

1
2
3 **The Rates, Duration, and Determinants of Exclusive Breastfeeding to Six Months in**
4
5 **Nova Scotia Women**
6
7

8
9
10 Brown CRL¹, Dodds L^{1,2}, Attenborough R³, Bryanton J⁴, Elliott Rose A³, Flowerdew G¹,
11
12 Langille D¹, Lauzon L³, and Semenic S⁵
13

14
15 ¹ Department of Community Health & Epidemiology, Dalhousie University
16

17 ² Departments of Obstetrics & Gynecology and Pediatrics, Dalhousie University,
18

19 ³ Reproductive Care Program of Nova Scotia, Halifax
20

21 ⁴ School of Nursing, University of Prince Edward Island
22

23 ⁵ School of Nursing, McGill University
24
25
26
27
28

29 Corresponding Author: Dr. Linda Dodds, Perinatal Epidemiological Research Unit, IWK
30
31 Health Centre, Room G7108, 5980 University Avenue / P.O. Box 9700, Halifax, Nova
32
33 Scotia, Canada, B3K 5R8.
34

35
36 Telephone: 1-902-470-7191 Fax: 1-902-425-1125 E-mail: l.dodds@dal.ca
37
38
39
40

41 Requests for reprints should be addressed to the corresponding author.
42
43
44
45

46 This study received funding from the Nova Scotia Health Research Foundation and the
47
48 IWK Health Centre.
49
50

51
52
53 Word Count: 2,473 Abstract Word Count: 249
54

55 This manuscript contains three tables and six figures.
56
57
58
59
60

Abstract

Background: Despite compelling evidence that exclusive breastfeeding for the first six months of life provides important health benefits to both mothers and their infants, most mothers do not meet the Canadian breastfeeding recommendation. This study aimed to identify predictors of longer exclusive breastfeeding duration.

Methods: This population-based longitudinal cohort study used data obtained via a record linkage between a perinatal database and a public health database for infants born between 2006 and 2009 in two District Health Authorities in Nova Scotia, Canada. The cohort followed 4,533 mother-infant dyads from the mother's first pre-natal visit until her infant was six months old. Hazard ratios for shorter exclusive breastfeeding were determined through Cox proportional hazards regression modeling.

Results: While 64.1% of mothers initiated breastfeeding, only 10.4% of mothers exclusively breastfed for the recommended six months. The largest drop-off in exclusive breastfeeding occurred between birth and six weeks. Significant predictors of shorter exclusive breastfeeding identified by multivariate modeling include lower education levels, poorer neighbourhood income, single motherhood, smoking, pre-pregnancy obesity, no intention to breastfeed, and no early breast contact.

Interpretation: Most breastfeeding predictors are intertwined with the social determinants of health, but this study identified four potentially modifiable risk-factors. Their association with shorter exclusive breastfeeding is likely a mix of causal and non-causal

1
2
3 components. As such, continued efforts in smoking cessation and obesity reduction may
4
5 help contribute to longer exclusive breastfeeding duration. Of importance, the first six
6
7 weeks after birth represents a critical intervention window to help promote and support
8
9 exclusive breastfeeding.
10
11

12
13
14
15 *Keywords:* exclusive breastfeeding, breastfeeding duration, Cox proportional hazards
16
17 regression, Nova Scotia, predictors
18
19

20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Confidential

The Rates, Duration, and Determinants of Exclusive Breastfeeding to Six Months in Nova Scotia Women

Introduction

Breast milk is the best food source for optimal infant growth and development. Research consistently offers compelling evidence that exclusive breastfeeding provides health benefits to both infant and mother throughout their lifespan, thereby significantly reducing health care costs.^{1,2} The World Health Organization and Health Canada recommend that infants be exclusively breastfed for the first six months of life.^{3,4} 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.⁴ Data from national cross-sectional surveys suggest that while nearly 90.3% of Canadian mothers initiate breastfeeding, less than one-quarter of mothers exclusively breastfeed their infant for the recommended six months.⁵ At 9.6%, the rate of exclusive breastfeeding in Nova Scotia is even lower.⁵

The low percentage of Nova Scotia and Canadian mothers whose breastfeeding practices meet current recommendations is a significant challenge for health care professionals. 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 recommendation for exclusive breastfeeding. More specifically, since the Health Canada recommendation was introduced in 2004, few Canadian longitudinal studies have been conducted on the factors that contribute to increased rates of breastfeeding duration and exclusivity.

1
2
3 Further, existing Canadian cohort studies on breastfeeding are limited to specific sub-
4
5 populations such as low-income mothers or single urban centres.⁶⁻⁹ By understanding the
6
7 factors associated with positive breastfeeding practices, health care providers will be
8
9 better equipped to promote and support breastfeeding. This study aims to identify the
10
11 predictors of longer exclusive breastfeeding duration by using a population-based cohort
12
13 of Nova Scotia mothers.
14
15
16
17
18
19

20 Methods

21 *Study Design*

22
23
24 This population-based longitudinal cohort study used data from the Nova Scotia
25
26 Atlee Perinatal Database (NSAPD) and the Healthy Beginnings Public Health Database.
27
28 Uniquely within Nova Scotia, public health nurses in two district health authorities, Cape
29
30 Breton District Health Authority (CBDHA) and Guysborough Antigonish Strait Health
31
32 Authority (GASHA), collected additional information on breastfeeding patterns of all
33
34 mothers as part of the province-wide Public Health Database. This included mother's
35
36 self-reported breastfeeding status collected prospectively at time of hospital discharge
37
38 and at five follow-ups timed at 1 and 6 weeks; and 2, 4, and 6 months after birth. Public
39
40 health nurses collected the breastfeeding data through telephone or face-to-face
41
42 interviews. Information on breastfeeding duration in the Public Health Database was
43
44 linked with the NSAPD, which began data collection in 1988 and includes all hospital
45
46 deliveries in Nova Scotia. The NSAPD contains extensive maternal, prenatal, labour,
47
48 birth, and in-hospital breastfeeding information for all pregnancies that resulted in the
49
50 birth of an infant greater than 20 weeks gestational age or greater than 500 grams.
51
52
53
54
55
56
57
58
59
60

1
2
3 This study received ethics approval from the Research Ethic Board of the IWK
4 Health Centre, as well as Research Ethic Boards in CBDHA and GASHA.
5
6
7
8
9

10 *Study Population*

11
12 The inclusion criterion for this study was all live newborns in Nova Scotia whose
13 mother resided in CBDHA or GASHA between January 1st, 2006 and December 31st,
14 2009. Together, these two district health authorities represent approximately 17% of
15 Nova Scotia's births.¹⁰ Multiple births were excluded from the analysis because of their
16 unique feeding challenges. A deterministic record linkage, based primarily on unique
17 health card number assigned to all residents of Nova Scotia, was used to link the two
18 databases. Records from the Public Health Database that did not have a corresponding
19 birth record in the Perinatal Database were excluded.
20
21
22
23
24
25
26
27
28
29
30
31
32
33

34 *Study Measures*

35
36 We followed Labbok and Krasonec's definition of "almost exclusive
37 breastfeeding" for exclusive breastfeeding.¹¹ Infants were considered exclusively
38 breastfed if the mother indicated at a follow-up that she provided her infant only breast
39 milk. Feeding was considered supplementary if the mother indicated at a follow-up that
40 she supplemented breast milk with formula, cow's milk, water, or other foods. Any
41 breastfeeding includes infants whose feeding was either exclusive or supplementary.
42
43
44
45
46
47
48
49

50 Breastfeeding duration was the time, measured in months, between the infant's
51 birth and when the infant stopped exclusive or any breastfeeding. Breastfeeding duration
52 was derived by interval censoring the follow-up data using mid-point imputation.
53
54
55
56
57
58
59
60

1
2
3 Specifically, exclusive breastfeeding duration was the time between the previous
4 assessment where the mother did report exclusive breastfeeding and the following visit
5 where she had introduced supplementary feeding or had stopped breastfeeding altogether.
6
7 For mother-infant dyads who never initiated breastfeeding, duration was 0 months. If the
8 mother was lost to follow-up (*i.e.* breastfeeding initiation was confirmed and some
9 information on breastfeeding duration was available, but there was no information on
10 when a mother stopped breastfeeding), breastfeeding duration was right censored using
11 left-point imputation.
12
13
14
15
16
17
18
19
20
21

22 We examined the association between twenty-five potential risk factors derived
23 from the literature and exclusive breastfeeding duration (Table 1). Mother's postal code
24 linked to Canadian census data was used to estimate neighbourhood income quintile.
25 Location of residence was dichotomized using Canada Post's forward sortation areas into
26 urban (for forward sortation areas 1-9) and rural (for forward sortation area 0). No
27 Canadian standards for body weight classification exist for females less than 18 years
28 old; however, the Institute of Medicine suggests that adolescent pre-pregnancy body mass
29 index (BMI) can be adequately categorized using adult cut-offs.¹² Therefore, for women
30 of all ages, mother's pre-pregnancy BMI was derived using the formula $BMI = \text{pre-}$
31 $\text{pregnancy weight} / \text{height}^2$. This continuous variable was classified into one of four
32 categories following the *Canadian Guidelines for Body Weight Classification in Adults*.¹³
33 Maternal smoking status was classified into one of three categories. Non-smokers
34 include mothers did not smoke at any time during pregnancy. Smokers who quit during
35 pregnancy included mothers who smoked at least one cigarette pre-pregnancy or at the
36 first pre-natal visit, but had ceased smoking at admission for delivery. Smokers
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 throughout pregnancy included mothers who smoked at least one cigarette at admission
4
5 for delivery.
6
7
8
9

10 *Data Analysis*

11
12 We performed a Kaplan-Meier survival analysis for all predictor variables.
13
14 Survival curves were stratified by each level of a predictor, and differences in the
15
16 survival curves were tested by a log-rank test of equality across strata. The survival
17
18 curves were also visually examined for violation of the proportionality assumption. We
19
20 used Cox's proportional hazards regression model to determine hazard ratios to estimate
21
22 the instantaneous relative risk of shorter duration of exclusive breastfeeding. All
23
24 predictive variables with an unadjusted test of equality of $P < 0.1$ were included in the
25
26 model. The model was built using backward modeling. Hazard ratios and associated
27
28 95% confidence intervals were calculated, and final predictors were considered
29
30 significant using the Likelihood Ratio test. Ties were accounted for using the exact
31
32 method. Eight variables had greater than 10% missing values. For these predictive
33
34 variables, a dummy "missing" category was created.
35
36
37
38
39

40
41 All analyses with one exception were conducted using SAS 9.1. Kaplan-Meier
42
43 survival curves were plotted in SPSS 16.0.
44
45
46
47

48 **Results**

49
50 Of the 5,353 mother-infant dyads available in the Public Health Database, 4,533
51
52 were included in the cohort (Figure 1). 681 pairs were unable to be linked to data in the
53
54 Atlee Perinatal Database and 139 pairs were excluded from the analysis. A further 576
55
56
57
58
59
60

1
2
3 dyads were censored due to incomplete follow-up for exclusive breastfeeding. As seen in
4
5 Table 2, mothers who initiated breastfeeding tended to be older, better educated, married
6
7 or in a common-law relationship, non-smokers, and intended to breastfeed.
8
9

10 Overall, 64.1% (95% CI = 62.7-65.5%) of mothers initiated breastfeeding. The
11
12 percent of mothers who initiated breastfeeding increased significantly from 60.5% in
13
14 2006 to 66.9% in 2009 ($p=0.0013$). At six weeks, 33.6% (32.2-35.0) of mothers were
15
16 exclusively breastfeeding their infant, and at six months, only 10.4% (9.5-11.4) of dyads
17
18 met the Canadian recommendation. There was little variation in the rates of exclusive
19
20 breastfeeding at six months between 2006 and 2009. Figure 2 shows the Kaplan-Meier
21
22 curve for exclusive breastfeeding duration among mothers who initiated breastfeeding.
23
24
25
26

27 Of the twenty-five factors evaluated, all but four (urban versus rural residence,
28
29 prenatal education, labour type, and perineal tears) were associated with duration of
30
31 exclusive breastfeeding at the $P<0.1$ level of significance in the univariate analysis. After
32
33 adjustment in the proportional hazards model, nine risk factors were independently
34
35 associated with shorter exclusive breastfeeding duration (Table 3): specifically, lower
36
37 level of education, lower neighbourhood income quintile, single mothers, pre-pregnancy
38
39 obesity, smoking, no pre-conception folic acid supplementation, primiparous mothers, no
40
41 breast contact with one hour of birth, and no intention to breastfeed. The model was also
42
43 adjusted for district health authority. Unadjusted Kaplan-Meier curves for marital status,
44
45 mother's highest level of education, smoking status, and pre-pregnancy body mass index
46
47 are presented in Figures 3-6. Clear gradients are seen across the six-month time period
48
49 between levels of each factors. As well, these figures illustrate that, among mothers who
50
51
52
53
54
55
56
57
58
59
60

1
2
3 initiate breastfeeding, the rates drop more quickly in the first six weeks than in the
4
5 remaining four months.
6
7
8
9

10 Interpretation

11
12 Although 64.1% of mothers initiated breastfeeding in these districts, only 10.4%
13
14 exclusively breastfed their infant for the recommended six months. Since a large
15
16 proportion of women stop breastfeeding within the first six weeks after birth, this time
17
18 period represents a critical intervention window for supporting breastfeeding in mothers.
19
20 Most exclusive breastfeeding predictors identified in this study are intertwined with the
21
22 social determinants of health; however, the present study identified four potentially
23
24 modifiable, albeit challenging to do so, risk factors: obese pre-pregnancy BMI, smoking,
25
26 no intention to breastfeed, and no early breast contact. Interestingly, most factors related
27
28 to the delivery and to the infant's health, including mode of delivery, receipt of epidural
29
30 analgesia, infant's gestational age and weight, and admittance to the SCN, were not
31
32 associated with exclusive breastfeeding duration.
33
34
35
36
37
38

39 While these breastfeeding patterns are similar to other Atlantic provinces,
40
41 compared with the Canadian average where 90.3% initiate breastfeeding and 14.4% are
42
43 exclusively breastfeeding at six months, Nova Scotia mothers are clearly struggling to
44
45 meet breastfeeding recommendations.⁵ Indeed, within Canada, a clear geographic
46
47 gradient exists: exclusive breastfeeding at six months is highest in Western Canada and
48
49 lowest in the Atlantic Provinces.¹⁴ The present study found a clear relationship between
50
51 shorter exclusive breastfeeding duration and disparities in the social determinants of
52
53 health. Most Canadian studies corroborate this association between poorer breastfeeding
54
55
56
57
58
59
60

1
2
3 practices with a lower level of maternal education, no partner, low income, and location
4 of residence.^{6-9,14-15}
5
6

7
8 Of the four potentially modifiable risk factors, no intention to breastfeed is an
9 obvious risk factor for early cessation to breastfeed, yet over 30% of Nova Scotia
10 mothers have no intention to breastfeed.⁵ Few interventional studies that aim to increase
11 breastfeeding intention have been published; however, the limited available research
12 suggests educational interventions are more effective when focused on improving
13 maternal self-efficacy than on enhancing knowledge.¹⁶ Moreover, less than one-third of
14 dyads among the cohort had breast contact within one hour of birth. Early skin-to-skin
15 contact between dyads promotes bonding and breastfeeding initiation, and it is one of the
16 10 steps of the WHO/UNICEF Baby-Friendly Hospital Initiative,¹⁷ an intervention shown
17 to increase both breastfeeding initiation and the duration of exclusive breastfeeding.¹⁸
18
19

20
21 The relationship between smoking and obesity with breastfeeding practices is not
22 fully understood. The associations are likely a mix of causal and non-causal components.
23 For instance, nicotine is known to increase dopamine secretion in the hypothalamus,
24 thereby reducing prolactin levels, which in turn tend to diminish milk yield.¹⁹ At the
25 same time, smoking mothers may be less health conscious, resulting in a lower
26 motivation to exclusively breastfeed.²⁰ Similarly, adipose tissue may inhibit the prolactin
27 response, compromising an obese woman's ability to produce milk, and in addition,
28 obese women encounter more socio-cultural and psychological barriers to
29 breastfeeding.²¹⁻²³ Interestingly, in the present study, obese women had both similar
30 intention to breastfeed (69% of obese mothers vs. 72% of normal weight mothers) and
31 rate of breastfeeding initiation (64% vs. 66%) as normal-weight mothers, but by six
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 months, obese mothers were significantly more likely to have ceased exclusive
4 breastfeeding (HR=1.43, 95% CI=1.23-1.65). This suggests a physiological explanation
5 for early breastfeeding cessation among obese women; beyond delayed lactogenesis,
6 obese women may also have practical difficulties achieving a proper latch, and they are at
7 higher risk for other medical conditions such as diabetes or polycystic ovary syndrome.²³
8
9

10
11 To the authors' best knowledge, this is the largest cohort study on the rates and
12 determinants of exclusive breastfeeding to six months conducted in Canada to date.
13
14 More importantly, this is the first Canadian cohort study on exclusive breastfeeding
15 duration that uses population-based data, thereby capturing all births in a defined
16 geographic region and time. Despite these strengths, this cohort may have limited
17 generalizability to larger Canadian urban centres with a high proportion of visible
18 minorities since the largest city in the study region is Cape Breton Regional Municipality
19 (population ~100,000). Indeed, compared to the Canadian sample in the Maternity
20 Experiences Survey, the study cohort has a younger age distribution, a lower educational
21 status, a higher proportion of single mothers, a higher proportion of smoking mothers,
22 and a higher proportion of overweight and obese mothers.⁵ Breastfeeding type at each
23 follow-up is self-reported which is similar to the methods used in previous national cross-
24 sectional surveys conducted via telephone such as the Maternity Experiences Survey.
25
26 The scope of the population-based databases is limited by an absence of data of important
27 breastfeeding predictors such as mother's ethnicity, breastfeeding self-efficacy,
28 postpartum employment, and workplace policies. The creation of a dummy "missing"
29 category is not ideal to treat missing covariates since it tends to underestimate uncertainty
30 in some analyses where sample size is inflated, while overestimating uncertainty in other
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 analyses because the degrees of freedom is increased.²⁴ In the present study, however, a
4 complete-case analysis would have resulted in a high risk of selection bias since many
5 mothers had at least one missing covariate. Finally, mid-point imputation offers a good
6 approximation when the time-period between follow-up observations is short and the data
7 are not skewed.^{25,26} While the first condition is met, breastfeeding duration is positively
8 skewed, so mid-point imputation may slightly overestimate exclusive breastfeeding
9 duration.
10
11
12
13
14
15
16
17
18
19

20 Our findings suggest that additional support for mothers and their newborns,
21 particularly within the first six weeks of life, is critical to close the gap between
22 breastfeeding recommendations and practices. This study also confirms that
23 breastfeeding tends to be closely associated with the social determinants of health:
24 mothers are less likely to breastfeed and less likely to do so exclusively if they are
25 poorly-educated, without a partner, and less wealthy. These factors are not likely to
26 change in the population in the short term. Our study, however, did identify some
27 potentially modifiable factors that may have some causal influences of breastfeeding
28 success. Breastfeeding interventions and policy should include provisions for
29 encouraging early breast contact as well as additional support for smokers and obese
30 women who may have specific physiological challenges to breastfeeding.
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

48 Acknowledgements

49
50 We thank the Reproductive Care Program of Nova Scotia as well as Public Health
51 Services in Cape Breton District Health Authority and Guysborough Antigonish Straights
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Health Authority for access to the data. We also thank Dr. Colleen O’Connell for technical support.

Confidential

References

1. World Health Organization. The optimal duration of exclusive breastfeeding: Report of an expert consultation. 2001 [cited 2012 Nov 26]. Available from: http://www.who.int/nutrition/publications/optimal_duration_of_exc_bfeeding_report_eng.pdf
2. World Health Organization. Global strategy for infant and young child feeding. 2003 [cited 2010 Nov 26]. Available from: http://www.paho.org/english/ad/fch/ca/GSIYCF_infantfeeding_eng.pdf
3. 54th World Health Assembly. Infant and young child nutrition. 2002 [cited 2010 Nov 26]. Available from: http://apps.who.int/gb/archive/pdf_files/WHA55/ewha5525.pdf
4. Health Canada. Exclusive breastfeeding duration. 2004 [cited 2010 Nov 26]. Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/infant-nourisson/excl_bf_dur-dur_am_excl-eng.php
5. Public Health Agency of Canada. What mothers say: The Canadian Maternity Experiences Survey. 2009 [cited 2010 Nov 30]. Available from: <http://www.phac-aspc.gc.ca/rhs-ssg/pdf/survey-eng.pdf>
6. Simard I, O'Brien HT, Beaudoin A, Turcotte D, Damant D, Ferland S, et al. Factors influencing the initiation and duration of breastfeeding among low-income women followed by the Canada prenatal nutrition program in 4 regions of Quebec. *J Hum Lact* 2005; 21: 327-337.
7. Clifford TJ, Campbell MK, Speechley KN, Gorodzinsky F. Factors influencing full breastfeeding in a southwestern Ontario community: Assessments at 1 week and at 6 months postpartum. *J Hum Lact* 2006; 22: 292-304.
8. Semenic S, Loiselle C, Gottlieb L. Predictors of the duration of exclusive breastfeeding among first-time mothers. *Res Nurs Health* 2008; 31: 428-441.
9. Kehler HL, Chaput KH, Tough SC. Risk factors for cessation of breastfeeding prior to six months postpartum among a community sample of women in Calgary, Alberta. *Can J Public Health* 2009; 100: 376-380.
10. Government of Nova Scotia. Nova Scotia Community Counts. 2012 [cited 2012 Feb 6]. Available at: <http://www.gov.ns.ca/finance/communitycounts/default.asp>
11. Labbok M, Krasovec K. Toward consistency in breastfeeding definitions. *Stud Fam Plann* 1990; 21: 226-230.
12. National Research Council. Weight gain during pregnancy: Reexamining the guidelines. Washington, DC: The National Academies Press; 2009.
13. Health Canada. The Canadian guidelines for body weight classification in adults. Ottawa: H49-179/2003E; 2003.
14. Al-Sahab B, Lanes A, Feldman M, Tamim H. Prevalence and predictors of 6-month exclusive breastfeeding among Canadian women: A national survey. *BMC Pediatr* 2010; 10:20.
15. Millar W, Maclean H. Breastfeeding Practices. *Health Reports* 2005; 16(2): 23-30.

16. Meedya S, Fahy K, Kable A. Factors that positively influence breastfeeding duration to 6 months: A literature review. *Women Birth* 2010; 23: 134-45.
17. Breastfeeding Committee For Canada. Breastfeeding committee for Canada integrated ten steps & WHO code practice outcome indicators for hospitals and community health services: Summary. 2011 [cited 2012 Mar 26]. Available from: http://breastfeedingcanada.ca/documents/2011-03-30_BCC_BFI_Integrated_10_Steps_summary.pdf
18. Kramer MS, Chalmers B, Hodnett ED, Sevkovskaya Z, Dzikovich I, Shapiro S, et al. Promotion of Breastfeeding Intervention Trial (PROBIT): A randomized trial in the Republic of Belarus. *JAMA* 2001; 285: 413-420.
19. Horta BL, Kramer MS, Platt RW. Maternal smoking and the risk of early weaning: A meta-analysis. *Am. J. Public Health* 2001; 91: 304-307.
20. Donath SM, Amir LH, ALSPAC Study Team. The relationship between maternal smoking and breastfeeding duration after adjustment for maternal infant feeding intention. *Acta Paediatr.* 2004; 93: 1514-1518.
21. Oddy WH, Li J, Landsborough L, Kendall GE, Henderson S, Downie J. The association of maternal overweight and obesity with breastfeeding duration. *J. Pediatr.* 2006; 149: 185-191.
22. Rasmussen KM, Kjolhede CL. Prepregnant overweight and obesity diminish the prolactin response to suckling in the first week postpartum. *Pediatrics* 2004; 113: e465-471.
23. Amir LH, Donath S. A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *BMC Pregnancy Childbirth* 2007; 7: 9.
24. Greenland S, Finkle WD. A critical look at methods for handling missing covariates in epidemiologic regression analyses. *Am. J. Epidemiol.* 1995; 142: 1255-1264.
25. Law CG, Brookmeyer R. Effects of mid-point imputation on the analysis of doubly censored data. *Stat.Med.* 1992; 11: 1569-1578.
26. Hewett P, Ganser GH. A comparison of several methods for analyzing censored data. *Ann. Occup. Hyg.* 2007; 51: 611-632.

Table 1: Description of potential predictors of exclusive breastfeeding

Factor	Description
Birth year	Infant's year of birth
Maternal age	Mother's age at time of delivery
Maternal education	Mother's highest level of education
Marital status	Marital status as time of delivery
Location of residence	Urban or rural residence
District Health Authority	Residence in CBDHA or GASHA
County of residence	Residence in Antigonish, Cape Breton, Guysborough, Inverness, Richmond, or Victoria
Income quintile	Neighbourhood income quintile
Pre-pregnancy body mass index	From self-reported weight and height at first prenatal visit: underweight, normal weight, overweight, and obese (IOM criteria)
Parity	Primiparous or multiparous
Prenatal education	Whether mother received prenatal education
Pre-conception folic acid supplementation	Whether mother took pre-conception folic acid supplements
Smoking status	Non-smoker, quit smoking during pregnancy, and smoker throughout pregnancy
Health condition during pregnancy	Whether the mother experienced at least one of: diabetes, hypertension, or hyperemesis gravidarum
Gestational weight gain	Using pre-pregnancy BMI and gestational weight gain: sub-optimal,

1		
2		
3		optimal, and excessive (IOM criteria)
4		
5		
6	Labour type	Spontaneous, induction of labour, or no labour
7		
8	Mode of delivery	Vaginal or cesarean birth
9		
10	Perineal tear	Whether mother experienced 3 rd of 4 th degree lacerations
11		
12	Epidural analgesia	Whether mother received an epidural during labour
13		
14	Gestational age	Pre-term (< 37 weeks) or term birth (≥ 37 weeks)
15		
16	Gestational age	Pre-term (< 37 weeks) or term birth (≥ 37 weeks)
17		
18	Infant birth weight	<2,500 grams) or $\geq 2,500$ grams
19		
20	Admittance to SCN	Whether the infant was admitted to a special care nursery
21		
22	Infant anomaly	Presence of a major anomaly in infant (<i>e.g.</i> Down's syndrome,
23		
24		congenial heart disease, cleft palate)
25		
26		
27	Intention to breastfeed	Whether mother intended to breastfeed, collected at pre-natal visit or
28		
29		admittance for delivery
30		
31		
32	Early breast contact	Whether infant had direct contact with mother's breast within one
33		
34		hour of birth
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		

Table 2: Characteristics of the 4,533 mothers in the study cohort

Characteristic	All Mothers	Mothers who Initiated BF
	(n=4,533)	(n=2,907)
	# (%) [*]	# (%) [*]
Maternal age		
< 20 years	326 (7.2)	143 (4.9)
20-24 years	961 (21.2)	548 (18.9)
25-29 years	1,333 (29.4)	864 (29.7)
30-34 years	1,278 (28.2)	899 (30.9)
35+ years	635 (14.0)	453 (15.6)
Maternal education		
Less than high school	472 (12.3)	188 (7.5)
High school graduate	1,223 (31.8)	671 (26.8)
College diploma	836 (21.8)	571 (22.8)
University degree	1,309 (34.1)	1,075 (42.9)
Single motherhood[†]	1,328 (36.3)	707 (29.2)
Obese pre-pregnancy body mass index	689 (24.4)	438 (23.6)
Smokers throughout pregnancy	1,040 (24.6)	438 (16.2)
Intention to breastfeed	2,800 (69.3)	2,541 (94.6)
Primiparous mothers	1,889 (41.7)	1,319 (45.4)
Cesarean birth	1,245 (27.5)	813 (28.0)

* Denominators for percentages do not include missing values.

† Single motherhood includes single, divorced, widowed, and separated mothers.

Table 3: Cox proportional hazard analysis of 2,639 mother-infant dyads for exclusive breastfeeding duration

Predictor	Adjusted Hazard Ratio^{*,†}	95% CI		p-value for Predictor
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	
Marital Status				
Married/common-law	1	-	-	0.0013
Single/divorced/widowed/separated	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	-	-	
Quit during pregnancy	1.09	0.92	1.29	<0.0001
Smoker throughout pregnancy	1.39	1.21	1.60	
Pre-Conception Folic Acid Supplementation				
Yes	1	-	-	
No	1.15	1.01	1.30	0.0424
Parity				
Primiparous mothers	1	-	-	
Multiparous mothers	0.76	0.69	0.84	<0.0001
Breast Contact Within One Hour				
Yes	1	-	-	
No	1.44	1.29	1.62	<0.0001
Intention to Breastfeed				
Yes	1	-	-	
No	1.78	1.44	2.16	<0.0001

* The model is also adjusted for mother's district health authority.

† "Missing" categories for maternal education, marital status, pre-pregnancy body mass index, pre-pregnancy folic acid supplementation, breast contact within one hour, and intention to breastfeed were included in model, but adjusted hazard ratios are not shown.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

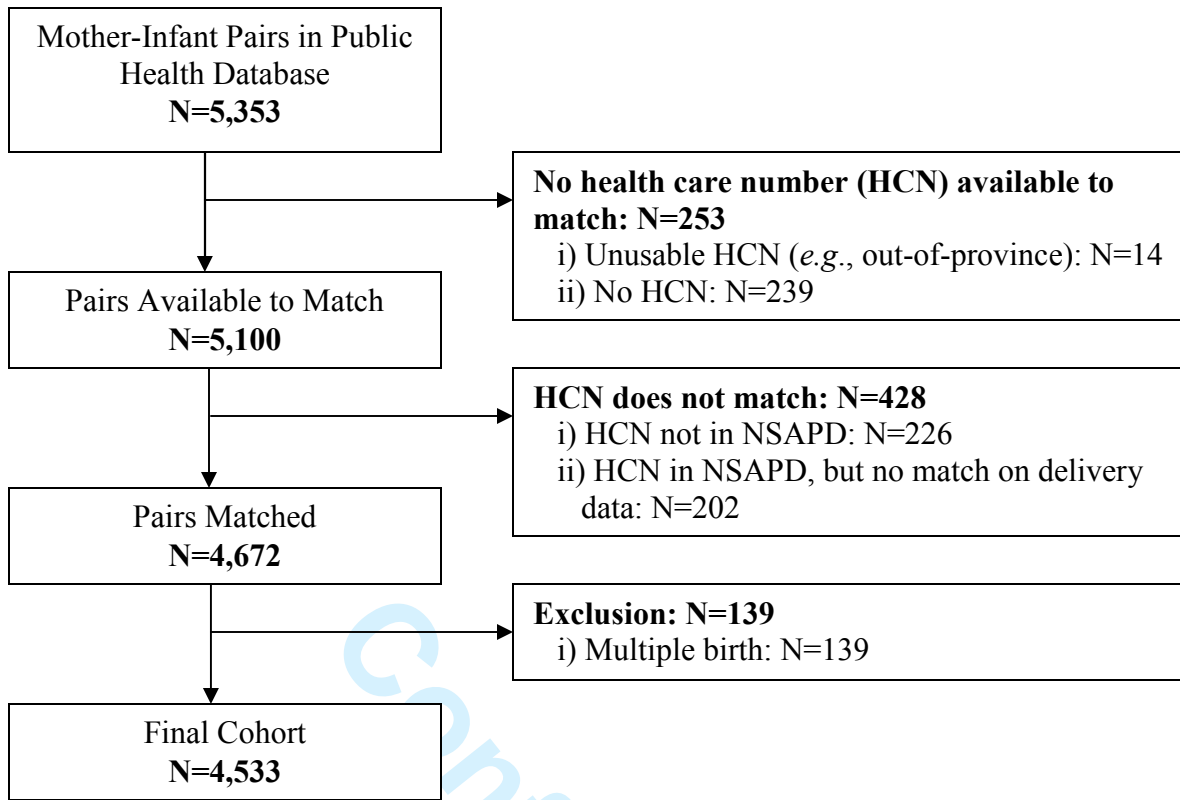


Figure 1: Flow diagram of mother-infant pairs available in Public Health Database and Nova Scotia Atlee Perinatal Database between 2006 and 2009



Figure 2: Kaplan-Meier curve of exclusive breastfeeding duration to six months among the 2,907 mothers who initiated breastfeeding

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

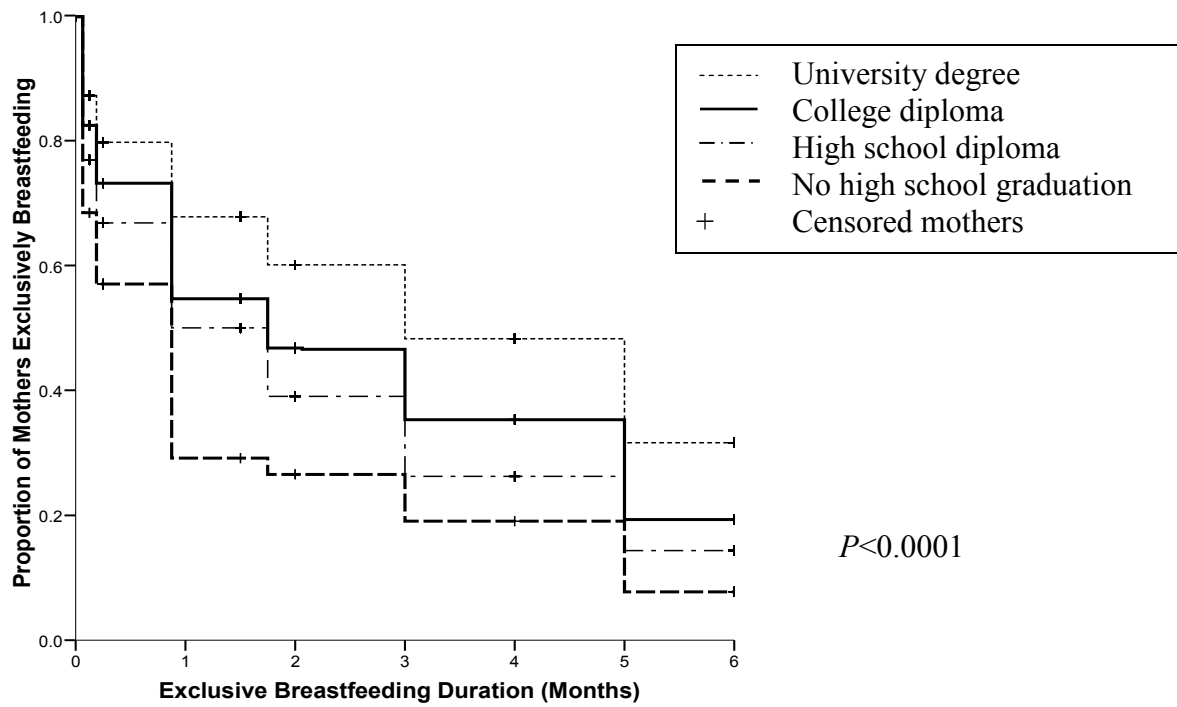


Figure 3: Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by highest level of maternal education among mothers who initiated breastfeeding

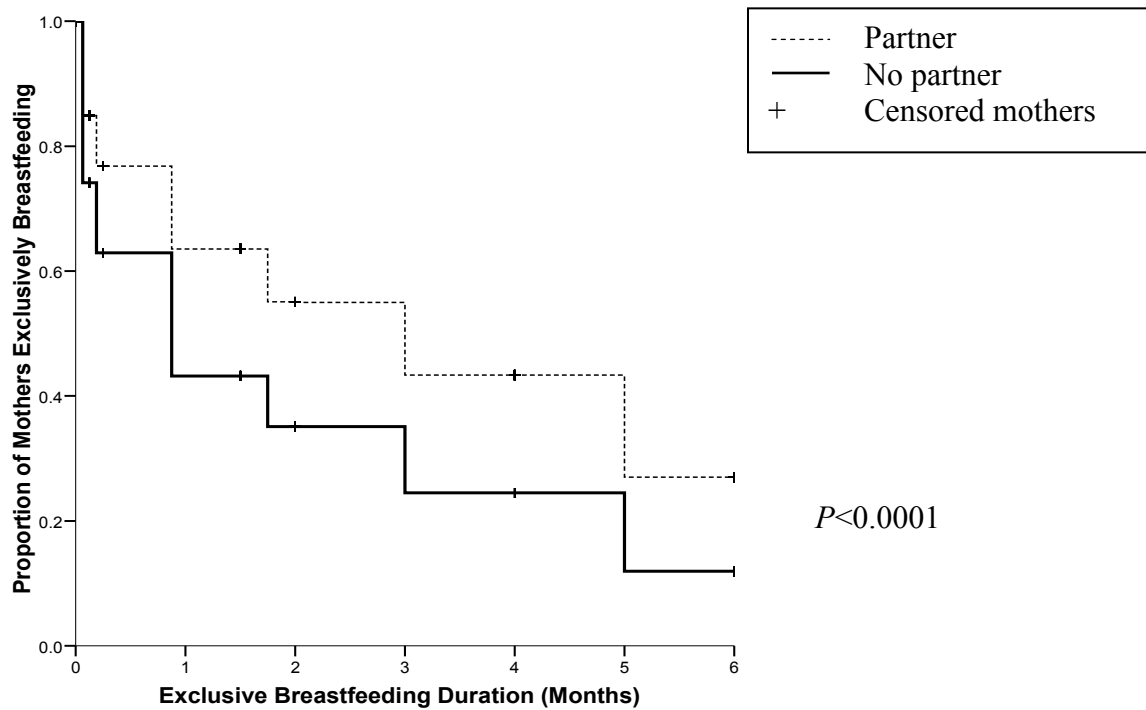


Figure 4: Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by marital status among mothers who initiated breastfeeding

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

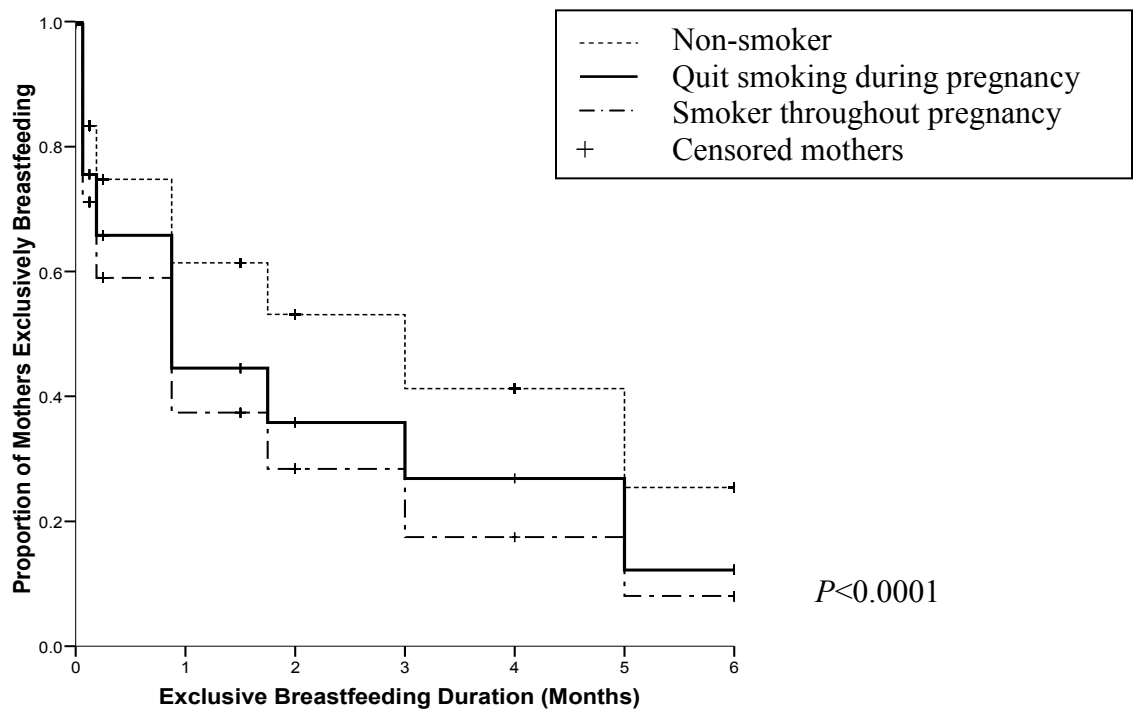


Figure 5: Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by maternal smoking status among mothers who initiated breastfeeding

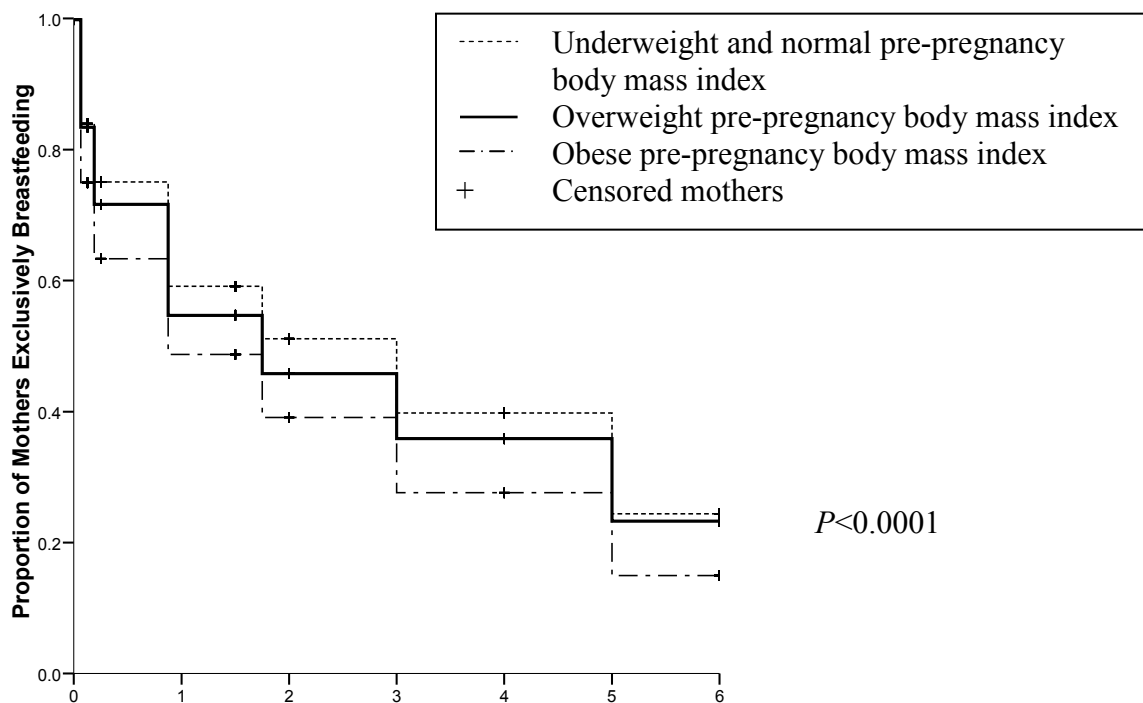


Figure 6: Kaplan-Meier curves of exclusive breastfeeding duration to six months stratified by maternal pre-pregnancy body mass index category among mothers who initiated breastfeeding