emotional interests of the infant.

CHAPTER 7 CONCLUSIONS

Public Health Services in CBDHA and GASHA should be commended for taking the initiative to develop and maintain their public health database that contains extensive information on breastfeeding duration and exclusivity. Having this information will enable the monitoring of breastfeeding duration and exclusivity rates over time. In this way, initiatives and interventions can be evaluated on these important outcomes. Other DHAs in Nova Scotia should consider expanding their "Healthy Beginnings" database to include breastfeeding duration and exclusivity information.

Although breastfeeding rates in CBDHA and GASHA remain significantly lower than elsewhere in Canada, breastfeeding intention and initiation rates significantly increased between 2006 and 2009 in the two DHAs. No significant trend over time in the rate of any and exclusive breastfeeding at six months was noted.

This study identified thirteen risk factors associated with poorer breastfeeding outcomes. Many of these risk factors are intertwined with the social determinants of health: lower maternal education, no partner, lower maternal age, and lower neighbourhood income quintile. This study confirms that breastfeeding tends to be stratified by class: mothers are less likely to breastfeed and less likely to do so exclusively if they are younger, poorly-educated, without a partner, and poorer. Over the long-term, improving the social determinants of health should improve breastfeeding practices. In the short-term, breastfeeding interventions and policy should include provisions for additional support within these vulnerable populations.

Four other risk factors were identified that are potentially modifiable during the course of a pregnancy: obese pre-pregnancy body mass index, maternal smoking during pregnancy, no breast contact between mother and infant within one hour of birth, and no intention to breastfeed. Policy makers should consider these potentially modifiable, albeit challenging to do so, risk factors when designing interventions to improve breastfeeding practices in Nova Scotia.

The Nova Scotia Department of Health and Wellness should continue to strive towards their 2011-2012 mandate of increasing breastfeeding initiation rates and of ensuring that the Baby Friendly Initiative is implemented in all Nova Scotia hospitals

over the next few years. Given that only 10.4% of mothers who live in GASHA and CBDHA currently meet the Canadian recommendation of six months exclusive breastfeeding, this represents a substantial gap between breastfeeding practices and recommendations. The Nova Scotia Department of Health and Wellness should strongly consider implementing this goal in future mandate statements in order to work towards achieving this important breastfeeding outcome.

Since a large proportion of women stop breastfeeding within the first six weeks of life, this time period represents a critical intervention window for supporting breastfeeding in mothers. Mothers could likely benefit from increased support from lactation consultants in hospital and public health nurses immediately post-discharge from delivery. In addition, Nova Scotia should continue promoting its social media campaign "Breastfeeding: Learning Makes It Natural" that supports breastfeeding in mothers during the first six weeks after birth and beyond. Ideally, this campaign should be expanded so that it is directed more widely than mothers; partners need to hear this message as do the extended families that support the often, newly formed family.

Continued research on the rates and determinants of breastfeeding duration and exclusivity in Nova Scotia and Canada is critical to closing the gap between breastfeeding recommendations and practices. A stronger understanding of the determinants associated with longer breastfeeding duration and higher proportion of exclusive breastfeeding will equip policy makers and health care providers to better promote, protect, and support breastfeeding in mothers and their infants.

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APPENDIX A

The 10 Steps of the WHO/UNICEF Baby-Friendly Hospital Initiative: Interpretation for Canadian Practice

1. Have a written breastfeeding policy that is routinely communicated to all health care providers and volunteers.
2. Ensure all health care providers have the knowledge and skills necessary to implement the breastfeeding policy.
3. Inform all pregnant women and their families about the importance and process of breastfeeding.
4. Place babies in uninterrupted skin-to-skin contact with their mothers immediately following birth for at least an hour or until completion of the first feeding or as long as the mother wishes: encourage mothers to recognize when the babies are ready to feed, offering help as needed.
5. Assist mothers to breastfeed and maintain lactation should they face challenges including separation from their infants.
6. Support mothers to exclusively breastfeed for the first six months, unless supplements are *medically* indicated.
7. Facilitate 24 hour rooming-in for all mother-infant dyads: mothers and infants remain together.
8. Encourage baby-led or cue-based breastfeeding.

   Encourage sustained breastfeeding beyond six months with appropriate introduction of complementary foods.
9. Support mothers to feed and care for their breastfeeding babies without the use of artificial teats or pacifiers (dummies or soothers).
10. Provide a seamless transition between the services provided by the hospital, community health services and peer support programs.

    Apply principles of Primary Health Care and Population Health to support the continuum of care and implement strategies that affect the broad determinants that will improve breastfeeding outcomes.

In addition to the 10 steps, Baby-Friendly hospitals should comply with the International Code of Marketing of Breastmilk Substitutes.

Source: Breastfeeding Committee for Canada (2011)[104]