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Prediction of breastfeeding outcomes: Results from the All Our Babies study

Nagulesapillai, Tharsiya

UNIVERSITY OF CALGARY

Prediction of breastfeeding outcomes: Results from the All Our Babies study

by

Tharsiya Nagulesapillai

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Abstract

Objective: The objective of this study was to examine and compare predictors of any breastfeeding and exclusive breastfeeding at 4 months postpartum between women residing in Canada for 5+ years and those new to Calgary and Canada.

Methods: As part of a longitudinal study, women completed questionnaires about pregnancy experiences and breastfeeding practices. Bivariate analysis and multivariable logistic regression were conducted to identify the prevalence and predictors associated with breastfeeding outcomes at 4 months postpartum.

Results: While numerous variables were found to be predictive of breastfeeding outcomes, the key factors were perceived prenatal physical health, pre-pregnancy BMI and smoking status prior to and during pregnancy. These three factors were consistently found to be predictive of both breastfeeding outcomes across all populations assessed.

Conclusion: Although certain predictors of breastfeeding duration were similar between the groups, several were dissimilar, suggesting that these groups might benefit from different strategies to optimize breastfeeding outcomes.

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List of Abbreviations and Nomenclature

Symbol	Definition
AOB	All Our Babies
AOR	Adjusted odds ratio
BFI	Baby friendly initiatives
BFHI	Baby friendly hospital initiatives
BMI	Body mass index
CLS	Calgary Laboratory Services
CCHS	Canadian Community Health Survey
CI	Confidence interval
EBF	Exclusive breastfeeding
EPDS	Edinburgh Postnatal Depression Scale
HCP	Health care providers
LICO	Low income cut-off
LOTR	Life Orientation Test-Revised
MES	Maternity Experiences Survey
MOS SSS	Medical Outcomes Study Social Support Scale
PMI	Parenting Morale Index
PSS	Perceived Stress Scale
OR	Odds ratio
SAI	Spielberger State Anxiety Inventory
WHO	World Health Organization

Chapter One: Introduction

There are well established medical, psychological and economic benefits of breastfeeding both to the infant and mother, ranging from providing optimal nutrition, reducing the risk of obesity, asthma, and other inflammatory and chronic diseases, improved cognitive development and facilitating a secure infant-mother relationship. As a result, the World Health Organization (WHO) has set goals for breastfeeding and recommends exclusive breastfeeding (EBF) for the first six months of life and a combination of breastfeeding and complementary food until at least two years of age.[1,2] In fact, WHO recommends that breastfeeding be initiated within the first hour after birth as the colostrum produced at the end of pregnancy is optimal nourishment for newborns.[1] This recommendation aligns closely with the recommendations from Health Canada[3] and Canadian Pediatric Society.[4]

Achieving the Millennium Development Goals established by the United Nations requires eliminating health disparities among different segments of the population that occur by gender, race, ethnicity, income, geographical location, disability, and sexual orientation. Breastfeeding is an unsurpassed way of providing ideal food for healthy infant growth and development[2] but is an area of significant health disparity.[5] Various studies have examined predictors of breastfeeding,[6-10] however the role of immigrant status in understanding disparities in breastfeeding rates warrants further research.

1.1 Purpose

Breastfeeding rates differ markedly by immigration status. Understanding how socio-cultural environments influence breastfeeding practices is particularly important in Canada because of the large, growing visible minority population.[11] The purpose of this study was to

examine the prevalence and predictors (demographic, obstetric, mental health, psychosocial and behavioural risk factors) of any breastfeeding and exclusive breastfeeding (EBF) at 4 months postpartum among women residing in Canada/Calgary for 5 or more years and new Calgarians and new Canadians.

1.2 Objectives

1. To quantify the prevalence and odds of any breastfeeding at 4 months postpartum associated with various predictors among women in the AOB cohort who have been residing in Canada/Calgary for more than 5 years.
2. To quantify the prevalence and odds of any breastfeeding at 4 months postpartum associated with various predictors among new Calgarians (5 years or less) and new Canadians (5 years or less).
3. To quantify the prevalence and odds of EBF at 4 months postpartum associated with various predictors among women in the AOB cohort who have been residing in Canada/Calgary for more than 5 years.
4. To quantify the prevalence and odds of EBF at 4 months postpartum associated with various predictors among new Calgarians (5 years or less) and new Canadians (5 years or less).

1.3 Operational definitions

For the purposes of this study, new Canadians were defined as women residing in Canada for 5 years or less (≤5) and new Calgarians were defined as women residing in Calgary for 5 years or less (≤5). EBF was defined as the practice of feeding only breast milk.

1.4 Rationale

Many existing studies that assessed prevalence and predictors of breastfeeding utilize cross-sectional data in which mothers recall breastfeeding practices from the past which increases the chances of recall bias. The All Our Babies (AOB) study measured the duration of breastfeeding, difficulties associated with breastfeeding, the support available to the mother during the prenatal and postnatal periods, and also assessed various demographic, obstetric, psychological well-being factors. The AOB study is a prospective study and information was collected prior to knowledge of the outcome, reducing the likelihood of recall bias, and enhancing the understanding of the direction of effect.

The predictors and risk factors of breastfeeding among Canadian women have been well-documented.[7,9,10,12,13] However, a better understanding of the predictors and risk factors of breastfeeding among mothers new to Canada and Calgary is required because mothers who have moved from their country of origin and are unfamiliar with the Canadian context may face additional challenges during pregnancy and postpartum years. Women new to Calgary or Canada may lack access to services (as physician practices may be at capacity) because of challenges associated with accessing maternity care and may face isolation due to lack of informal social support. Health behaviours of immigrants are important in understanding the well-being of children given that almost 20% of Canada's population is foreign born.[14] In Calgary, almost one-quarter (23.6%) of the population is foreign-born as of 2006, up from 20.9% in 2001.[14]

The information obtained from this study could be of value to members of the community, policy makers and service providers. Identification of the factors associated with breastfeeding can better equip policy makers and public health practitioners in designing programs for women at risk of early breastfeeding cessation. The ultimate goal is to inform and

optimize perinatal health services for newcomers, by ensuring that health policies and services are meeting the unique needs of this growing population.

Chapter Two: Literature Review

Breast milk has been recognized globally as the best food source for infants for its economic, immediate and long-term health benefits.[1,4,7,15] Breastfeeding is beneficial to the infant, mother, and family. It has been associated with decreased incidence and severity of bacterial meningitis, diarrhoea, respiratory conditions and otitis media among infants[7] and reduced risk of obesity in later life.[16-18] Breastfeeding also provides many benefits to the mother and family including increased birth spacing through delayed ovulation, decreased postpartum bleeding, an earlier return to pre-pregnancy weight and increased maternal sensitivity and better mother-infant attachment.[7,19] Recently, breastfeeding has also been linked to reduced risk of ovarian and breast cancer.[7] Despite these benefits, current breastfeeding duration among Canadian women is below the WHO's target goal of EBF for the first 6 months of life. Although the prevalence of breastfeeding in Canada has risen and over 90% of Canadian mothers now initiate breastfeeding,[20] the proportion of breastfeeding mothers (exclusive and partial) at 6 months remain short of the recommended WHO targets of EBF, as only 44.2% of Canadian mothers continue any form of breastfeeding until this time.[20] According to the Canadian Maternity Experiences Survey (MES), 94.6% (95% CI: 92.8–96.3) of women surveyed in Alberta reported initiating breastfeeding in 2006-2007, but only 15.8% (95% CI: 13.0–18.7) reported exclusively breastfeeding at 6 months.[21] Rates in Alberta were higher than the averages for Canada which were 90.3% (95% CI: 89.6–91.0) reporting initiating breastfeeding and only 14.4% (95% CI: 13.5–15.4) reported exclusively breastfeeding at 6 months.[21]

Breastfeeding is promoted by several large health authorities, including WHO,[22] UNICEF,[1] Health Canada, Canadian Paediatric Society, Dieticians of Canada, and Breastfeeding Committee for Canada.[3,4] In 1992, WHO/UNICEF jointly launched the Baby Friendly Hospital

Initiative (BFHI), a global 10-step programme that includes specific practice and organizational recommendations for maternity units to ensure that all women and their babies receive the health and social benefits of breastfeeding.[23] The Promotion of Breastfeeding Intervention Trial (PROBIT) in Belarus led by Kramer *et al.* (2001) provided clear evidence that infants from maternity sites that were modeled on BFHIs were significantly more likely than control infants from maternity sties with usual infant feeding practices and policies to be breastfed at 12 months, be exclusively breastfed at 3 months and 6 months, and have a significant reduction in the risk of gastrointestinal tract infections and atopic eczema.[24] The BFHI has been adapted and modified to baby friendly initiative (BFI) in Canada which supports the continuum of care between hospital and community services.[3] Hospitals and community facilities that integrate and adhere to the 10 steps in practice receive the BFI designation, led by the provincial and territorial governments in collaboration with the Breastfeeding Committee for Canada.[3] Breastfeeding interventions have been identified to have a potential to prevent 13% of all under 5 deaths in developing areas of the world and is ranked as the most important preventive measure for saving child lives.[25]

In recent years since the implementation of BFHI, there have been increases in the duration and exclusivity of breastfeeding.[24,26-29] The BFHI is one of many predictors that have been examined to impact breastfeeding. Other predictors include maternal age, ethnicity, maternal education, income, marital status, parity, mode of delivery, mental health and psychosocial factors.[7,9] In general, predictors could be classified into demographic, obstetric, psychological well-being, and behavioural risk factors. Such factors may have differential influences on various groups of women, particularly women new to the country. A recent multi-centre study by Dennis *et al.* (2012) compared predictors of breastfeeding duration among 1014 migrant (asylum seekers, refugees and immigrants) and 489 Canadian-born women and found

that at 16 weeks, migrant women had higher breastfeeding rates than Canadian-born women. Factors associated with the likelihood of breastfeeding at 16 weeks postpartum among migrant women were high gross domestic index (GDI) score of country of origin, previous breastfeeding experience, breast engorgement pain at 1 week and positive peer breastfeeding behaviours, whereas maternal smoking and residing in Toronto were associated with lower likelihood of breastfeeding at 16 weeks postpartum for Canadian born women.[30] There are within and between country differences in breastfeeding practices which can be attributed to socio-cultural factors as well as personal, social and structural biases against breastfeeding. The discussion on the international breastfeeding practices follows the discussion of demographic factors associated with breastfeeding.

2.1 Demographic factors and breastfeeding

2.1.1 Maternal age

Maternal age has consistently been associated with the initiation and duration of breastfeeding in developing and developed countries. Mothers older than 25 are more likely to initiate and continue breastfeeding compared to younger mothers.[7] Studies have found that younger mothers are likely to terminate breastfeeding early,[12,31] and this is exacerbated among younger mothers with lower levels of education.[12] An analysis of the 1998-2002 Longitudinal Study of Child Development in Quebec (n=2223) found that in comparison to young mothers under 25 years of age, the probability of exclusively breastfeeding at 4 months is 3.1 times higher for mothers between 25-29 years, 4.7 times higher for mothers aged 30-34 years, and 5.7 times higher for mothers aged 35-39 years after adjustment for education level, family income, family type and parents' working situations.[9] This representative sample of children born in

Quebec suggests a gradient between the likelihood of breastfeeding and increasing maternal age. In addition, maternal age was found to be a significant predictor of breastfeeding duration among both migrant and Canadian-born mothers, but more significantly influenced the latter.[30] Mothers who breastfed tend to be older than mothers who formula-fed.[32] The Norwegian Infant Nutrition Survey also found that EBF at 4 months was greater with increasing maternal age, as the adjusted odds for mothers 25 to 34 years was 1.74 (95% CI: 1.27 to 2.40) and 2.04 (95% CI:1.38 to 3.02) for mothers over 35 years compared to mothers younger than 24 years of age.[33] In summary, the best quality evidence to date suggests that older mothers are more likely to breastfeed compared to younger mothers.

2.1.2 Maternal education

Maternal education has been repeatedly found to be associated with initiation and duration of breastfeeding. A 2003 Canadian health report found that the initiation of breastfeeding tends to rise with education and household income.[31] Among women with less than secondary education, 71% started breastfeeding compared to 89% of postsecondary graduates.[31] Similarly, a more recent report in 2009 found that the rates of breastfeeding of women with a postsecondary diploma or degree (90.4%) were greater than those without higher education (81.96%).[34]

The population level study in Quebec mentioned above found that mothers with university degrees were 5 times more likely to be any breastfeeding from birth to 4 months, and 8 times more likely to exclusively breastfeed at 3 months compared to mothers without a high school diploma.[9] In addition, the Community Perinatal Care (CPC) study that consisted of a cohort of pregnant women in Alberta identified that women with less than 12 years of education were more likely (AOR: 2.18; 95% CI: 1.42 to 3.36) to cease breastfeeding prior to 6 months,

after adjusting for postpartum employment, pre-pregnancy obesity and anxiety during pregnancy.[12] In summary, the best evidence has found that lower levels of education are associated with shorter breastfeeding duration because these women may be less informed about the benefits of breastfeeding and may be unaware of the resources and support programs available.

2.1.3 Income

Income is commonly contingent on education, and has found to be positively associated with breastfeeding initiation and duration in developed countries[7]. The 2003 Canadian health report mentioned above reported that initiation of breastfeeding ranged from 74% in low income to 89% in high income households, and the prevalence of EBF at 6 months declined to 13% in low income and 19% in high income households.[31] The availability of infant formula through welfare food programmes in certain countries could be an economic factor that contributes to low-income women failing to breastfeed. In high-income countries, like Canada, lowest rates of breastfeeding are found in lower-income groups. The MES reported that in 2006-2007, women living in households above the low income cut-off (LICO) were more likely to initiate breastfeeding (91.1%, 95% CI: 90.3–91.9) than those living at or below this level (87.7%, 95% CI: 85.8–89.6).[21] EBF at 6 months were greater among women living above the LICO (15.4%, 95% CI: 14.3–16.6) compared to women living at or below the LICO (11.6%, 95% CI: 9.5–13.7).[21] Infants of low-income families who were breastfed less often and for shorter durations had more chronic health problems and hospital admissions than infants that were breastfed for 4 months or longer.[35] The most common causes of chronic conditions among these infants were allergies and bronchitis, while causes of hospital admissions were respiratory and gastro-intestinal diseases.[35] Regardless of income, longer duration of maternal breastfeeding was

associated with less hospitalizations.[35] On the other hand, in developing countries, an increase in SES is generally associated with a reduction in breastfeeding incidence and duration.[36] Women with higher household income consider breastfeeding old-fashioned and a sign of lesser social status, and perceive bottle-feeding as modern and Westernized.[37] In summation, higher income has been consistently found to be associated with greater rates of breastfeeding in developed countries.

2.1.4 Marital status

Marital status has been associated with breastfeeding initiation, with married mothers having higher breastfeeding initiation and EBF rates than unmarried or divorced mothers.[7] A UK study found that stronger inter-parent bonds (bonds between two parents), common among married women, were associated with an increase in initiation of breastfeeding.[38] Furthermore, the Norwegian Infant Nutrition Survey report the odds of EBF at 4 months were significantly lower for cohabitants (AOR: 0.82; 95% CI: 0.68 to 0.99) and unmarried women (AOR: 0.59; 95% CI: 0.36 to 0.97) compared to married mothers. The presence of a partner provides additional support for the mother easing the feeding process and prolonging breastfeeding duration.[6] The impact of marital status on immigrant mothers' breastfeeding practices has not been adequately assessed.

2.1.5 Parity

Multiparous mothers are likely to breastfeed for a longer duration compared to nulliparous mothers because women with previous pregnancies have increased knowledge and self confidence from earlier breastfeeding experiences and typically breastfeed subsequent children.[7,10] Based on the MES, mothers with multiple pregnancies had an increased likelihood (AOR: 1.16; 95% CI: 1.09 to 1.23) of EBF for 6 months, after adjusting for other demographic

factors.[6] Li *et al.* (2002) concluded that while primiparous mothers (55%) had a higher rate of initiating breastfeeding than multiparous mothers (52%), they had a lower rate of continuing breastfeeding (6% vs. 10%) throughout the infant's first year.[39] Similarly, a study utilizing the Norwegian Infant Nutrition Survey found a dose-response relationship between odds of EBF and number of children.[33] The odds of EBF at 4 months was 1.37 (95% CI: 1.11 to 1.70) for women with two previous children and 1.94 (95% CI: 1.49 to 2.52) for women with three or more previous children compared to the reference group of first time mothers.[33] This association between parity and breastfeeding duration varies with culture.[40] Amatayakul *et al.* (1999) found that in comparison to mothers in Western countries, mothers of Thai origin have high rates of breastfeeding regardless of previous experiences.[40] The authors speculate that this reflects the cultural pattern of breastfeeding among Thai women and traditional practices that encourage close contact between the mother and her newborn. Parity was not an important predictor of successful and prolonged breastfeeding in this Thai population.[40] In addition, whereas the number of children may be a determining factor for continuation of breastfeeding among Canadian-born women, being primiparous increased the duration among migrant mothers.[30] The difference reflects cultural norms regarding breastfeeding practices of first-time mothers in migrant women's countries of origins.[30] In summary, previous breastfeeding experience associated with parity has frequently been found to be an important predictor of subsequent breastfeeding. The following maternal characteristics have consistently been associated with increased breastfeeding at 4 months or longer: increased maternal age, greater income and education levels, being married and multiparous.

2.1.6 Ethnicity

Ethnicity has been found to be related to breastfeeding practices, particularly cessation and perceived difficulties of breastfeeding.[7] Cultural factors may contribute to differing breastfeeding practices that translate into barriers to breastfeeding. The steadily increasing immigrant population[11] has resulted in raising awareness for understanding the health needs of this population, and how these needs change with assimilation into the larger culture of Canada[41]. Health behaviours change with acculturation.[41] To understand how breastfeeding may be influenced by acculturation in Canada, it is essential to have an understanding of breastfeeding practices locally and in different countries. Breastfeeding rates and duration seems to vary based on ethnicity and years residing in a Western country. Despite the current state of the research, there is limited information on how breastfeeding practices may vary for newcomers to a country or city as a result of barriers with access to health services or due to unfamiliarity with health care systems.

2.2 Breastfeeding practices: a Canadian overview

Breastfeeding trends in Canada today have shifted since the 19th century. With advances in medical technology, women moved from delivering at home to the hospital where cow's milk products were promoted as the modern way to nourish a newborn. This was followed by the women's movement in 1920 that allowed women to pursue other interests beyond motherhood which subsequently led to declining breastfeeding rates.[42] Fortunately by the 1970s, breastfeeding rates began to rise in Western countries, including Canada, with the recognition of the short and long-term effects of breastfeeding to women and their infants.[42] The initiation of breastfeeding increased from 26% in 1965-1971 to 61% in 1978.[42] Duration rates also increased,

31% of mothers continued breastfeeding for at least 4 months in 1973 compared to 59% in 1982.[42] The introduction of BFHIs by WHO/UNICEF in 1991 placed an onus on hospitals and health care providers to promote breastfeeding, which resulted in an increase in initiation rates. By the turn of the century, breastfeeding rates continued rising; the percentage of mothers who reported breastfeeding or trying to breastfeed their last child increased from 2001 (81.5%) to 2003 (84.9%) but remained stable from 2003 to 2009-2010.[20] Similarly, EBF at 4 months increased from 2003 (37.3%) to 2005 (43.1%), but remained stable between the reporting periods 2005 (43.1%), 2007-2008 (42.8%) and 2009-2010 (44.2%).[20] EBF at 6 months followed a similar pattern and increased from 2003 (17.3%) to 2005 (20.3%), but remained stable between the reporting periods 2005 (20.3%), 2007-2008 (23.1%) and 2009-2010 (25.9%).[20]

Assessing the trends of breastfeeding in Canada involves understanding the characteristics of women who breastfeed and those who do not. In Canada, EBF is significantly more common among urban residents,[31] women with higher education,[9,31] and older mothers.[9,31] Among Canadian-born mothers, variables that were associated with decreased duration of breastfeeding at 4 months included residing in Toronto, being younger, less educated, being of lower income and smoking, while residing with and receiving support from the infant's father increased the likelihood of breastfeeding.[30] A study using data from 5616 mothers who had babies aged 6 month and older at the time of the MES found EBF rate to be 13.8% at 6 months (95% CI: 12.9-14.8%), a decline from 63.6% (95% CI: 62.3-64.9%) at 1 month and 50.4% (95% CI: 48.2-50.9%) at 3 months.[6] Predictors that were found to be associated with EBF included marital status, parity, older maternal age and lower pre-pregnancy BMI while smoking during pregnancy was negatively associated with EBF. Women giving birth at home were 5 times more likely to exclusively breastfeed than those who gave birth at hospitals or clinics. The authors

found years of education to be a significant predictor of 6-month EBF, and inferred that mothers with higher education are able to make well-informed decisions regarding breastfeeding practices.[6] It could also be that educated mothers did not have to return to work as early due to living in higher income households. Another factor associated with EBF was mode of delivery. Vaginal deliveries increased the odds of EBF at 6 months (OR: 1.25; 95% CI: 1.0 to 1.53), this association may be related to the pain and discomfort that prevent women with caesarean deliveries from breastfeeding.[6] Others find the opposite effect because women who had a caesarean delivery tend to have longer hospital stays and may be provided with more information and encouragement about breastfeeding from hospital staff.[43] The relationship between mode of delivery and breastfeeding in Canada requires more research given the increasing rate of caesarean births worldwide. Another increasing occurrence is obesity, and there are limited studies examining the association between maternal obesity and breastfeeding. A Canadian study of indigenous women found that maternal weight had no relationship with infant feeding because overweight and obese women had greater levels of breastfeeding compared to normal weight women.[44] However, a systematic review and meta-analysis found epidemiological evidence suggesting that overweight and obese women are less likely to breastfeed than normal weight women due to biological, psychological, behavioural or cultural reasons.[45] Further research is required to understand the association between infant feeding decisions and maternal obesity among different groups in Canada.

2.2.1 Health care utilization

Prenatal care provides invaluable opportunity for monitoring and support for pregnant women and can be effective in detecting, treating and preventing poor maternal and infant health outcomes. The Society of Obstetricians and Gynaecologists of Canada recommend that prenatal

care be sought out every four to six weeks in early pregnancy, every two to three weeks after 30 weeks' gestation, and every one to two weeks after 36 weeks' gestation.[46] According to the MES, the average number of prenatal care visits was 12.9 with only 1.1% of women having four or fewer prenatal care visits. Most women (94.9%, 95% CI: 94.3–95.4) initiated care in the first trimester (at 13 weeks' gestation or earlier).[21] Younger mothers (15-19 years), women with less than high school education and those living in a household at or below LICO were more likely to initiate prenatal care after the first trimester.[21] Most women report being satisfied with the medical care received while pregnant.[47] An evaluation of health care utilization using the Canadian Community Health Survey (CCHS) found that despite language barriers and cultural attitudes toward Western medicine, members of visible minority groups make use of primary care providers as well as their Caucasian counterparts.[48] Health services were used more frequently among immigrants who have resided in Canada longer. Among Canadian-born individuals, health services were used less frequently among visible minorities compared to Caucasians. This disparity in health utilization between immigrants and Canadian-born visible minorities could not be explained by acculturation alone,[48] but is likely a result of the healthy immigrant effect, the observation that newly-arrived immigrants are often in superior health compared to native-born population, but lose their health advantage over time.[49] In addition, a Calgary study conducted telephone surveys of South Asian and Canadian-born women who delivered at community hospitals and found that South Asian women reported spoken and written language as a barrier to receiving medical care at all stages of pregnancy.[50] Alberta Health Services currently provides translation services to target immigrant populations, but such services are underutilized by most groups.[50] Women reported using family members as interpreters when necessary,[50] however this may be problematic as interpretation by family

members are not always accurate. In addition, there was a significant difference between South Asian and Caucasian women with regards to preference for physician gender, with South Asian women largely preferring a female physician.[50]

The Ontario Mother and Infant Survey designed to determine the patterns of health and social services utilization of 1250 postpartum women from five hospital sites in Ontario, Canada found that early breastfeeding termination was associated with early hospital discharge, minimal breastfeeding support, and receiving advice on formula feeding.[51] Mothers' initial intention to breastfeed for only a short duration of time (less than 4 months) was an important risk factor for early cessation,[51] suggesting that intention to breastfeed is a strong predictor of actual breastfeeding. The study also found that mothers who did not participate in moms' groups or drop-in centres were more likely to discontinue breastfeeding early. Women also reported that in-home breastfeeding support by peer counsellors were more beneficial than breastfeeding clinics. Interestingly, women who reported visiting family physicians for self care had breastfed for a shorter duration compared to those who did not seek clinical care. The authors speculate that while most physicians promote the benefits of breastfeeding, many lack the training to address lactation problems common among women.[51] They suggested that exposure to health care providers with expertise in lactation counselling may improve the duration of breastfeeding among primiparous women.[51]

Research has found that different forms of prenatal and postnatal care may allow women to seek additional help and utilize resources more resulting in higher breastfeeding rates. For example, a randomized controlled trial that examined the impact of supplementary prenatal care on resource use among community-based pregnant women in Calgary, Alberta found that the use of community-based resources increased as a result of additional support provided by health care

professionals.[52] Particularly, additional support by nursing staff resulted in increased attendance in prenatal and parenting classes and nutritional counseling.[52] In general, providing additional support to pregnant women increased their utilization of resources available that may typically be underutilized.[52] Another randomized community-based trial was conducted in Baltimore to assess whether providing breastfeeding support resulted in higher rates of breastfeeding among urban low-income mothers. They found that mothers in the intervention group which included home visits, telephone support and 24-hour pager access to nurses had a higher overall 6-week any breastfeeding rates (66.7% vs. 56.9%) compared with the control group.[53] However, this intervention was not able to sustain exclusive breastfeeding rates at 12 weeks (49.4% vs. 40.6%) and 24 weeks postpartum (29.2% vs. 28.1%).[53]

2.3 Breastfeeding practices: an international overview

Breastfeeding practices among immigrants are influenced by acculturation.[7] Acculturation is the extent to which people from one culture adapt or accommodate their behaviour and thoughts to their perception of the norms of a second culture.[41,54] Among immigrants, breastfeeding may be common in their country of origin, but upon migration to Canada or other Western countries where women discontinue breastfeeding earlier due to the ample availability of formula, women may adopt the habits of the dominant culture.[55] It has been noted that women who are the least acculturated may be the most likely to successfully initiate breastfeeding.[54,56] Rassin *et al.* (1994) found that mothers who identified themselves as Mexicans were more likely to breastfeed compared to mothers who identified themselves as Mexican-Americans.[54] The influence of acculturation on breastfeeding would be better understood with awareness of breastfeeding practices in different countries.

2.3.1 The Western World

There has been a resurgence of breastfeeding initiation in the Western World. Similar to Canada, the United Kingdom's Department of Health recommends EBF for the first 6 months of life and breastfeeding along with complementary food be promoted until the second year of life.[57] In the United Kingdom, the breastfeeding manifesto coalition produced the Breastfeeding Manifesto in 2006 to improve awareness of the health benefits of breastfeeding and its role in reducing health inequalities across the UK.[58] This manifesto outlines 7 objectives, including the implementation of the Global Strategy for infant and child feeding developed by the WHO and UNICEF and improved training for health professionals.[58] In Australia, the Dietary Guidelines for Children and Adolescents incorporates the Infant Feeding Guidelines for Health Workers[59] and recommends EBF for around six months as the best and safest food source during this period and recommend that initiation rate be at 90% and 6-month breastfeeding rate be at 80%.[59]

In 2011, the US Surgeon General issued a *Call to Action* to eliminate obstacles to breastfeeding, by suggesting 20 actions at different levels of the public health sector including mothers and families, communities, health care, employment, and research and surveillance.[60] These actions include the following: (1) give mothers the support they need to breastfeed their babies, (2) develop programs to educate fathers and grandmothers about breastfeeding, (3) strengthen programs that provide mother-to-mother support and peer counseling, (4) use community-based organizations to promote and support breastfeeding, (5) create a national campaign to promote breastfeeding, (6) ensure that the marketing of infant formula is conducted in a way that minimizes its negative impacts on exclusive breastfeeding, (7) ensure that maternity care practices throughout the United States are fully supportive of breastfeeding, (8) develop systems to guarantee continuity of skilled support for lactation between hospitals and

health care settings in the community, (9) provide education and training in breastfeeding support for all health professionals who care for women and children, (10) include basic support for breastfeeding as a standard of care for midwives, obstetricians, family physicians, nurse practitioners and pediatricians, (11) ensure access to services provided by International Board Certified Lactation Consultants, (12) identify and address obstacles to greater availability of safe banked donor milk for fragile infants, (13) work toward establishing paid maternity leave for all employed mothers, (14) ensure that employers establish and maintain comprehensive, high-quality lactation support programs for their employees, (15) expand the use of programs in the workplace that allow lactating mothers to have direct access to their babies, (16) ensure that all child care providers accommodate the needs of breastfeeding mothers and infants, (17) increase funding of high-quality research on breastfeeding, (18) strengthen existing capacity and develop future capacity for conducting research on breastfeeding, (19) develop a national monitoring system to improve the tracking of breastfeeding rates as well as the policies and environmental factors that affect breastfeeding, and (20) improve national leadership on the promotion and support of breastfeeding.[60] By 2020, the aim is to increase the proportion of infants who are 'ever' breastfed to 82%, and increase the proportion of mothers who are breastfeeding at 6 months to 61%, and to 34% at 1 year.[60] In addition, the US surgeon general is aspiring to increase infants exclusively breastfed at 6 months to 25% from a current 14%.[60]

2.3.2 Africa

Among countries in Africa, it is common practice for infants to receive water, traditional medicines and porridge before 6 months of age in addition to breast milk.[61] For example, in Nigeria, exclusive breastfeeding is defined differently as it comprises both water and milk which reflects the cultural belief that water is required to quench the child's thirst.[61] Early introduction

of complementary foods, early weaning practices, and failure to initiate breastfeeding are common among mothers in Africa. A study in Guinea Bissau, West Africa revealed that mothers defined weaning as the complete termination of breastfeeding, compared to the introduction of complementary foods in combination with breast milk. The reasons for premature termination of breastfeeding are often perceived or validated insufficient milk supply,[62] illness of the child,[63] illness of the mother,[62,63] or subsequent pregnancy.[63] The fear that breastfeeding alone may not be sufficient reflects maternal concern more so than the lack of knowledge about the advantages of breast milk.[64] In addition, there appears to be differences in breastfeeding practices in Africa based on the child's gender. Boys were more likely to be introduced to complementary feedings earlier compared to girls due to the belief that breastfeeding alone does not meet the feeding demands of male infants.[62]

2.3.3 Arab countries

Arab countries include parts of North Africa and Middle East. Pre-lacteal feeding defined as foods given to newborns before breastfeeding is established and before breast milk "comes in" usually on the first day of life is commonly practiced among Arab countries. Delayed breastfeeding initiation and pre-lacteal feeding can be explained by the misperception among Muslim cultures that colostrum is harmful to the infant.[65] Women believe colostrum to be 'dirty, stale milk' that has been stored in the breast for nine months.[65] In Jordan, mothers tend to give glucose and water as pre-lacteal feedings instead of colostrum reflecting cultural practices and a lack of understanding about the benefits of colostrum.[66] EBF is defined differently among Jordanian women as they do not consider the use of supplements as non-EBF.[66] Women in Arabian gulf countries believe that bottle-feeding is a symbol of Westernization and introduce it to the infant at a young age.[67] A study in Kuwait found that while majority of women (92.5%)

initiate breastfeeding, less than one-third of infants were exclusively breastfed at time of discharge from hospital.[65] In summary, the benefits of breastfeeding are underestimated in Arab countries.

2.3.4 Latin America

Latin America includes Mexico and countries in South and Central America. Among low-income Latino mothers, combination feeding of both breast milk and formula is common because it provides their babies with the "best of both" worlds.[68] In Mexico, tea, water and bottled milk were introduced within the first two months by many mothers.[69] The use of prelacteal feedings, not feeding the infant colostrum, and Latin ethnicity were associated with shorter duration of exclusive breastfeeding.[70] Mexican mothers' reported that they breastfed to provide the child with good nutrition, prevent illness in the child and better growth.[69] Some mothers who bottle-fed did so because it gave them more freedom to do other activities.[69] In Brazil, high levels of maternal education were associated with continuation of EBF among infants younger than 6 months. Latin American countries have breastfeeding initiatives, BFHI, human milk banks and training of health care professionals to promote and educate women on the benefits of breastfeeding.

2.3.5 East Asia

Among major areas in East Asia (China, Hong Kong, Japan, etc), Western culture is dominant, although traditional beliefs still persist. Researchers have observed that traditional health beliefs, socio-cultural and environment factors are important influences on Chinese mothers' decisions about infant feeding practices. Chen (2010) noted that low rates of breastfeeding among Chinese women were associated with traditional health beliefs such as yin-yang theory (hot-cold theory), in which the inability to produce breast milk signified disharmony

in the body.[71] Women abstained from breastfeeding and perceived breast milk as unstable food when their health and diet were imbalanced[71]. In traditional Chinese culture, 'pei yue' refers to the practice whereby new mothers are expected to stay at home and avoid all household chores and social activities during the first month after delivery. This along with maternal education, living conditions and marital status influenced women's decision to exclusively breastfeed.[37] The presence of the baby's grandmother in a household has been associated with higher breastfeeding self-efficacy (self-reported confidence in breastfeeding), but has no impact on EBF.[37] Hong Kong fails to meet the recommendations set by WHO of EBF for the first 6 months. This has been linked to the early return of postpartum women to work, as paid maternity leave is only 6 to 10 weeks after delivery in Hong Kong.[72] In addition, infants are fed congee (rice porridge), resulting in the marked decline in EBF.[37] In summary, the rates of breastfeeding is variable among East Asian countries, however the overarching belief is the same: success of breastfeeding depends on the holistic functioning of the human body.

2.3.6 South Asia

Rates of EBF initiation in India are low and decrease during the first 6 months, even among mothers who delivered in baby-friendly hospitals.[73] In Pakistan, children are given pre-lacteal feedings in the form of honey, ghutti, glucose saline, glucose water, and water. The main reasons for not EBF and early weaning in India and Pakistan are perceived insufficiency of milk,[73,74] working mothers, chronically-ill mothers, and children with a congenital diseases.[74] Breastfeeding duration was shorter among women who were illiterate, poor and who had delivered a female child.[74] In Sri Lanka, tandem nursing, the practice of breastfeeding a new baby while continuing to breastfeed an older child is very common. Sri Lanka is known for its prolonged breastfeeding practices, with median duration of 2.9 years. Researchers have linked

this to the cultural practice of mother-child bed-sharing which fosters frequent night-time breastfeeding.[75] There have been concerns about under nutrition between 6 to 24 month as a result of early introduction of breast milk substitutes and late introduction of semi-solid complementary foods in South Asia.[76]

In summary, there are commonalities in breastfeeding initiation and cessation among developing countries. The main reason for non-exclusive breastfeeding or early cessation reflects a cultural perception of the limited value of colostrum and breastmilk.[62,73,74] Early weaning may also be a consequence of maternal or infant illness. Breastfeeding is of particular importance in developing countries where the leading cause of infant and child mortality are nutritional deficiencies and infectious diseases.[64] Despite the well-documented advantages of breastfeeding to mothers, infants and the society, ethnic and cultural differences which reflect diverse beliefs and perception of breastfeeding have pose a challenge to meeting the WHO guidelines of EBF for 6 months.

2.4 Maternal psychosocial health and breastfeeding

Breastfeeding is significantly linked to identity and mental health. The perception of successful breastfeeding can have an empowering effect on women, and this perception is linked to maternal attitudes and confidence. The role of psychological factors on breastfeeding initiation and duration has been studied for many years, and an understanding of this influence would help inform strategies to promote breastfeeding.

2.4.1 Depression

Between 10 to 20% of women will experience some symptoms of depression during pregnancy.[77] Antenatal depression is a risk factor for postpartum depression and research has

revealed that mothers who are depressed experience more difficulty breastfeeding than mothers who are not depressed.[78] Women with symptoms of depression in the perinatal period tend not to initiate breastfeeding. Mothers with depression may have poor parenting practices and hence fail to respond to the needs of the infant, including breastfeeding.[78] Consequently, early weaning may occur due to challenges of breastfeeding and depression may overwhelm some women. This may be different for immigrant women, for example one study found that Chinese women who had antenatal depressive symptoms at 32 weeks of gestation were more likely (OR=1.14; 95% CI: 1.02 to 1.27) to breastfeed for a relatively longer period (>3 weeks),[78] after adjusting for demographic factors. Postpartum depression was not assessed in the study. The authors speculated that some women with depression receive emotional benefits from the experience of breastfeeding and continued breastfeeding may be due to a decrease in the severity of depressive symptoms over time.[78]

2.4.2 Anxiety

Pregnancy specific anxiety can be defined as fears about pregnancy, childbirth, health of the infant, and future parenting[79]. The fear of lactation failure and milk insufficiency are the most common reasons for mothers' failing to initiate breastfeeding or early termination[2]. These reasons may be linked with maternal anxiety as it inhibits the physiological milk-ejection reflex leading to inadequate milk flow. This experience can precipitate maternal frustration and further anxiety.[64] If women continue to breastfeed despite feelings of anxiety, then breastfeeding has found to be associated with lower levels of anxiety and a decrease in negative mood.[80] A meta-analysis on the correlation between anxiety symptoms during pregnancy and perinatal outcomes found no evidence of a relationship between general anxiety symptoms and birth weight and gestational age at birth.[81] However, anxiety symptoms in pregnancy were strongly associated

with postpartum psychosocial variables such as depressive symptoms and social support.[81] Women most at risk of anxiety symptoms during pregnancy were those with a history of psychological difficulties or those experiencing significant stress.[81]

2.4.3 Stress

The cumulative impact of stress over the course of pregnancy may impact the risk of adverse birth outcomes and intention to breastfeed. A study of 2420 women in western Australia, found that women who experience stressful events, such as loss of a relative or job loss during pregnancy, had increased risk of early cessation of breastfeeding (OR=1.34; 95% CI: 1.04 to 1.71) compared to women who did not experience stressful events during pregnancy.[82] Mothers who breastfed scored lower on the Perceived Stress Scale (PSS) compared to mothers who bottle-fed after controlling for infant's age, number of children, mother's work status.[83] This association was also found among ethnic groups, as a study on 424 Hispanic women in Massachusetts found that women with the highest levels of perceived stress in early pregnancy were approximately 24% less likely to report an intention to breastfeed compared to women with lower levels, after adjusting for important predictors.[84] Furthermore, breastfeeding has been associated with a biological response to stress in the form of decreased neuroendocrine release when women are faced with stressors.[85,86]

2.4.4 Social support

Social support that a mother receives for breastfeeding is important for the continuation and promotion of breastfeeding.[7] Support from one's partner or spouse has been noted as a key predictor of initiation and duration of breastfeeding.[7] Women who indicated that their partners preferred breastfeeding were significantly more likely to initiate breastfeeding when compared to women with partners who were ambivalent or preferred bottle-feeding, regardless of maternal

age, education level, and marital status.[87] Receiving additional support from friends and relatives also increased the odds of breastfeeding. One study found that social support increases with maternal age, as mothers who have experience in breastfeeding previous children tend to have greater supportive networks which may partly explain why multiparous mothers have better success at breastfeeding than first-time mothers.[6] Midwives and public health nurses were reported to be the main source of formal social support among Irish women.[88]

Social support as related to breastfeeding varies across ethnic groups.[54] Among Hispanics, having a male partner was strongly associated with the intention to breastfeed, whereas among African Americans, a close girlfriend was pivotal. Mexican women reported that having support from a grandmother was key for breastfeeding success.[89] In Canada and the United States, women who deliver in hospitals that actively promote breastfeeding are more likely to do so.[89] However, mothers who delivered at home were five times more likely to exclusively breastfeed than mothers giving birth at hospitals. This may be linked to the promotion of formula supplementation provided in hospitals[6,51] or reflect the characteristics of women who chose to deliver at home. Overall, social support is one factor that has consistently been shown to have a positive influence on breastfeeding.

2.5 Obstetric factors and breastfeeding

2.5.1 Method of delivery

Breastfeeding has been linked to method of delivery. For example, Leung *et al.* (2002) found that caesarean delivery was a risk factor for not initiating breastfeeding or doing so for less than 1 month.[90] Assisted delivery with forceps or vacuum appeared to be associated with reduced breastfeeding duration.[90] A systematic review and meta-analysis utilizing data from 31 countries

found strong support for the significant adverse association that caesarean delivery had on early breastfeeding.[91] A random effects model determined that the rate of early breastfeeding was significantly lower for women with caesarean deliveries (pooled OR: 0.57; 95% CI: 0.50 to 0.64).[91] However, once initiated, breastfeeding at 6 months does not appear to be affected by method of delivery. Another study found that compared to vaginally delivered infants, those delivered by vacuum extraction or by caesarean section started suckling later, were given formula prescription during the first 4 days of life, and were less likely to be breast-fed during nights of their hospital stay.[92] However, once discharged from hospital, prevalence of breastfeeding remained the same for both groups.

2.5.2 Body mass index

Having lower pre-pregnancy BMI was found to be significantly associated with EBF at 6 months.[6] A study by Baker *et al.* (2007) found that women classified as overweight were at greater risk of early termination of any breastfeeding.[93] Similar conclusion was reached by Li *et al.* (2003) who found that obese women were less likely to initiate breastfeeding than women of normal pre-pregnancy BMI.[94] Gestational weight gain did not play a role in this association. There also appears to be linearity between weight and breastfeeding initiation rates, as Donath & Amir (2008) found that breastfeeding initiation rates for normal-weight, overweight, and obese women were 95.1, 92.8, and 87.1%, respectively.[95]

2.6 Behavioural risk factors and breastfeeding

2.6.1 Smoking

A negative association between maternal smoking and breastfeeding duration has been reported in current literature.[6,7] For example, Horta, Kramer & Platt (2001) conducted a meta-

analysis and found that maternal smoking increased the risk of early weaning of breastfeeding (OR=1.93) before 3 months.[96] There is also some evidence for a biological plausibility and causality between breastfeeding and risk of early weaning[96] as nicotine has a negative effect on breast milk supply and suppresses prolactin levels. Another study adjusted for breastfeeding intention, and found that women who smoked during pregnancy were more likely to not breastfeed compared to non-smokers.[97] Though physiological effect of smoking on milk supply is an important factor, the lack of breastfeeding among smokers is related more strongly to motivation, rather than physiology. Women who smoke seem to have significantly less motivation to breastfeed and are less likely to seek help with breastfeeding difficulties.[98] Amir & Donath (2003) argue that the negative physiological effect of smoking on breastfeeding must be seen universally across all populations for the effect to be validated, which thus far has not been the case.[98] Rather, the social and behavioural differences between smokers and non-smokers may be the determining factor of reduced breastfeeding rates among smokers. Smoking is closely linked to confounding factors, such as maternal age and socioeconomic status.

2.6.2 History of abuse

Sexual abuse is not directly associated with breastfeeding; rather childhood sexual abuse is associated with adult characteristics that may decrease the likelihood of breastfeeding. For example, women who were abused as children are more likely to experience abuse as adults, have lower educational attainment, experience unintended pregnancies, and be at risk of mental health difficulties, which may all influence breastfeeding intention and duration.[99,100] However, some literature supports the contrary. A study by Prentice *et al.* (2002) found that women who reported being sexual abuse were 2.6 times more likely to initiate breastfeeding compared to women who reported no abuse.[99] Heightened parenting concerns among abuse survivors could

explain this association, though it was not supported significantly. A qualitative study found that the decisions about breastfeeding for women who had been sexually abused as children were related to the relationship women had with their breasts.[100] Women experienced a sense of shame when touching their own bodies to breastfeed and having their bodies be touched by infants.[100] Other women reported that having a positive breastfeeding experience facilitated an overall experience of healing from sexual abuse. The effect of sexual abuse on breastfeeding warrants further research for a better understanding.

Chapter Three: Methods

3.1 Research design

The research objective was addressed through an analysis of the All Our Babies observational cohort dataset.

3.2 The All Our Babies study

The All Our Babies (AOB) study is a community-based longitudinal observational cohort study designed to investigate pregnancy experiences and maternal and infant outcomes among women residing in Calgary and its surrounding areas.

3.2.1 Recruitment strategies

Study participants were recruited between May 2008 and June 2009. Multiple strategies were used for AOB study recruitment. Since the objective was to recruit a population based cohort of pregnant women in Calgary, Alberta, study participants were recruited in four different outpatients settings: family physician maternity clinics, obstetrician practices, local health region's laboratory services (Calgary Laboratory Services (CLS)) and directly from the community through word of mouth and posters. This sampling strategy was designed to attain a comprehensive representation of pregnant women in Calgary, as any woman who had a pregnancy related blood test through CLS was eligible to be contacted and invited to participate.

3.2.2 Inclusion and exclusion criteria for the AOB study

Women were eligible to participate if they were less than 24 weeks and 6 days pregnant at the time of enrolment, older than 17 years of age, able to complete the questionnaires in English, and were attending prenatal care services in the (former) Calgary Health Region. All eligible women were invited to participate in the study.

3.2.3 Data collection

Eligible participants were asked to complete questionnaires at three points: before 25 weeks of pregnancy, between 32 and 36 weeks of pregnancy, and at four months postpartum. These questionnaires assessed variables such as maternal well-being, demographics, pregnancy history, exercise practices, mental health, social support, lifestyle factors, and breastfeeding practices and experiences. Some of the validated instruments included in the questionnaires were Edinburgh Postnatal Depression Scale (EPDS)[101], Spielberger State Anxiety Inventory (SAI)[102], MOS Social Support Scale (MOS SSS)[103], and Perceived Stress Scale (PSS)[104]. Other variables and domains of functioning were assessed using questions designed specifically for the AOB study. The questionnaires were developed with input from health care providers, epidemiologists and community program experts. The questionnaires were pilot tested on pregnant women in the community to ensure clarity and cultural sensitivity. Questionnaires were mailed with an information letter, consent form, and postage pre-paid envelope. Once the questionnaires were mailed back to the research team, trained research assistants ensured completeness and clarity of the information provided. If not, attempts were made to contact the participant for missing or clarification of responses. The participants were provided with library and grocery store gift cards as an appreciation for their time to complete the questionnaire.

The raw data from questionnaires were scanned into Teleform (Version 10.1). Data were exported and cleaned according to data cleaning guidelines, including data coding, frequency and logical editing. Each participant was provided a unique identifier, preserving participant confidentiality and participant and questionnaire data were stored separately to ensure participant anonymity and discretion.

3.2.4 Sample size

The AOB observational cohort study recruited 1666 pregnant women. A final sample of 1377 women completed all three questionnaires, which is an 83% retention rate. The most common reasons for discontinuation were miscarriages, loss of interest/lack of time, lost to follow-up, or geographical moves.

3.3 The proposed study

3.3.1 Dependent variables

There were two outcomes of interest (both binary variables) which were derived from two questions from the third questionnaire completed at 4 months postpartum.

3.3.1.1 Any breastfeeding at 4 months

The first outcome variable of breastfeeding status was defined by responses to the following question, “Are you still breastfeeding your baby?” This assessed current feeding practices at 4 months postpartum, as women selected either ‘Yes’ or ‘No’ to respond to this question.

3.3.1.2 Exclusive breastfeeding

The second question, “In the past week, what best describes what your baby was fed?” assessed exclusive (EBF) and non-exclusive breastfeeding (non-EBF). Women selected one of the following responses: ‘only breast milk’, ‘mostly breast milk but with small amounts of formula’, ‘mostly formula but with small amounts of breast milk’, and ‘only formula’. Based on these responses, women were classified into two categories for analysis: EBF and non-EBF. Non-EBF included children receiving only formula or those receiving formula or other supplements in addition to breast milk. EBF included children receiving only breast milk[9999].

3.3.2 Independent variables

Several variables were included in the analysis to determine which factors would be associated with breastfeeding among the cohort. The selection of variables was based on current literature[7,10,13,31,77] and generally classified into the following categories: demographic, obstetric, psychological well-being and behavioural risk factors.

3.3.2.1 Demographic factors

The demographic factors of interest were maternal age, marital status, maternal education, ethnicity, Canada-born status, income, parity, employment status during pregnancy and home ownership. Data were derived from the first questionnaire at 24 weeks of pregnancy.

3.3.2.2 Obstetric factors

Obstetric variables included feelings about current pregnancy, method of delivery, difficulty obtaining prenatal care, pre-pregnancy BMI and preterm delivery.

3.3.2.3 Psychological well-being factors

3.3.2.3.1 Depressive symptoms

The presence of depressive symptoms during pregnancy was evaluated using the Edinburgh Postnatal Depression Scale (EPDS) from the two questionnaires during pregnancy. The EPDS is a ten item self-report questionnaire used to measure postpartum depression.[105] In the current study, the EPDS was use to measure antenatal depression as the scale has been validated in the antenatal period.[101] The EPDS is among the most widely used screening tool for depression in the antenatal period and has been translated to over 50 languages.[106] In literature, a optimum cut-off score for major depression in postpartum English-speaking women has been consistently found to be 13 or greater,[107] and women who scored greater than or equal to 13 were identified as having symptoms for major depression.[108]

The EPDS has also been shown to have good reliability and validity. In a community sample of 60 postpartum women with major or minor depression, the internal consistency of EPDS was 0.87.[105] For women with major depression alone, the sensitivity for EPDS was relatively high, that is a positive screen correctly identified major depression in women. The positive predictive value for identifying women who met the Research Diagnosis Criteria was 73%.[105]

For the purposes of this study, a score of 13 or more at either time points during pregnancy classified participants as having depressive symptoms, and a categorical variable was created based on this cut-off. Participants who scored greater than or equal to 13 at one or both prenatal time points were classified as 'Yes' for depressive symptoms, while participants who scored lower than 12 at both time points were classified as 'No'.

3.3.2.3.2 Anxiety

Anxiety during pregnancy was assessed through items on the Spielberger State Anxiety inventory (SAI) from the two questionnaires administered during pregnancy. This inventory is made up of 20 items rated on a 4-point intensity scale. A total anxiety score is calculated by summing all items and may range from 20 to 80. Higher scores indicate greater anxiety.[102,109]

A synthesis of studies evaluating the relationship between self-reported anxiety symptoms during pregnancy and perinatal outcomes found the scale to be the most frequently used measure of state and trait anxiety[81]. This scale has overall good reliability and validity. Internal consistency and reliability of the scale was originally examined among a sample of high school and college students.[102] Cronbach's alpha values for the SAI were found to be 0.92 for females. The SAI has a positive correlation in scores with other tools that measure anxiety, including Anxiety Scale Questionnaire (ASQ) and Manifest Anxiety Scales (MAS).[109] Among a

sample of pregnant women who were asked open-ended questions about how they felt about their pregnancy, women who made positive comments had lower scores on this scale than women who made anxious comments.[110] This indicates that this scale has some capacity to reflect present pregnancy-related anxieties of women,[110] however exact cut-offs to use for pregnant women have not been verified.

According to the scale manual, a score of 40 or greater is considered 'high anxiety',[102] and this cut-off was used in the present study to classify individuals into low and high anxiety groups. Since there were two questionnaires during pregnancy, a categorical variable for risk of prenatal anxiety with ‘Yes’ or ‘No’ categories was created. Participants who scored 40 or greater on the state anxiety scale at one or both time points were classified as ‘Yes’ for prenatal anxiety, while those who scored lower than 40 at both time points were classified as ‘No’ for prenatal anxiety.

3.3.2.3.3 Stress

Stress during pregnancy was assessed using items pertaining to the Perceived Stress Scale (PSS) from the two questionnaires during pregnancy. The PSS is composed of 10 items scored on a 5-point Likert scale and assesses the degree to which individuals perceive situations in their lives to be stressful.[104] Four items worded in a positive direction were reverse-scored. Scores of the 10 items were summed to create a perceived stress score ranging from 0 to 40, with higher scores indicating greater perceived stress.

The PSS demonstrates good reliability and validity. Among approximately 2300 individuals who were interviewed via telephone by Louis Harris (Harris Poll sample), internal consistency (Cronbach’s alpha) for the PSS-10 was 0.78.[111] Among two samples of college students and a smoking cessation group, the internal consistency of the PSS estimated by

Cronbach's alphas were found to be 0.84, 0.85 and 0.86 respectively.[104] The test-retest correlation in the college samples were 0.85 but lower in the smoking cessation group (0.55).[104] The PSS correlated in a predicted way with other measures of stress, including the Job Responsibilities scale and Life Events scale.[104]

The PSS is not a diagnostic instrument, thus there is no cut-off.[104,111] For the purposes of this study, to establish a cut-off, we calculated frequency distribution of PSS scores and percentile ranks to get detailed normative data for the cohort. Based on the distribution of scores, the score corresponding to the 75th percentile was used as the cut-off. The cut-off score was established to be 19 and 17 in the first and second questionnaire, respectively. In other words, a woman who scores above the cut-offs has greater stress levels than 75% of the women in the study sample. Percentile-based scoring is useful when interpreting differences across scales during the prenatal period and allows for a more accurate depiction of perceived stress among the participants in the study. A categorical variable for perceived stress was created with categories based on these cut-offs. Since there were two questionnaires during pregnancy, participants who scored greater than the respective cut-offs mentioned above on one or both time points were classified as high and those who scored lower than the cut-offs on both time points were classified as low.

3.3.2.3.4 Social support

Social support during pregnancy was assessed using the Medical Outcomes Study Social Support Scale (MOS SSS) from data obtained from the first two questionnaires. The MOS SSS is a 19-item, self-report questionnaire scored on a 5-point Likert scale, measuring functional social support and subscales that measure emotional/informational, affectionate, tangible, and positive social interaction.[103] The instrument is widely used and considered to have high reliability and

validity. The reliability of the MOS SSS was examined among a sample of 2987 patients with chronic conditions.[103] The internal consistency of the overall support scale and all subscales was found to be high, as Cronbach's alpha ranged from 0.91-0.97, while 1-year test retest correlations ranged from 0.72-0.78.[103]

Items on the MOS SSS were summed to create a total score with a theoretical range between 0 and 100. Higher scores were indicative of greater social support. A cut-off of 69 or greater to define adequate social support that was previously used in literaure[112] was used for this study. Women who scored below 69 were classified as having inadequate social support. Since there are two questionnaires during pregnancy, participants who scored 69 or greater on one or both time points were classified as having adequate social support, while those who scored lower than 69 on both time points were classified as having inadequate social support.

3.3.2.3.5 Optimism

Optimism during pregnancy was assessed with the Life Orientation Test-Revised (LOTR)[113] from the second questionnaire at 34-36 weeks of pregnancy. The LOTR is a 10-item scale with possible scores ranging from 0 to 24, with higher scores indicative of higher optimism. Among a representative population-based sample of 2372 German subjects across all age groups, the dimensionality of the LOTR was measured.[114] The authors confirmed the bi-dimensionality of LOTR, that is, optimism and pessimism are independent constructs with a low correlation (r=-.20).[114] This negative correlation was more evident among young, well-educated subjects.[114] For the purposes of this study, to establish a cut-off, frequency distribution of LOTR scores and percentile ranks were calculated to get detailed normative data. Based on the distribution of scores, the score corresponding to the 25th percentile was used as the cut-off. The

cut-off score was established to be 15. That is, women who scored below 15 on this scale were classified as low on optimism.

3.3.2.3.6 Parenting morale

Parenting Morale Index (PMI) is a 10-item questionnaire designed to measure parent morale or positive spirits to explore a parent's psychological energy and parenting enthusiasm.[115] PMI was derived from the third questionnaire at 4 months postpartum. Higher scores are indicative of higher parenting morale. This measure was originally developed for families of children with disabilities.[115] A study on 195 Canadian mothers of children with disabilities who completed the PMI among other measures found strong internal consistency and temporal stability of PMI.[116] PMI appeared to be an indicator of mothers' parenting morale or psychological coping resources.[116] The PMI score corresponding to the 25th percentile was used to establish a cut-off score to distinguish between low and high parenting morale in this study. The cut-off score was established to be 35; therefore women who scored below 35 were classified as having low parenting morale.

3.3.2.3.7 Self-rated prenatal physical and emotional health

Perceived health is a subjective measure of overall health status. Studies have demonstrated this indicator to be a reliable and valid measure, associated with functional decline, morbidity and mortality.[117] Perceived health is also more effective than clinical measures for predicting help-seeking behaviours and health service use.[117] Prenatal physical health was derived using one item ("In general, how would you rate your physical health?") from the SF-12, a multipurpose short form survey with 12 questions, all selected from the SF-36 Health Survey.[118] Prenatal emotional health was derived from question, "In general, how would you rate your emotional health?" Participants selected one of the following to answer each question

on physical and emotional health: “excellent”, “very good”, “good”, “fair”, and “poor”. The positive responses (excellent, very good, and good) were grouped into a “good” category, while the negative responses (fair and poor) were grouped into a “poor” category. Participants who replied negatively at one or both prenatal time points were classified as having “poor” physical/emotional health. Participants who replied positively at both time points were classified as having “good” physical/emotional health. The use of single-item questions to evaluate physical and emotional health during the prenatal period allows for simplicity and reliability. Single item measures are less sensitive to changes in patients’ conditions over time than well constructed multi-item scales.[119]

3.3.2.3.8 Perceived satisfaction of support received from family, friends and health care providers during the prenatal period

Perceived satisfaction with support received was derived from question, “How satisfied are you with the social and/or emotional support you receive from your [family]?” This question was asked separately for family, friends, and health care providers. Participants selected one of the following to answer the questions: “very satisfied”, “satisfied”, “unsatisfied”, and “very unsatisfied”. The positive responses were grouped into a “satisfied” category, while the negative responses were grouped into an “unsatisfied” category. Participants who replied unsatisfied at one or both prenatal time points were classified as ‘unsatisfied’ with support received, while participants who replied satisfied at both time points were classified as ‘satisfied” with support received.

The use of a single question to assess satisfaction of support received has been corroborated by previous studies. A study examined the relationship between satisfaction of family-centred behaviours of health care providers and health status from the perspective of the

adolescent patient's caregivers and found that a single question for satisfaction is as good of an indicator as a scale.[120] Similarly, another study that was conducted on 5000 elderly persons in Texas found that a simple survey tool based on single-item questions could be useful for monitoring patient satisfaction and self-rated health.[121]

3.3.2.4 Behavioural risk factors

Financial, sexual, physical or emotional abuses were collected as individual variables in the cohort and captured abuse that occurred in both childhood and adulthood. However, given the overlap of different types of abuses, a composite history of abuse variable was derived such that women with any one or more of these experiences were considered to have a history of abuse. In addition, smoking 12 months prior to and during pregnancy were also assessed. All the different variables assessed as potential predictors are listed in Figure 1.

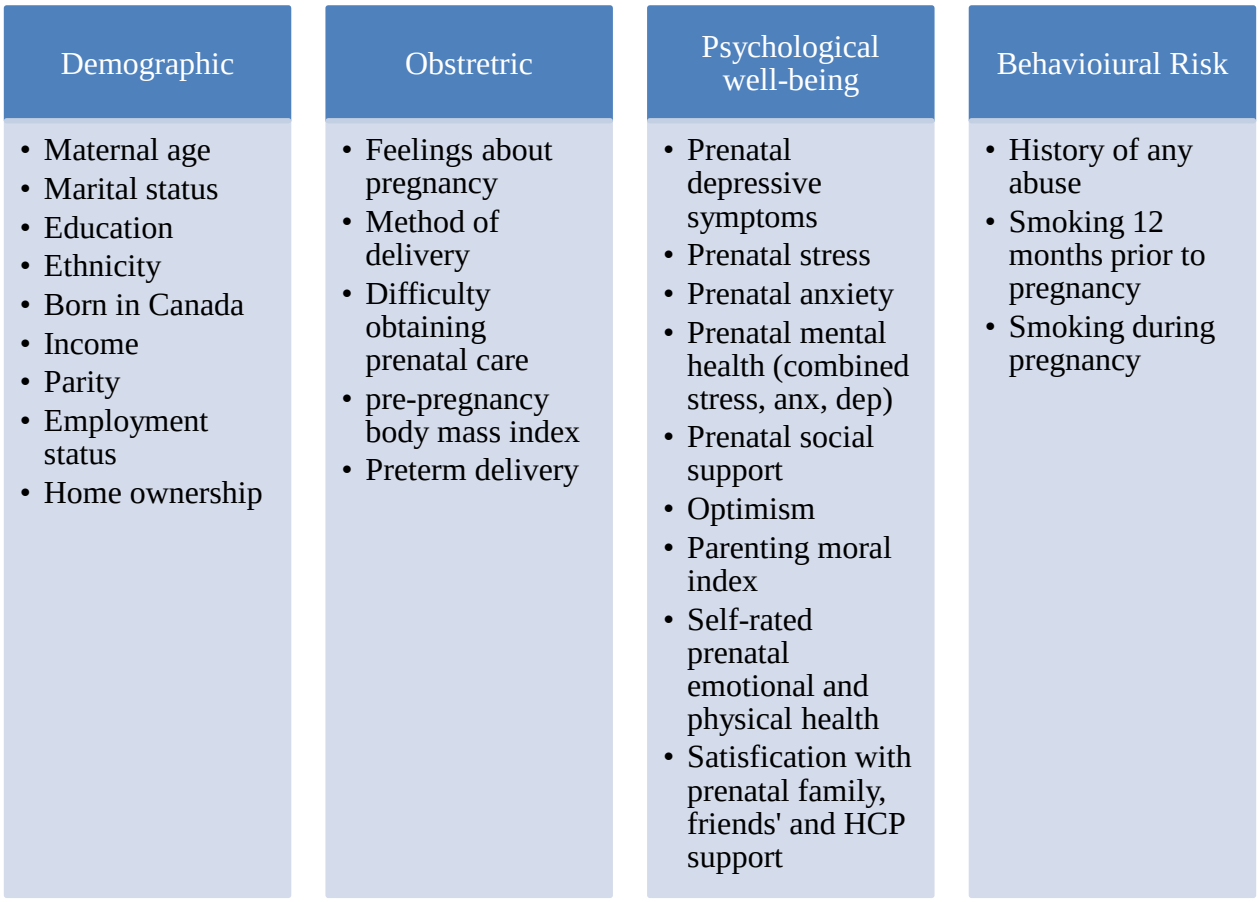


Figure 1 Possible predictors of breastfeeding outcomes

3.4 Ethical considerations

The AOB study was approved by the Child Health Research Office and the Conjoint Health Research Ethics Board of the Faculties of Medicine, Nursing, and Kinesiology, University of Calgary. Participants provided consent at the time of recruitment. The present study received ethics approval from the Conjoint Health Research Ethics Board, Faculty of Medicine, University of Calgary (Appendix A).

3.5 Data analysis

All statistical analyses were performed with Stata software, version 11.0.

3.5.1 Categorization of variables

Variables were recoded for the purpose of statistical analyses. Continuous variables, including maternal age and psychological well-being variables were categorized to make their values interpretable and to calculate odds ratios. In addition, categorical variables were collapsed into two to three categories to increase strata cell size and allow for meaningful comparisons between strata. Table I lists all the variables that were used in the analysis, including the breakdown of categories, reference groups and the questionnaire item for each variable. In general, variables were categorized as specified for intuitive interpretation and to attain policy relevant categories.

Table I: Variable categories

Variable	Reference group	Risk group	Item
Demographic			
Maternal age	19-24	25-34 35+	What is your birth date? Please enter today's date These two variables were used to calculate the mother's age in years.
Marital status	Other	Married/Common law	How would you describe your current marital status?
Education	High school or less	-Some or complete university/college -Some or complete grad school	What is the highest level of education you have completed?
Ethnicity	Non-Caucasian/Other	Caucasian/White	How would you describe your ethnic background?
Canadian born	No	Yes	Were you born in Canada?
Income	< $40,000	-$40-$80,000 ->$80,000	What is the total income, before taxes and deductions, of all household members from all sources in the past 12 months?
Parity	No previous births	Previous birth	Have you ever been pregnant before? Have you ever experienced live births? These two variables were used to determine if the mother had previously given birth.
Employment status	Not working	Working	Which describes your main activity? Working, homemaker, looking for a job, on mat leave, student, on medical leave or other
Home ownership	Other	Own	Do you rent or own the housing you are currently living in?
Obstetric			
Feelings about pregnancy	Unhappy/not sure	Happy	How did you feel when you found out you were pregnant?
Method of delivery	Vaginal	Caesarean	How was your new baby (babies) delivered?
Difficulty obtaining prenatal care	No	Yes	Has it been difficult for you to obtain prenatal care?
Pre-pregnancy BMI	≤ 24.9	≥ 25	Derived from height and weight
Preterm Delivery	No (≥37weeks)	Yes (≤36 weeks)	How many weeks pregnant were you when your baby/babies was/were born?
Psychological well-being			
Depression	No	Yes	EPDS
Anxiety	No	Yes	SAI
Stressed	No	Yes	PSS
Prenatal mental health	Good	Poor	Derived from EPDS, SAI, and PSS
Optimism	High	Low	LOTR
Parenting morale index	High	Low	PMI

Variable	Reference group	Risk group	Item
Prenatal emotional health	Good	Not good	In general, how would you rate your emotional health?
Prenatal physical health	Good	Not good	In general, how would you rate your physical health?
Satisfaction with family support	Unsatisfied	Satisfied	How satisfied are you with the social and/or emotional support you receive from your family?
Satisfaction with friends' support	Unsatisfied	Satisfied	How satisfied are you with the social and/or emotional support you receive from your friends?
Satisfaction with HCP support	Unsatisfied	Satisfied	How satisfied are you with the social and/or emotional support you receive from your health care providers?
Behavioural Risk			
History of any abuse	No	Yes	Derived (from financial, sexual, physical or emotional abuse)
Smoking 12 months prior to pregnancy	No	Yes	In the 12 months before you got pregnant, did you smoke cigarettes?
Smoking during pregnancy	No	Yes	Since becoming pregnant (including before you knew you were pregnant), have you smoked cigarettes?

3.5.2 Principal component analysis

Depression, anxiety and stress are variables that measure the common construct of psychological well-being. Principal component analysis was employed to determine if there was justification for reducing these individual variables to one factor that underlie psychological well-being. Principal component analysis is a technique used for data reduction purposes based on the assumption that factors are truly measuring an underlying latent structure.[122] It is used to detect relationships among variables that are continuous and assumed to be normally distributed.

3.5.3 Descriptive statistics

To describe the characteristics of the AOB sample, the frequency and percent of categorical variables were computed, while the distributions, mean and standard deviation of numerical variables were computed.

3.5.4 Bivariate analysis

There were two outcomes of interest: any breastfeeding and exclusive breastfeeding at 4 months postpartum. A bivariate analysis using Pearson's chi-square test was used to determine the distribution of any breastfeeding and exclusive breastfeeding, and whether they differed for each level of demographic, obstetric, psychological well-being and behavioural risk factors for the following populations:

a) Women in the entire AOB cohort (excluding women in (b) and (c))
b) Women within the AOB cohort who are new to Canada (≤5 years)
c) Women within the AOB cohort who are new to Calgary (≤5 years)

If the expected cell counts were five or less, p-values were calculated by the Fisher's exact test. Unadjusted odds ratio (OR) estimates and 95% confidence intervals (CI) were also calculated.

3.5.5 ***Multivariable analysis***

Multivariable logistic regression was completed to identify predictors of any breastfeeding and EBF. Logistic regression methods are used when the outcome is discrete, taking on two or more possible values. The two outcomes of this study were binary. There are two assumptions in fitting a logistic model: independence and linearity. Firstly, it is assumed that observations are independent from each other,[122] that is, each observation in the study refers to different participants. For example, there were 1654 observations for 1654 participants in this study. Secondly, continuous predictors are assumed to have a linear relationship with the outcome; this assumption does not apply here as there were no continuous predictors.

In addition, the presence of multicollinearity was assessed. Multicollinearity occurs when two or more predictor variables are correlated to the extent they convey the same information about the observed variation in the outcome variable.[123] To assess multicollinearity, the

coefficient and standard errors of two collinear variables were compared. If the addition of the second variable increased the standard error and no longer achieves statistical significance of the model, this indicates the presence of sampling variability in the estimated coefficients. This is an indication that the added variable does not explain any additional variability in the outcome. In such cases, a decision was made to remove any collinear variables based on clinical relevance. The decision about what variables to assess for collinear relationships was based on literature review and expert input. The following was identified *a priori* as potentially collinear: income and education. In the case of the psychological well-being variables described above, depression, anxiety and stress are correlated and prinicipal component analysis was performed to create one underlying factor. Multicollinearity would not have been appropriate for these variables as omitting one variable over another implies greater significance of the remaining variable to the model.

3.5.5.1 Model building strategies

One purpose of statistical model building involves seeking the most parsimonious model to explain the data and to ensure that the model is numerically stable and more easily generalizable.[124] The model was developed with reference to principals of theoretical model development.[124,125] Model building strategies described were utilized to select those variables that result in the best model using sound statistical methods within the scientific context of the research question. The variables that were determined to be statistically significant ($P \leq 0.10$) from the bivariate analysis were eligible for entry into the regression analyses. The use of 0.10 significance level may have included variables that are of questionable importance, however, this concern was resolved by reviewing each of the variables added to the model critically. Critical evaluation included consideration of the following: evidence from literature of potential

relationships, expert input, biologic plausibility, magnitude of the odds ratio at the bivariate level and relevance to the hypothesis. Using a higher threshold for significance at the bivariate level is important, as one problem with any bivariate approach is that it ignores the possibility that a variable by itself that is weakly associated with the outcome can become an important predictor of the outcome in the presence of other variables when taken together.[124]

There were 26 independent predictors evaluated at the bivariate level: maternal age, marital status, maternal education, ethnicity, born in Canada, income, parity, employment status, home ownership, feelings about pregnancy, method of delivery, difficulty obtaining prenatal care, pre-pregnancy BMI, preterm delivery, mental health, social support, optimism, parenting morale, self-rated emotional and physical health, satisfaction with support from family, friends and health care providers, history of abuse, and smoking prior to and during pregnancy. Given the number of variables and the preference for a parsimonious model the following conceptual strategy was employed. Blocks of variables were manually entered in a hierarchal fashion: demographic variables were entered first, followed by obstetric variables, psychological well-being variables, and finally, behavioural risk variables. Variables that were non-significant in this model were dropped and a final model was developed that included only variables that remained significant ($p \leq 0.05$), and a likelihood ratio test was performed to compare the simpler and complex model. The estimated coefficients of the remaining variables were compared to those from the simpler model, to ensure that the coefficients did not drastically change in magnitude. This strategy was used because if all predicting variables were included together in one model, this would increase the estimated standard errors and consequently increase the dependence of the model on the observed data.[124] The robustness of the model was examined by adding all the non-significant variables into the final model, and examining the Wald statistic

and significance of the added variables. The Wald test is the ratio of the coefficient to its standard error.[122] This was helpful in identifying variables that, by themselves, were not significantly related to the outcome, but would make an important contribution in the presence of other variables.[124] Any added variables that were significant were kept in the model. Interaction was assessed by adding the cross-product term (X_1*X_2) of two predictors, and evaluating if the coefficient for the term was statistically significant.[122] Since there were many potential predictors, there could be many interaction terms, however only interactions which have been reported in the literature were examined. Interaction terms that were assessed were decided *a priori* to model building and included: preterm delivery*delivery mode, parity*delivery mode, preterm delivery*smoking during pregnancy and pre-pregnancy BMI*self-rated prenatal physical health. Interaction terms remained in the model if they were significant. Adjusted odds ratios and exact 95% confidence intervals were reported for the final model.

Multivariable logistic regression was undertaken to determine the predictors associated with breastfeeding outcomes among women who had resided in Canada/Calgary for >5 years. Regression models were not developed for the subpopulation of women new to Canada and Calgary because of zero cell counts in the strata of some variables. Including variables with zero cell counts in any logistic regression model causes undesirable numerical outcomes to occur.[124] While there are strategies that can be used to handle zero cell count, none were appropriate. These strategies may include collapsing the categories of the independent variable in some sensible manner to eliminate the zero cell, eliminating the category completing, or if the variable was ordinal, modelling the variable as if it were continuous.[124]

3.5.6 Predicted probabilities

Predicted probabilities of any breastfeeding and EBF at 4 months were calculated for groups of women based on income, ethnicity and marital status. These three factors were assessed because they are non-modifiable demographic factors (by a public health intervention) and allow for a population-level understanding of women who are likely to breastfeed at 4 months postpartum.

3.5.7 Sample size calculation

Sample size in logistic regression analysis is important because it is related to the power a study has to detect the effect of interest, and whether the sample can adequately support the fitting of a logistic model.[122] A rule of thumb used for multivariable logistic regression is that there should be a minimum of 10 events per predictor/independent variable.[126,127] Therefore, for this study, a conservative approach will be taken and an upper limit of 20 events per variable will be utilized. Since this study involves secondary data analysis, sample size calculation was completed after the final model was fitted for each outcome.

Chapter Four: Results

4.1 Characteristics of mothers

A total of 1654 women were recruited into the AOB study, and inevitably, the number of responses varied for some variables. The characteristics of participants have been categorized into three groups: demographic, psychological well-being, and behavioural risk variables, and presented in Table II.

4.1.1 Demographics

Majority of participants in the study were older than 24 years of age: 72.4% were 25 to 34 years old and 20.9% were older than 35 years. Most were married or in a common-law relationship (93.3%), had some or completed university/college (71.9%), were Canadian born (76.1%), had an annual family household income of greater than $80,000 (67.8%), worked during their pregnancy (57.5%), were home owners (75.7%), had a pre-pregnancy BMI less than 24.9 (69.7%) and were expecting their first child (52.2%).

4.1.2 Psychological well-being

Based on the scales, 12.4%, 30%, and 30% were found to have depressive symptomology, high anxiety and high stress, respectively, at least once during the prenatal period. Other variables that were assessed as possible predictors included social support, optimism, parenting morale, self-rated physical and emotional health and perceived satisfaction of support received. Based on MOS SSS, 20.3% of women were found to have inadequate social support at least once during the prenatal period, while 20.0% of women reported low optimism, based on scores from LOTR. Almost 20% were found to have low parenting morale based on their scores from PMI. While 12.8% perceived their emotional health as poor, 15.3% perceived their physical health as poor. Only a small proportion of participants reported being unsatisfied

with the support they received during the prenatal period: 1.9%, 3.4%, and 2.6% were unsatisfied with support received from family, friends, and health care providers, respectively.

4.1.3 Behavioural risk

One-third (29.7%) of participants reported having a history of abuse (accounting for abuse that occurred during both childhood and adulthood), either in the form of emotional, financial, physical or sexual abuse. While 20.8% of women reported smoking 12 months prior to pregnancy, only 11.7% reported smoking during pregnancy.

4.2 Characteristics of birth and infants

4.2.1 Obstetric

There were a total of 1330 singletons and 24 twin pregnancies, with 51% male and 49% female infants. Most babies were delivered via vaginal delivery (77%) and mothers reported being happy with the current pregnancy (87%). Gestational age and birth weight were reported separately for singletons and twins. Gestational age ranged from 27 to 43 weeks, with a mean of 39.1 weeks for singletons, and ranged from 31 to 38 weeks, with a mean of 35.7 weeks for twins. About 7.9% of the births were preterm (born before 37 weeks of gestation). Birth weight ranged from 860 to 5613g, with a mean of 3358.3g for singletons, and ranged from 930 to 3544g, with a mean of 2371g for twins (Table III).

4.3 Characteristics of breastfeeding

Almost all women (97.9%) reported initiating breastfeeding even if only for a short period of time and for most women (95.2%), their first attempt at breastfeeding was within 24 hours of giving birth (Table IV). During the first week of the baby's life, 59.5% of women

reported only feeding breast milk, 28.2% fed mostly breast milk but with small amounts of formula, 11.9% fed mostly formula but with small amounts of breast milk, and less than 1% fed only formula. In comparison at 4 months postpartum 59.5% report feeding only breast milk, 17.2% fed mostly breast milk but with small amounts of formula, 5.7% fed mostly formula but with small amounts of breast milk, and 17.6% fed only formula. The prevalence of women who fed only breast milk during the first week and four months were identical. While many women who fed only breast milk during the first week continued with feeding only breast milk at 4 months, there are some women who exclusively breastfed at 4 months but did not during the first week or vice versa and some women who fed exclusively during the first week but combine breast milk and formula at 4 months. Overall, 79.5% of the women in the sample reported that they were still (any) breastfeeding at 4 months postpartum. The most common reason reported for discontinuing breastfeeding was not producing enough milk (40.0%). In terms of breastfeeding support, 43.0% reported seeing a lactation consultant before leaving the hospital. More than half the participants reported seeking additional breastfeeding support since leaving the hospital, largely from a public health nurse or breastfeeding clinic.

Table II: Characteristics of the mother

Variable	Frequency	Percent (%)
Demographics		
Maternal age		
19-24	88	6.7
25 – 34	950	72. 4
35+	274	20.9
Marital status		
Married/common law	1379	93.3
Other	99	6.7
Education		
High school or less	166	11.3
Some or completed university/college	1066	71.9
Some or completed graduate school	249	16.8
Born in Canada		
Canadian-born	1127	76.1
Foreign-born	355	23.9
Income		
< $40,000	143	9.9
$40,000 to $80,000	318	22.3
>$80,000	971	67.8
Parity		
No previous births	770	52.2
Previous birth	704	47.8
Employment status during pregnancy		
Not working	595	42.5
Working	804	57.5
Home ownership		
Own	358	24.3
Other	1118	75.7
Pre-pregnancy BMI		
≤ 24.9	1011	69.7
≥ 25.0	439	30.3
Psychological well-being		
Depression		
No	1306	87.6
Yes	184	12.4
Anxiety		
No	1039	70.3
Yes	440	29.7
Stress		
No	1045	70.5
Yes	438	29.5

Variable	Frequency	Percent (%)
Prenatal social support		
Adequate	1186	79.7
Inadequate	302	20.3
Optimism		
High optimism	939	80.0
Low optimism	235	20.0
Parenting morale index		
High parenting morale	1074	80.2
Low parenting morale	265	19.8
Prenatal self-rated emotional health		
Good	1309	87.2
Not good	183	12.8
Prenatal self-rated physical health		
Good	1264	84.7
Not good	228	15.3
Satisfaction of support received from family		
Unsatisfied	22	1.9
Satisfied	1145	98.1
Satisfaction of support received from friends		
Unsatisfied	39	3.4
Satisfied	1126	96.6
Satisfaction of support received from health care providers		
Unsatisfied	30	2.6
Satisfied	1134	97.4
Behavioural risk		
History of abuse		
No	972	70.3
Yes	410	29.7
Smoking 12 months prior to pregnancy		
No	1174	79.2
Yes	308	20.8
Smoking during pregnancy		
No	1236	88.3
Yes	164	11.7

Table III: Characteristics of birth and infant

Variable	Frequency	Percent
Obstetric		
Method of delivery		
Vaginal	1047	77.4
Caesarean	305	22.6
Feelings about current pregnancy		
Unhappy/Not sure	197	13.4
Happy	1275	86.6
Preterm birth		
No	1236	92.1
Yes	106	7.9
Number of babies at delivery		
Singletons	1330	98.2
Twins	24	1.8
Baby gender		
Boy	690	51.1
Girl	660	48.9

Variable	Frequency	Percent	Range	Mean	SD
Gestational age (wks)					
Singletons	1318	98.2	27-43	39.15	1.82
Twins	24	1.8	31-38	35.71	1.78
Birth weight (g)					
Singletons	1287	96.4	860-5613	3358.32	499.04
Twins	48 (24 pairs)	3.6	930-3544	2371	541.17

Table IV: Characteristics of breastfeeding

Variable	Frequency	Percent
Initiate breastfeeding		
Yes	1324	97.9
No	29	2.1
First attempt at breastfeeding within 24 hours of giving birth		
Yes	1260	95.2
No	63	4.8
Breastfeeding status at 4 months		
Breastfeeding	1053	79.5
Not breastfeeding	271	20.5

Variable	Frequency	Percent
Infant feeding at first week of life		
Only breast milk	785	59.5
Mostly breast milk but with small amounts of formula	372	28.2
Mostly formula but with small amounts of breast milk	157	11.9
Only formula	6	0.4
Infant feeding at 4 months		
Only breast milk	786	59.5
Mostly breast milk but with small amounts of formula	228	17.2
Mostly formula but with small amounts of breast milk	75	5.7
Only formula	233	17.6

4.4 Characteristics of discontinued participants

The demographic characteristics between women who dropped out of the study after the first questionnaire, excluding pregnancy losses, and those who continued to the second and/or third questionnaire were compared. Women who stopped participation were more likely to be younger, non-Caucasian and foreign born, have lower education and household incomes, were not married/or in a common-law relationship and reported poorer psychosocial health in early pregnancy.[128] The two groups did not differ in gravidity, or feelings about current pregnancy.[128]

The following sections report the analyses completed to evaluate the predictors of two outcomes: 1) any breastfeeding at 4 months and 2) exclusive breastfeeding at 4 months. The results of the bivariate and multivariable logistic regression analyses for women residing in Canada/Calgary for >5 years are reported. Bivariate analyses for the subcohort of new Calgarians and new Canadians are also provided. New Calgarians were defined as participants who reported having been in Calgary for 5 years or less, while new Canadians were defined as participants who reported having been in Canada for 5 years or less.

4.5 Principal component analysis

Principal components analysis was used to identify and compute a composite psychological well-being variable for depression, anxiety and stress. Each variable was included in the analysis as continuous variables. The loadings for depression, anxiety and stress at questionnaire 1 were 0.92, 0.89 and 0.91, respectively. The high loadings signify the importance of each factor in defining the composite factor. A principal-components factor analysis of the 3 items, using varimax and orthogonal rotations was conducted, with depression explaining 82.3% of the variance. Similarly, the loadings for depression, anxiety and stress at questionnaire 2 were 0.90, 0.89 and 0.90, respectively, and depression explained 81.1% of the variance. The results indicate that depression, anxiety and stress could be combined into one composite variable.

4.6 Any breastfeeding at 4 months postpartum among women residing in Canada/ Calgary for >5 years

4.6.1 Objective

The objective was to quantify the prevalence and the odds of any breastfeeding at 4 months postpartum associated with various predictors among women residing in Canada/Calgary for 5+ years.

4.6.2 Prevalence

The prevalence of any breastfeeding at 4 months postpartum among women residing in Canada/Calgary for >5 years was 78.7%.

4.6.3 Bivariate analysis

A bivariate analysis between each independent variable and dependent variable was performed to generate crude unadjusted odds ratio (OR) estimates and 95% confidence intervals. The proportion and percents of any breastfeeding at 4 months by each level of demographic,

obstetric, psychological well-being and behavioural risk variables are presented in Table V. All predictor variables were identified *a priori*. P-values from Pearson's chi-square test or Fisher's Exact test (when appropriate) are also displayed.

4.6.3.1 Demographics

Women older at delivery, in a married/common-law relationship, with higher education, higher household income, working during pregnancy, of non-Caucasian ethnicity and home owners were significantly more likely to be breastfeeding at 4 months postpartum. In comparison to younger mothers (19 to 24 years of age), women older than 35 years of age at delivery were 4.68 (95% CI: 2.45-8.12) times more likely to breastfeed, whereas those 25 to 34 years old were 4.42 (95% CI: 2.54-7.68) times more likely to breastfeed. Married women or those in a common law relationship were 3.91 (95% CI: 2.15-7.10) times more likely to breastfeed at 4 months than non-married women. The odds of any breastfeeding for women with some or complete university/college and those with some or complete graduate school were 2.63 (95% CI: 1.68-4.16) and 4.8 (95% CI: 2.43-9.46) times, respectively, more likely than the odds of any breastfeeding for women with lower education level (high school or less). The likelihood of any breastfeeding at 4 months among women with annual household incomes between $40-$80,000 and women with incomes of $80,000 or more were 1.99 (95% CI: 1.04-3.81) and 3.7 (95% CI: 2.04-6.71) times, respectively, of that for women of lower income (<$40,000) households. Women who were employed during pregnancy were 1.45 (95% CI: 1.04-2.02) times more likely to breastfeed, while home owners were 2.06 (95% CI: 1.39-3.05) times more likely. Finally, compared to non-Caucasians, Caucasian women were 0.61 (95% CI: 0.39-0.95) times less likely to breastfeed.

4.6.3.2 Obstetric

Women who delivered via caesarean section, had a preterm delivery and had a pre-pregnancy BMI of over 25.0 were less likely to breastfeed. The odds of any breastfeeding among women who delivered via caesarean were 0.68 (95% CI: 0.47-0.99) times the odds of any breastfeeding among women with vaginal deliveries. Women with preterm deliveries were 0.35 (95% CI: 0.21-0.58) times less likely to breastfeed compared to women who delivered on term. In addition, women who had a pre-pregnancy BMI of over 25 were 0.65 (95% CI: 0.46-0.91) less likely to breastfeed compared to women with BMI lower than 24.9.

4.6.3.3 Psychological well-being

Women found to be depressed, anxious and stressed on respective scales were less likely to breastfeed. The composite variable found that women with poor psychological well-being during the prenatal period were 0.58 (95% CI: 0.42-0.81) times less likely to breastfeed at 4 months postpartum than women with good prenatal psychological well-being.

Women with low optimism, poor prenatal emotional and physical health were less likely to breastfeeding. The likelihood of any breastfeeding for women with low optimism was 0.35 (95% CI: 0.23-0.52) times that for mothers with high optimism, while women with poor prenatal emotional health were 0.61 (95% CI: 0.38-0.97) times less likely to breastfeed compared to women with good prenatal emotional health. Women with poor prenatal physical health were 0.54 (95% CI: 0.36-0.82) times less likely to breastfeed in comparison to women with good prenatal physical health.

4.6.3.4 Behavioural risk

Women who smoked 12 months prior to and during pregnancy were less likely to breastfeed. In comparison to non-smokers, women who smoked 12 months prior to and during

pregnancy were 0.49 (95% CI: 0.34-0.71) and 0.36 (95% CI: 0.23-0.55) times less likely to breastfeed, respectively.

Figure 2 illustrates the log odds ratio for each of the predictors from the bivariate analysis. Bars in orange indicate the predictors that were later found to be significant in the multivariable model. The natural log of odds ratio allows for a symmetry of odds ratio above and below zero and decreases standard error. Values greater than 0 on log odds ratio indicate higher odds, while values below 0 indicated lower odds compared to the reference group.

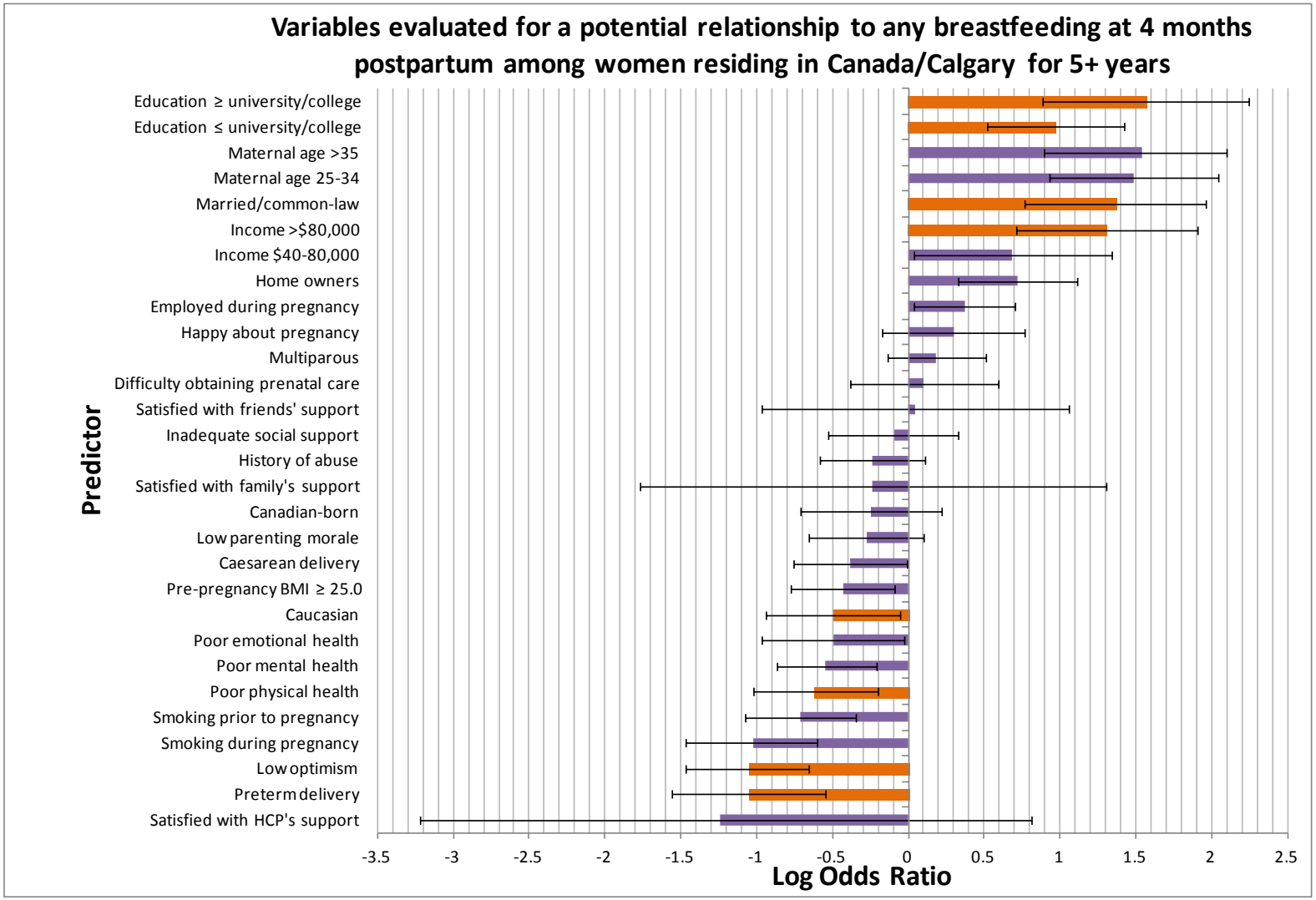
Table V: Bivariate analysis of variables evaluated for a potential relationship to any breastfeeding at 4 months postpartum among women residing in Canada/Calgary for >5 years

Variable	Not BF (n=190)	BF (n=703)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Demographics				
Maternal age at delivery (years)				
19-24	30 (16.2)	28 (4.2)	Ref	<0.001
25-34	120 (64.9)	495 (73.2)	4.42 (2.54 to 7.68)	
35 +	35 (18.9)	153 (22.6)	4.68 (2.45 to 8.12)	
Marital status				
Other	23 (12.2)	24 (3.4)	Ref	<0.001
Married/Common Law	165 (87.8)	673 (96.6)	3.91 (2.15 to 7.10)	
Education				
High school or less	38 (20.3)	57 (8.1)	Ref	<0.001
Some or complete university/college	135 (71.8)	533 (76.4)	2.63 (1.68 to 4.16)	
Some or complete grad school	15 (7.9)	108 (15.5)	4.8 (2.43 to 9.46)	
Ethnicity				
Non-Caucasian/Other	28 (14.9)	156 (22.3)	Ref	0.03
Caucasian/White	159 (85.)	542 (77.7)	0.61 (0.39 to 0.95)	
Born in Canada				
No	25 (13.3)	114 (16.3)	Ref	0.31
Yes	163 (86.7)	854 (83.7)	0.78 (0.49 to 1.25)	
Income				
< $40,000	22 (12.1)	28 (4.2)	Ref	<0.001
$40,000 - $80,000	50 (27.5)	127 (18.9)	1.99 (1.04 to 3.81)	
>$80,000	110 (60.4)	518 (76.9)	3.70 (2.04 to 6.71)	
Parity				
No previous births	105 (55.6)	353 (50.9)	Ref	0.26
Previous birth	84 (44.4)	340 (49.1)	1.20 (0.87 to 1.66)	
Employment Status during pregnancy				
Not working	81 (45.0)	251 (36.1)	Ref	0.03
Working	99 (55.0)	444 (63.9)	1.45 (1.04 to 2.02)	
Home ownership				
Other	47 (25.0)	97 (13.9)	Ref	<0.001
Own	141 (75.0)	599 (86.1)	2.06 (1.39 to 3.05)	

Variable	Not BF (n=190)	BF (n=703)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Obstetric				
Feelings about Pregnancy				
Unhappy/not sure	27 (14.4)	77 (11.1)	Ref	0.21
Happy	161 (85.6)	619 (88.9)	1.35 (0.84 to 2.16)	
Method of delivery				
Vaginal	140 (73.7)	564 (80.5)	Ref	0.04
Caesarean	50 (26.3)	137 (19.5)	0.68 (0.47 to 0.99)	
Difficulty obtaining prenatal care				
No	156 (87.2)	592 (85.9)	Ref	0.67
Yes	23 (12.8)	97 (14.1)	1.11 (0.68 to 1.81)	
Pre-pregnancy BMI				
≤ 24.9	111 (60.3)	482 (70.0)	Ref	0.012
≥ 25.0	73 (39.7)	206 (30.0)	0.65 (0.46 to 0.91)	
Preterm Delivery				
No	159 (84.6)	653 (93.9)	Ref	<0.001
Yes	29 (15.4)	42 (6.1)	0.35 (0.21 to 0.58)	
Psychological well-being				
Depression during prenatal period EPDS≥13				
No	161 (85.2)	645 (91.8)	Ref	0.007
Yes	28 (14.8)	58 (8.2)	0.52 (0.32 to 0.84)	
Anxious during prenatal period (STAI > 40)				
No	117 (62.2)	527 (75.3)	Ref	<0.001
Yes	71 (37.8)	173 (24.7)	0.09 (0.38 to 0.76)	
Stressed during prenatal period				
No	116 (61.4)	527 (75.2)	Ref	<0.001
Yes	73 (38.6)	174 (24.8)	0.52 (0.37 to 0.74)	
Psychological well-being during prenatal period (depression, anxiety, stress)				
Good well-being	101 (53.7)	465 (66.5)	Ref	0.001
Poor well-being	87 (46.3)	234 (33.5)	0.58 (0.42 to 0.81)	
Social support during prenatal period				
Adequate	156 (82.5)	587 (83.9)	Ref	0.67
Inadequate	33 (17.5)	113 (16.1)	0.91 (0.59 to 1.39)	
Optimism				
High optimism	107 (67.7)	487 (85.7)	Ref	<0.001
Low optimism	51 (32.3)	81 (14.3)	0.35 (0.23 to 0.52)	

Variable	Not BF (n=190)	BF (n=703)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Parenting morale index				0.16
High parenting morale	142 (75.9)	562 (80.6)	Ref	
Low parenting morale	45 (24.1)	135 (19.4)	0.76 (0.52 to 1.11)	
Self-rated emotional health during prenatal period				0.04
Good	161 (85.2)	636 (90.5)	Ref	
Not good	28 (14.8)	67 (9.5)	0.61 (0.38 to 0.97)	
Self-rated physical health during prenatal period				0.003
Good	149 (78.8)	614 (87.3)	Ref	
Not good	40 (21.2)	89 (12.7)	0.54 (0.36 to 0.82)	
Satisfaction with family support during prenatal period				0.76
Unsatisfied	2 (1.3)	9 (1.6)	Ref	
Satisfied	156 (98.7)	555 (98.4)	0.79 (0.17 to 3.70)	
Satisfaction with friends' support during prenatal period				0.92
Unsatisfied	5 (3.2)	17 (3.1)	Ref	
Satisfied	153 (96.8)	547 (96.9)	1.05 (0.38 to 2.87)	
Satisfaction with HCP during prenatal period				0.23
Unsatisfied	1 (0.6)	12 (2.1)	Ref	
Satisfied	157 (99.4)	550 (97.9)	0.29 (0.04 to 2.26)	
Behavioural Risk				
History of any abuse				0.19
No	117 (65.0)	481 (70.1)	Ref	
Yes	63 (35.0)	205 (29.9)	0.79 (0.56 to 1.12)	
Smoking 12 months prior to pregnancy				<0.001
No	129 (68.3)	567 (81.4)	Ref	
Yes	60 (31.7)	130 (18.6)	0.49 (0.34 to 0.71)	
Smoking during pregnancy				<0.001
No	141 (77.9)	629 (90.8)	Ref	
Yes	40 (22.1)	64 (9.2)	0.36 (0.23 to 0.55)	

*Denominator varies due to missing values for some variables



Reference groups: Education≤ high school; Maternal age 19-24; Not married/Other; Income≤ $40,000; Not home owners; Unemployed during pregnancy; Unhappy about pregnancy; Nullparous; No difficulty obtaining prenatal care; Unsatisfied with friends' support; Adequate social support; No history of abuse; Unsatisfied with family's support; Foreign-born; High parenting morale; Vaginal delivery; Pre-pregnancy BMI <24.9; Other ethnicity; Good emotional health; Good mental health; Good physical health; No smoking prior to pregnancy; No smoking during pregnancy; High optimism; Term delivery; Unsatisfied with HCP's support

Figure 2 Predictors of any breastfeeding at 4 months postportum among women residing in Canada/Calgary for 5+ years

4.6.4 Multivariable analysis

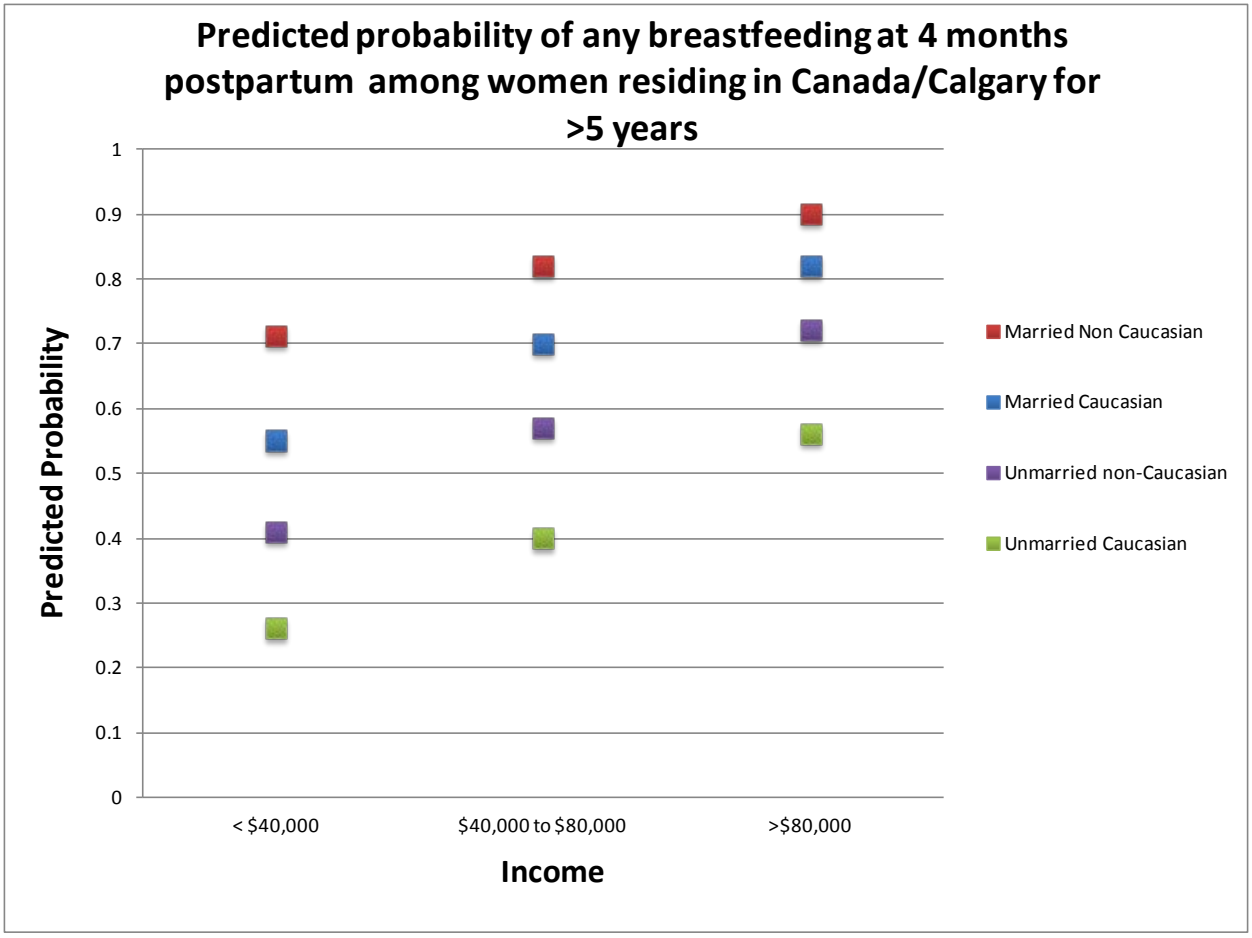
Logistic regression analysis was performed to determine the prediction of any breastfeeding versus not breastfeeding at 4 months postpartum. Adjusted odds ratio and exact 95% confidence intervals for the independent predictors retained in the final model are presented in Table VI. Among women residing in Canada/Calgary for >5 years, significant predictors associated with the likelihood of any breastfeeding at 4 months postpartum included being married or in a common law relationship, higher maternal education, greater income, while being Caucasian, having low optimism, delivering preterm, and having poor self-rated prenatal physical health were associated with lower likelihood of any breastfeeding.

Table VI: Multivariable model of predictors that distinguish women who were still (any) breastfeeding at 4 months from women who have resided in Canada/Calgary for >5 year (n= 685)

Variable	AOR (95% CI)	P-value
Marital status		
Other	1.00	
Common law/married	4.61 (2.01 to 10.57)	<0.001
Education		
High school or less	1.00	
Some or complete university/college	1.87 (1.02 to 3.42)	0.04
Some or complete grad school	3.08 (1.32 to 7.17)	0.009
Income		
< $40,000	1.00	
$40,000 - $80,000	1.83 (0.78 to 4.2)	0.16
>$80,000	2.69 (1.18 to 6.11)	0.02
Ethnicity		
Non-Caucasian/Other	1.00	
Caucasian/White	0.53 (0.31 to 0.90)	0.02
Optimism		
High optimism	1.00	
Low optimism	0.47 (0.29 to 0.74)	0.001
Preterm Delivery		
No	1.00	
Yes	0.43 (0.23 to 0.81)	0.008
Self-rated physical health during prenatal period		
Good	1.00	
Not good	0.59 (0.35 to 0.99)	0.048

4.6.5 Predicted probabilities of any breastfeeding

Based on the logistic regression model with non-modifiable demographic factors (income, ethnicity and marital status), predicted probabilities for any breastfeeding at 4 months were calculated. As illustrated in figure 3, there appears to be a linear pattern of increasing probability of any breastfeeding with increasing income levels. The probabilities of any breastfeeding were higher for women who were married/in a common-law relationship and non-Caucasian women. For example, a married non-Caucasian woman with an annual household income of >$80,000 had a predicted probability of 90% for any breastfeeding at 4 months. The probability of any breastfeeding declines for married non-Caucasian women with decreasing income levels, with 82% probability for those with income level between $40,000 to $80,000 and 71% probability of any breastfeeding for women below the $40,000 income level. The probability of any breastfeeding at the highest income levels were greatest for married non-Caucasians, followed by married Caucasians, unmarried non-Caucasians, and finally unmarried Caucasians.



Calculated from log $(p/1-p)=\beta_0 + \beta_{income} + \beta_{maritalstatus} + e_{thnicity}$

Figure 3 Predicted probability of any breastfeeding

4.6.6 Sample size calculation

The proportion of women who responded to breastfeeding at 4 months variable was 78.7% (703 of 893). Using the upper limit rule of thumb of 20 events per each independent variable in the model, the final model could have up to 35 variables. In the final multivariable model, there were 6 predictors for this outcome among a total sample of 685, indicative of adequate sample size.

4.7 Any breastfeeding at 4 months postpartum among new Calgarians

4.7.1 Objective

The objective was to quantify the prevalence and odds of any breastfeeding at 4 months postpartum associated with various predictors among new Calgarians.

4.7.2 Prevalence

The prevalence of any breastfeeding at 4 months postpartum among new Calgarians was 86.8%.

4.7.3 Bivariate analysis

Table VII presents the estimated percentage, unadjusted (OR) estimates, 95% confidence intervals and p-values of women new to Calgary who breastfed their infants at 4 months by selected demographic, obstetric, psychological well-being and behavioural risk variables.

4.7.3.1 Demographics

Household annual income, employment status during pregnancy and home ownership were factors of any breastfeeding among new Calgarian mothers. In comparison to women with household income of ≤ $40,000, the likelihood of breastfeeding was 1.85 (95% CI: 0.95-3.59) times greater for women with annual household income of $80,000 or more, and slightly higher (OR=1.09; 95% CI: 0.52-2.29) among the middle income group. However, both confidence intervals cross the null OR of 1, indicating that income is not a significant predictor. Women who were employed during pregnancy (OR=1.73; 95% CI: 1.04-2.86) and home-owners (OR=1.88; 95% CI: 1.14-3.08) were also more likely to breastfeed at 4 months compared to unemployed women and non-home owners.

4.7.3.2 Obstetric

Women new to Calgary who reported being happy about their pregnancy were more likely (OR=1.74; 95% CI: 0.94-3.24) to breastfeed at 4 months compared to women who

reported not being happy about pregnancy, however, this variable is not a significant predictor (CI crosses 1). Women who had pre-pregnancy BMI ≥ 25.0 were less likely (OR=0.46; 95% CI: 0.28-0.78) to breastfeed compared to women with BMI≤ 24.9.

4.7.3.3 Psychological well-being

Women who reported not having good physical health during the prenatal period were less likely (OR=0.37; 95% CI: 0.21-0.65) to breastfeed at 4 months compared to women with good physical health.

4.7.3.4 Behavioural risk

Women who smoked 12 months prior to pregnancy (OR=0.47; 95% CI:0.27- 0.83) and during pregnancy (OR=0.47; 95% CI: 0.23-0.97) were less likely to breastfeed compared to non-smokers.

Table VII: Predictors of any breastfeeding at 4 months postpartum among new Calgarians

Variable	Not BF (n=81)	BF (n=349)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Demographic				
Maternal age at delivery (years)				
19-24	8 (10.2)	21 (6.2)	Ref	0.24
25-34	54 (68.3)	263 (76.9)	1.85 (0.78 to 4.41)	
35 +	17 (21.5)	58 (16.9)	1.30 (0.49 to 3.45)	
Marital status				
Other	6 (7.4)	19 (5.5)	Ref	0.50
Married/Common Law	75 (92.6)	328 (94.5)	1.38 (0.53 to 3.58)	
Education				
High school or less	10 (12.4)	27 (7.8)	Ref	0.39
Some or complete university/college	55 (67.9)	242 (69.5)	1.63 (0.74 to 3.56)	
Some or complete grad school	16 (19.7)	79 (22.7)	1.82 (0.74 to 4.51)	
Ethnicity				
Non-Caucasian/Other	22 (27.5)	113 (32.5)	Ref	0.39
Caucasian/White	58 (72.5)	235 (67.5)	0.79 (0.46 to 1.35)	
Born in Canada				
No	28 (34.6)	144 (41.3)	Ref	
Yes	53 (65. 4)	205 (58.7)	0.75 (0.45 to 1.25)	0.27
Income				
< $40,000	16 (20.3)	47 (13.9)	Ref	0.07
$40,000 - $80,000	23 (29.1)	74 (21.8)	1.09 (0.52 to 2.29)	
>$80,000	40 (50.6)	218 (64.3)	1.85 (0.95 to 3.59)	
Parity				
No previous births	49 (60.5)	186 (53.6)	Ref	0.26
Previous birth	32 (39.5)	161 (46.4)	1.32 (0.81 to 2.17)	
Employment status during pregnancy				
Not working	45 (59.2)	158 (45.7)	Ref	0.03
Working	31 (40.8)	188 (54.3)	1.73 (1.04 to 2.86)	
Home ownership				
Other	37 (46.3)	109 (31.4)	Ref	0.01
Own	43 (53.7)	238 (68.6)	1.88 (1.14 to 3.08)	

Variable	Not BF (n=81)	BF (n=349)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Obstetric				
Feelings about Pregnancy				
Unhappy/not sure	17 (21.3)	46 (13.4)	Ref	0.08
Happy	63 (78.7)	297 (86.6)	1.74 (0.94 to 3.24)	
Method of delivery				
Vaginal	61 (75.3)	262 (75.1)	Ref	0.97
Caesarean	20 (24.7)	87 (24.9)	1.01 (0.58 to 1.77)	
Difficulty obtaining prenatal care				
No	58 (77.3)	258 (74.6)	Ref	0.62
Yes	17 (22.6)	88 (25.4)	1.16 (0.64 to 2.10)	
Pre-pregnancy BMI				
≤ 24.9	46 (59.7)	260 (76.3)	Ref	0.004
≥ 25.0	31 (40.3)	81 (23.7)	0.46 (0.28 to 0.78)	
Preterm Delivery				
No	73 (90.1)	322 (92.8)	Ref	0.42
Yes	8 (9.9)	25 (7.2)	0.70 (0.31 to 1.63)	
Psychological well-being				
Depression during prenatal period EPDS≥13				
No	67 (82.7)	300 (85.9)	Ref	0.46
Yes	14 (17.3)	49 (14.1)	0.78 (0.41 to 1.50)	
Anxious during prenatal period (STAI > 40)				
No	53 (65.4)	242 (69.9)	Ref	0.43
Yes	28 (34.6)	104 (30.1)	0.81 (0.49 to 1.36)	
Stressed during prenatal period				
No	52 (65.0)	248 (71.7)	Ref	0.24
Yes	28 (35.0)	98 (28.3)	0.73 (0.44 to 1.23)	
Psychological well-being during prenatal period (depression, anxiety, stress)				
Good well-being	45 (56.3)	209 (60.8)	Ref	0.46
Poor well-being	35 (43.7)	135 (39. 2)	0.83 (0.51 to 1.36)	
Social support during prenatal period				
Adequate	57 (70. 4)	259 (74.2)	Ref	0.48
Inadequate	24 (29.6)	90 (25.8)	0.83 (0.49 to 1.41)	
Optimism				
High optimism	50 (81.9)	233 (77.9)	Ref	0.48
Low optimism	11 (18.1)	66 (22.1)	1.29 (0.63 to 2.61)	

Variable	Not BF (n=81)	BF (n=349)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Parenting morale index				
High parenting morale	68 (83.9)	276 (80.2)	Ref	0.44
Low parenting morale	13 (16.1)	68 (19.8)	1.29 (0.67 to 2.47)	
Self-rated emotional health during prenatal period				
Good	66 (81.5)	301 (86. 3)	Ref	
Not good	15 (18.5)	48 (13.7)	0.70 (0.37 to 1.33)	0.27
Self-rated physical health during prenatal period				
Good	57 (70.4)	302 (86.5)	Ref	<0.001
Not good	24 (29.6)	47 (13.5)	0.37 (0.21 to 0.65)	
Satisfaction with family support during prenatal period				
Unsatisfied	2 (3.2)	5 (1.7)	Ref	0.42
Satisfied	60 (96.8)	293 (98.3)	1.95 (0.37 to 10. 31)	
Satisfaction with friends' support during prenatal period				
Unsatisfied	2 (3.3)	11 (3.7)	Ref	0.87
Satisfied	59 (96.7)	287 (96.3)	0.88 (0.19 to 4.09)	
Satisfaction with HCP during prenatal period				
Unsatisfied	3 (4.9)	13 (4.4)	Ref	0.85
Satisfied	58 (95.1)	284 (95.6)	1.13 (0.31 to 4.09)	
Behavioural Risk				
History of any abuse				
No	50 (67.6)	260 (76.5)	Ref	0.11
Yes	24 (32.4)	80 (23.5)	0.64 (0.37 to 1.10)	
Smoking 12 months prior to pregnancy				
No	58 (71.6)	294 (84.2)	Ref	0.008
Yes	23 (28.4)	55 (15.8)	0.47 (0.27 to 0.83)	
Smoking during pregnancy				
No	64 (84.2)	318 (91.9)	Ref	0.038
Yes	12 (15.8)	28 (8.1)	0.47 (0.23 to 0.97)	

*Denominator varies due to missing values for some variables

4.8 Any breastfeeding at 4 months postpartum among new Canadians

4.8.1 Objective

The objective was to quantify the prevalence and odds of breastfeeding at 4 months postpartum associated with predictors among new Canadians.

4.8.2 Prevalence

The prevalence of any breastfeeding at 4 months postpartum among new Canadians was 84.5%.

4.8.3 Bivariate analysis

Table VIII presents the estimated percentage, unadjusted odds ratio (OR), 95% confidence intervals, and p-values of women new to Canada who were breastfeeding their infants at 4 months by selected demographic, obstetric, psychological well-being and behavioural risk variables.

4.8.3.1 Demographics

Only household annual income was a predictor of any breastfeeding among new Canadian mothers at P<0.10 level. However, the confidence interval crosses the null OR of 1, signifying no association.

4.8.3.2 Obstetric

Women who had a preterm delivery were 0.29 times (95% CI: 0.09-0.90) less likely to breastfeed at 4 months compared to women who did not have a preterm delivery.

4.8.3.3 Psychological well-being

The chances of any breastfeeding among women who reported being anxious during the prenatal period was about 32% (OR=0.32; 95% CI: 0.12-0.86) of the odds of non-anxious women breastfeeding. Similarly, women who had poor well-being during the prenatal period (depression, anxiety and stress) were also less likely to be breastfeeding. Women new to Canada

who reported having inadequate prenatal social support were less likely to breastfeed, compared to those that reported having adequate social support.

Table VIII: Predictors of any breastfeeding at 4 months postpartum among new Canadians

Variable	Not BF (n=20)	BF (n=109)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Demographic				
Maternal age at delivery (years)				
19-24	1 (5.3)	7 (6.5)	Ref	0.52
25-34	11 (57.9)	74 (69.2)	0.96 (0.11 to 8.58)	
35 +	7 (36.8)	26 (24.3)	0.53 (0.06 to 5.06)	
Marital status				
Other	0	5 (4.7)	--	0.32
Married/Common Law	20 (100.0)	102 (95.3)		
Education				
High school or less	4 (20.0)	8 (7.5)	Ref	0.19
Some or complete university/college	12 (60.0)	71 (65.7)	2.96 (0.77 to 11. 38)	
Some or complete grad school	4 (20.0)	29 (26.8)	3.62 (0.74 to 17. 81)	
Ethnicity				
Non-Caucasian/Other	13 (68.4)	76 (70.4)	Ref	0.87
Caucasian/White	6 (31.6)	32 (29.6)	0.91 (0.31 to 2.61)	
Income				
< $40,000	6 (31.6)	26 (24.1)	Ref	0.08
$40,000 - $80,000	9 (47.4)	30 (27.8)	0.77 (0.24 to 2.45)	
>$80,000	4 (21.0)	52 (48.1)	3 (0.77 to 11.57)	
Parity				
No previous births	10 (50.0)	57 (52.8)	Ref	0.82
Previous birth	10 (50.0)	51 (47.2)	0.89 (0.34 to 2.32)	
Employment Status during pregnancy				0.14
Not working	14 (73.7)	60 (55.6)	Ref	
Working	5 (26.3)	48 (44.4)	2.24 (0.75 to 6.65)	
Home ownership				
Other	11 (55.0)	46 (42.6)	Ref	0.31
Own	9 (45.0)	62 (57.4)	1.65 (0.63 to 4.30)	

Variable	Not BF (n=20)	BF (n=109)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Obstetric				
Feelings about Pregnancy				
Unhappy/not sure	2 (10.5)	18 (17.1)	Ref	0.47
Happy	17 (89.5)	87 (82.9)	0.57 (0.12 to 2.68)	
Method of delivery				
Vaginal	13 (65.0)	75 (68.8)	Ref	0.74
Caesarean	7 (35.0)	34 (31.2)	0.84 (0.31 to 2.30)	
Difficulty obtaining prenatal care				
No	15 (78.9)	78 (72.9)	Ref	0.58
Yes	4 (21.0)	29 (27.1)	1.40 (0.42 to 4.55)	
Pre-pregnancy BMI				
≤ 24.9	12 (66.7)	84 (80.0)	Ref	0.21
≥ 30	6 (33.3)	21 (20.0)	0.50 (0.17 to 1.49)	
Preterm Delivery				
No	14 (70.0)	96 (88.9)	Ref	0.03
Yes	6 (30.0)	12 (11.1)	0.29 (0.09 to 0.90)	
Psychological well-being				
Depression during prenatal period EPDS≥13				
No	17 (85.0)	95 (87.2)	Ref	0.79
Yes	3 (15.0)	14 (12.8)	0.83 (0.22 to 3.22)	
Anxious during prenatal period (STAI > 40)				
No	8 (40.0)	72 (67.3)	Ref	0.02
Yes	12 (60.0)	35 (32.7)	0.32 (0.12 to 0.86)	
Stressed during prenatal period				
No	11 (55.0)	78 (72.9)	Ref	0.11
Yes	9 (45.0)	29 (27.1)	0.45 (0.17 to 1.21)	
Psychological well-being during prenatal period (depression, anxiety, stress)				
Good well-being	7 (35.0)	60 (56.6)	Ref	0.08
Poor well-being	13 (65.0)	46 (43.4)	0.41 (0.15 to 1.18)	
Social support during prenatal period				
Adequate	9 (45.0)	72 (66.1)	Ref	0.07
Inadequate	11 (55.0)	37 (33.9)	0.42 (0.16 to 1.10)	
Optimism				
High optimism	9 (60.0)	70 (73.7)	Ref	0.27
Low optimism	6 (40.0)	25 (26.3)	0.54 (0.17 to 1.65)	

Variable	Not BF (n=20)	BF (n=109)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Parenting morale index				
High parenting morale	18 (90.0)	89 (83.9)	Ref	0.49
Low parenting morale	2 (10.0)	17 (16.0)	1.72 (0.36 to 8.10)	
Self-rated emotional health during prenatal period				
Good	17 (85.0)	93 (85.3)	Ref	
Not good	3 (15.0)	16 (14.7)	0.97 (0.26 to 3.71)	0.97
Self-rated physical health during prenatal period				
Good	14 (70.0)	91 (83.5)	Ref	0.15
Not good	6 (30.0)	18 (16.5)	0.46 (0.16 to 1.37)	
Satisfaction with family support during prenatal period				
Unsatisfied	0	2 (2.1)	--	0.56
Satisfied	16 (100.0)	92 (97.9)		
Satisfaction with friends' support during prenatal period				
Unsatisfied	1 (6.7)	5 (5.3)	Ref	0.83
Satisfied	14 (93.3)	89 (94.7)	1.27 (0.14 to 11. 70)	
Satisfaction with HCP during prenatal period				
Unsatisfied	0	6 (6.4)	--	0.29
Satisfied	16 (100.0)	88 (93.6)		
Behavioural Risk				
History of any abuse				
No	13 (76.5)	89 (85.6)	Ref	0.34
Yes	4 (23.5)	15 (14.4)	0.55 (0.16 to 1.91)	
Smoking 12 months prior to pregnancy				
No	18 (90.0)	101 (92.7)	Ref	0.68
Yes	2 (10.0)	8 (7.3)	0.71 (0.14 to 3.63)	
Smoking during pregnancy				
No	19 (100)	100 (93.5)	Ref	0.25
Yes	0	7 (6.5)	--	

*Denominator varies due to missing values for some variables

4.9 Exclusive breastfeeding at 4 months postpartum among women residing in Canada/Calgary for >5 years

4.9.1 Objective

The objective was to quantify the prevalence and odds of exclusive breastfeeding (EBF) at 4 months postpartum associated with various participant characteristics/predictors among women residing in Canada/Calgary for >5 years.

4.9.2 Prevalence

The prevalence of EBF at 4 months postpartum among women residing in Canada/Calgary for >5 years was 59.4%.

4.9.3 Bivariate analysis

The proportion and percents for EBF at 4 months by each level of demographic, obstetric, psychological well-being and behavioural risk variables are presented in Table IX. All predictor variables were identified *a priori*. P-values from Pearson's chi-square test or Fisher's Exact test (when appropriate) are also displayed. Odds ratio and 95% confidence intervals associated with each variable are also presented.

4.9.3.1 Demographics

Demographic factors that were predictive of EBF at 4 months were older age at delivery, married/in a common-law relationship, higher education, higher household income, multiparous, and home ownership. In comparison to younger mothers (19 to 24 years of age), women who were 35 and older at delivery were 2.00 (95% CI: 1.10-3.63) times more likely to EBF, whereas those 25 to 34 years old were 2.28 (95% CI: 1.32-3.94) times more likely. The likelihood of EBF among married/common-law women was 4.11 (95% CI: 2.13-7.91) times that of non-married women. In comparison to women with lower educational level (high school or less), women who had some or complete university/college education were 1.99 (95% CI: 1.29-3.08) times more

likely to EBF at 4 months and women who had some or complete graduate school education were 2.73 (95% CI: 1.57-4.76) times more likely. The likelihood of EBF was 2.40 (95% CI: 1.25-4.64) times greater among women with annual household income between $40-80,000 and 3.25 (95% CI: 1.78-5.97) times greater among women with income of ≥$80,000 compared to those of lower households income (<$40,000). Women who had a previous birth were 1.37 (95% CI: 1.05-1.80) times more likely to EBF than first-time mothers. The likelihood of EBF is 1.92 (95% CI: 1.34-2.76) times greater among home owners than non-home owners.

4.9.3.2 Obstetric

Women who had a caesarean and preterm delivery were less likely to EBF at 4 months. The chance of EBF among women who delivered via caesarean was 58% of the odds of EBF among women with vaginal deliveries, whereas the chance of EBF among women with preterm deliveries was 36% of the odds of EBF among women with term deliveries.

4.9.3.3 Psychological well-being

Women who were anxious and stressed during the prenatal period were less likely to EBF at 4 months. Women who had poor well-being during the prenatal period were 0.65 (95% CI: 0.49-0.86) times less likely to EBF at 4 months postpartum compared to women with good prenatal well-being. Women with low optimism, poor prenatal emotional and physical health were less likely to EBF. Women with low optimism were 0.54 (0.37 to 0.78) times less likely to EBF compared to women with high optimism. Those with poor prenatal emotional and physical health were 0.63 (95% CI: 0.41-0.97) and 0.47 (95% CI: 0.32-0.68) times less likely to EBF, respectively, than those with good emotional and physical health.

4.9.3.4 Behavioural risk

Women who smoked 12 months prior to and during pregnancy were less likely to EBF. The likelihood of EBF among women who reported having smoked 12 months prior to and during pregnancy was 0.44 (95% CI: 0.32-0.61) and 0.38 (95% CI: 0.25-0.59) times the odds of EBF of non-smoker, respectively.

Figure 4 illustrates the log odds ratio for each of the predictors from the bivariate analysis. Bars in orange indicate the predictors that were later found to be significant in the multivariable model.

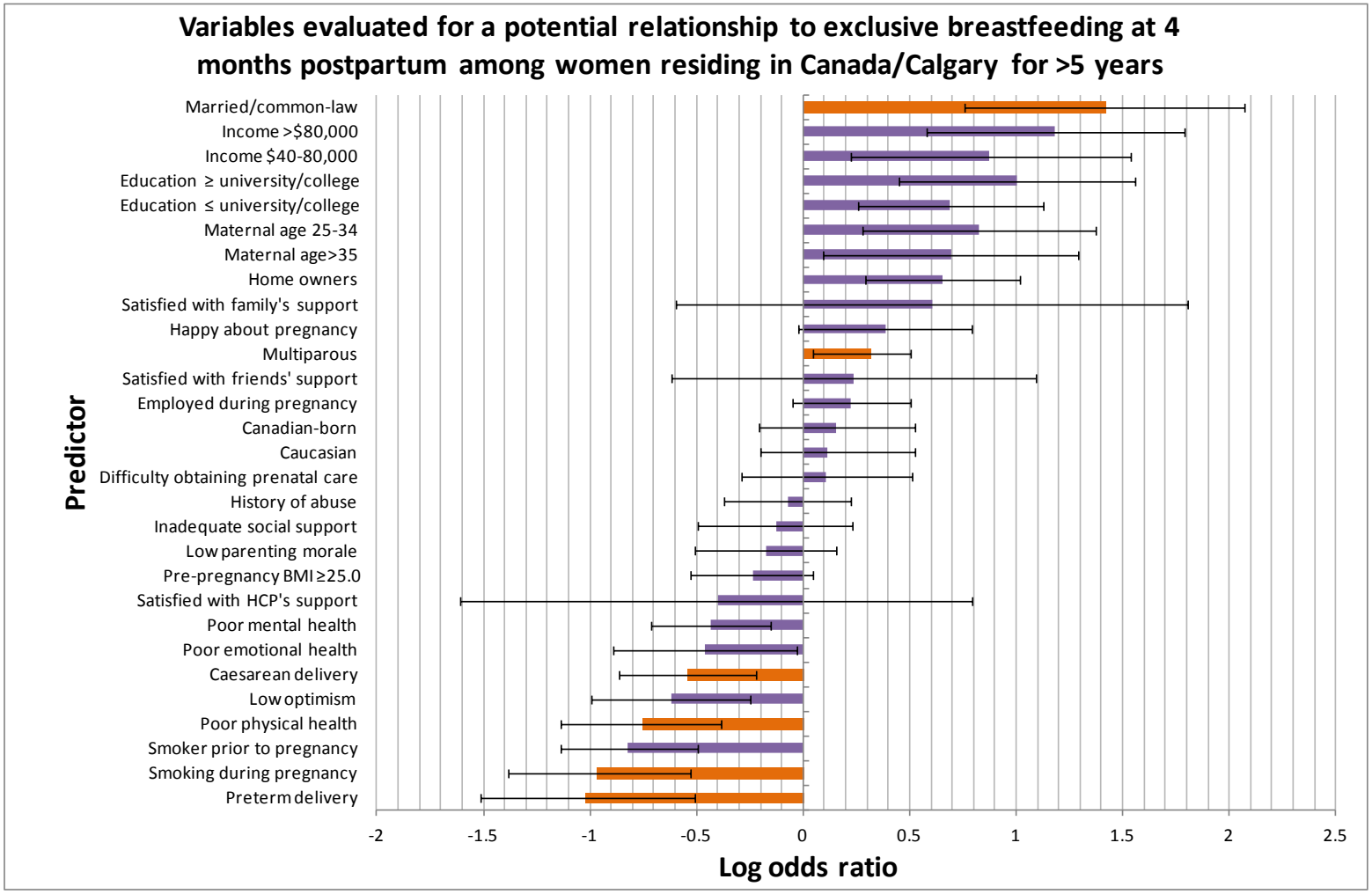
Table IX: Predictors of exclusive breastfeeding at 4 months postpartum among women residing in Canada/Calgary for >5 years

Variable	Not EBF (n=363)	EBF (n=531)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Demographic				
Maternal age at delivery (years)				
19-24	34 (9.8)	24 (4.7)	Ref	0.010
25-34	236 (67.8)	380 (73.9)	2.28 (1.32 to 3.94)	
35 +	78 (22.4)	110 (21.4)	2.00 (1.10 to 3.63)	
Marital status				
Other	34 (9.4)	13 (2.7)	Ref	<0.001
Married/Common Law	326 (90.6)	513 (97.3)	4.11 (2.13 to 7.91)	
Education				
High school or less	54 (15.0)	41 (7.7)	Ref	0.001
Some or complete university/college	266 (73.9)	403 (76.5)	1.99 (1.29 to 3.08)	
Some or complete grad school	40 (11.1)	83 (15.8)	2.73 (1.57 to 4.76)	
Ethnicity				
Non-Caucasian/Other	79 (22.1)	105 (19.9)	Ref	0.45
Caucasian/White	280 (77.9)	422 (80.1)	1.13 (0.82 to 1.57)	
Born in Canada				
No	61 (16.9)	78 (14.8)	Ref	
Yes	299 (83.1)	449 (85.2)	1.17 (0.81 to 1.69)	0.86
Income				
< $40,000	33 (9.5)	17 (3.4)	Ref	<0.001
$40,000 - $80,000	79 (22.8)	98 (19.2)	2.40 (1.25 to 4.64)	
>$80,000	235 (67.7)	394 (77.4)	3.25 (1.78 to 5.97)	
Parity				
No previous births	203 (56.6)	255 (48.7)	Ref	0.02
Previous birth	156 (43.4)	269 (51.3)	1.37 (1.05 to 1.80)	
Employment status during pregnancy				
Not working	143 (41.1)	189 (35.9)	Ref	0.11
Working	205 (58.9)	339 (64.1)	1.25 (0.95 to 1.65)	
Home ownership				
Other	78 (21.7)	66 (12.6)	Ref	<0.001
Own	282 (78.3)	459 (87.4)	1.92 (1.34 to 2.76)	

Variable	Not EBF (n=363)	EBF (n=531)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Obstetric				
Feelings about Pregnancy				
Unhappy/not sure	51 (14.2)	53 (10.1)	Ref	0.07
Happy	309 (85.8)	472 (89.9)	1.47 (0.98 to 2.21)	
Method of delivery				
Vaginal	267 (73.6)	438 (82.8)	Ref	0.00
Caesarean	96 (26.4)	91 (17.2)	0.58 (0.42 to 0.80)	
Difficulty obtaining prenatal care				
No	301 (89.9)	448 (85.7)	Ref	0.58
Yes	45 (13.1)	75 (14.3)	1.11 (0.75 to 1.67)	
Pre-pregnancy BMI				
≤ 24.9	230 (64.9)	364 (70.1)	Ref	0.108
≥ 25.0	124 (35.1)	155 (29.9)	0.79 (0.59 to 1.05)	
Preterm Delivery				
No	313 (87.4)	500 (95.1)	Ref	<0.001
Yes	45 (12.6)	26 (4.9)	0.36 (0.22 to 0.60)	
Psychological well-being				
Depression during prenatal period EPDS≥13				
No	321 (88.7)	486 (91.5)	Ref	0.16
Yes	41 (11.3)	45 (8.5)	0.72 (0.46 to 1.13)	
Anxious during prenatal period (STAI > 40)				
No	241 (66.9)	404 (76.4)	Ref	0.002
Yes	119 (33.1)	125 (23.6)	0.63 (0.47 to 0.84)	
Stressed during prenatal period				
No	237 (65.7)	407 (76.8)	Ref	<0.001
Yes	124 (34.3)	123 (23.2)	0.58 (0.43 to 0.78)	
Psychological well-being during prenatal period (depression, anxiety, stress)				
Good well-being	208 (57.9)	359 (67.9)	Ref	0.003
Poor well-being	151 (42.1)	170 (32.1)	0.65 (0.49 to 0.86)	
Social support during prenatal period				
Adequate	298 (82.6)	446 (84.3)	Ref	0.49
Inadequate	63 (16.4)	83 (15.7)	0.88 (0.61 to 1.26)	
Optimism				
High optimism	220 (76.1)	374 (85.6)	Ref	0.001
Low optimism	69 (23.9)	63 (14.4)	0.54 (0.37 to 0.78)	

Variable	Not EBF (n=363)	EBF (n=531)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Parenting morale index				
High parenting morale	280 (77.9)	425 (80.8)	Ref	0.31
Low parenting morale	79 (22.1)	101 (19.2)	0.84 (0.60 to 1.17)	
Self-rated emotional health during prenatal period				
Good	314 (86.7)	484 (91.1)	Ref	0.04
Not good	48 (13.3)	47 (8.9)	0.63 (0.41 to 0.97)	
Self-rated physical health during prenatal period				
Good	289 (79.8)	475 (89.5)	Ref	<0.001
Not good	73 (20.2)	56 (10.5)	0.47 (0.32 to 0.68)	
Satisfaction with family support during prenatal period				
Unsatisfied	6 (2.1)	5 (1.2)	Ref	0.32
Satisfied	281 (97.9)	430 (98.8)	1.84 (0.55 to 6.07)	
Satisfaction with friends' support during prenatal period				
Unsatisfied	10 (3.5)	12 (2.8)	Ref	0.59
Satisfied	277 (96.5)	423 (97.2)	1.27 (0.54 to 2.98)	
Satisfaction with HCP during prenatal period				
Unsatisfied	4 (1.4)	9 (2.1)	Ref	0.51
Satisfied	281 (98.6)	426 (97.9)	0.67 (0.20 to 2.21)	
Behavioural Risk				
History of any abuse				
No	235 (68.1)	363 (69.7)	Ref	0. 63
Yes	110 (31.9)	158 (30.3)	0.93 (0.69 to 1.25)	
Smoking 12 months prior to pregnancy				
No	254 (70.4)	443 (84.2)	Ref	<0.001
Yes	107 (29.6)	83 (15.8)	0.44 (0.32 to 0.61)	
Smoking during pregnancy				
No	287 (82.0)	484 (92.2)	Ref	<0.001
Yes	63 (18.0)	41 (7.8)	0.38 (0.25 to 0.59)	

*Denominator varies due to missing values for some variables



Reference groups: Not married/Other; Income <$40,000; Education ≤ high school; maternal age 19-24; Not home owners; Unsatisfied with family's support; Unhappy about pregnancy; Nulliparous; Unsatisfied with friends' support; Unemployed during pregnancy; Foreign-born; Other ethnicity; No difficulty obtaining prenatal care; No history of abuse; Adequate social support; High parenting morale; Pre-pregnancy BMI <24.9; Unsatisfied with HCP's support; Good mental health; Good emotional health; Vaginal delivery; High optimism; Good physical health; Not smoking prior to pregnancy; Not smoking during pregnancy; Term delivery

Figure 4 Predictors of exclusive breastfeeding at 4 months postpartum among women residing in Canada/Calgary for 5+ years

4.9.4 Multivariable analysis

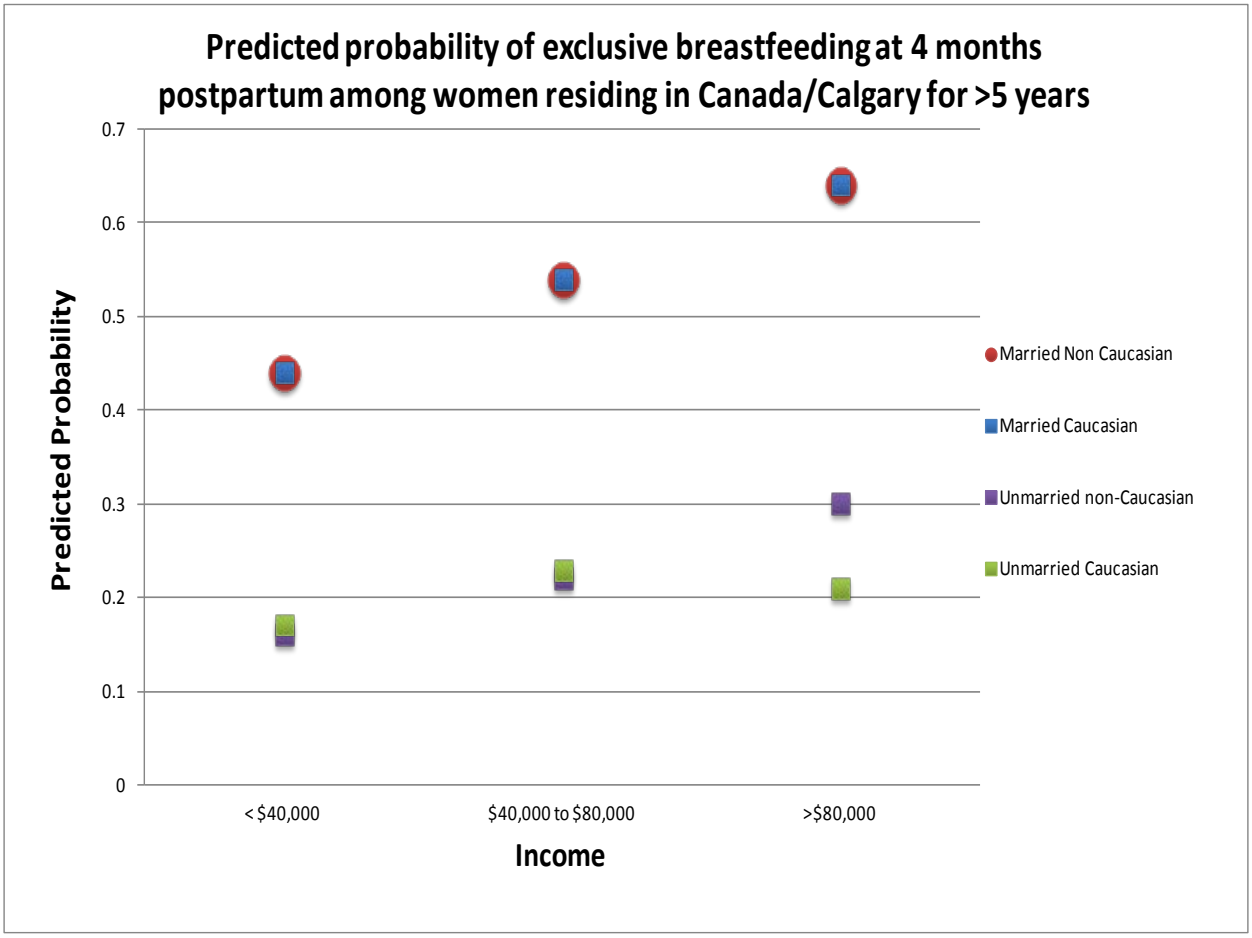
The same approach to multivariable analysis outlined earlier was taken for exclusive breastfeeding. The variables determined to be statistically significant ($P \leq 0.10$) from the bivariate analysis were considered for regression analyses. The purpose of the multivariable analysis was to identify factors that distinguished women who were EBF at 4 months postpartum from women who were not EBF in the cohort. Interaction terms assessed were not significant. Table X shows the adjusted odds ratio and exact 95% confidence intervals for independent predictors retained in the final model. Among women residing in Canada/Calgary for 5+ years, significant predictors associated with of exclusive breastfeeding at 4 months postpartum included: being married/in a common law relationship, having poor prenatal physical health, being multiparous, delivering preterm, smoking during pregnancy and caesarean delivery.

Table X: Multivariable model of predictors that distinguish women who were EBF at four months postpartum from women who were not among those residing in Canada/Calgary for >5 year (n= 852)

Variable	AOR (95% CI)	P-value
Marital status		
Other	Ref	
Common law/married	3.15 (1.58 to 6.29)	0.001
Self-rated prenatal physical health		
Good	Ref	
Poor	0.45 (0.30 to 0.67)	0.001
Parity		
No previous births	Ref	
Previous birth	1.34 (1.00 to 1.80)	0.04
Preterm Delivery		
No	Ref	
Yes	0.41 (0.24 to 0.70)	0.001
Smoking during pregnancy		
No	Ref	
Yes	0.42 (0.27 to 0.66)	<0.001
Method of delivery		
Vaginal	Ref	
Caesarean	0.61 (0.43 to 0.87)	0.006

4.9.5 Predicted probabilities of exclusive breastfeeding

Based on the logistic regression model with non-modifiable demographic factors (income, ethnicity and marital status), predicted probabilities of exclusive breastfeeding at 4 months were calculated. As illustrated in figure 5, the predicted probabilities of EBF at 4 months were identical for married non-Caucasians and married Caucasians at each income level. The probability of EBF for unmarried non-Caucasians with income level below $40,000 was 16%. A similar woman, whose only difference was being of household income between $40,000 and $80,000, had a probability of 22% for EBF at 4 months; while a woman with greater than $80,000 household income had a probability of 30%. Among unmarried Caucasians, the probability of EBF for those in the lowest income group was 17%, compared to 23% for women in the middle household income group and 21% in the highest income group. This increase in EBF from the highest income group to the middle income group among unmarried Caucasians was not clinically significant.



Calculated from log $(p/1-p)=\beta_0 + \beta_{income} + \beta_{maritalstatus} + e_{thnicity}$

Figure 5 Predicted probability of exclusive breastfeeding

4.9.6 Sample size calculation

The second outcome of exclusive breastfeeding at 4 months occurs to 531 (59.4%) participants out of a possible 894 participants. The upper limit rule suggests that the final model can have up to 26 variables. In the final multivariable model, there were 8 predictors for this outcome among a total sample of 829, reflecting adequate sample size.

4.10 Exclusive breastfeeding at 4 months postpartum among new Calgarians

4.10.1 Objective

The objective was to quantify the prevalence and odds of exclusive breastfeeding at 4 months postpartum associated with various predictors among new Calgarians.

4.10.2 Prevalence

The prevalence of EBF at 4 months postpartum among new Calgarians was 59.5%.

4.10.3 Bivariate analysis

Table XI presents the estimated percentage, unadjusted odds ratio (OR) and 95% confidence intervals, and p-values of women new to Canada who exclusively breastfed their infants at 4 months by select demographic, obstetric, psychological well-being and behavioural risk variables.

4.10.3.1 Demographics

Maternal age, education, household annual income, employment status during pregnancy and home ownership were significant factors of EBF among new Calgarian mothers. Older mothers are more likely to be EBF than younger mothers, with mothers aged 25-34 years 2.13 (95% CI: 0.99-4.59) times more likely and mothers older than 35 years 1.26 (95% CI: 0.53-2.99) times more likely to be EBF compared to younger mothers aged 19 to 24 years. In comparison to women with household income of less than $40,000, the likelihood of EBF was 1.98 times (95% CI: 1.13-3.48) greater for women with annual household income of $80,000 or more, and slightly higher (OR=1.44; 95% CI: 0.76-2.75) among the middle income group. Women working during pregnancy were more likely to be EBF (OR=1.43; 95% CI: 0.96 to 2.11) than women not working during pregnancy. Home-owners were also more likely to be EBF (OR=1.49; 95% CI:

0.99-2.23) at 4 months compared to non-home owners. However, only education and income were significant predictors as their OR does not cross the null value of 1.

4.10.3.2 Obstetric

Women new to Calgary who reported being happy about their pregnancy were more likely to be EBF at 4 months compared to women who reported not being happy about pregnancy, while women with pre-pregnancy BMI greater than 25 were significantly less likely (OR= 0.47; 95% CI: 0.30-0.73) to EBF compared to women with BMI less than 24.9.

4.10.3.3 Psychological well-being

Women who reported having inadequate social support (OR=0.58; 95% CI:0.37-0.89) and having poor physical health (OR=0.35; 95% CI: 0.21-0.59) during the prenatal period were less likely to be EBF at 4 months compared to women with adequate social support and good physical health, respectively.

4.10.3.4 Behavioural risk

Women who smoked 12 months prior (OR=0.38; 95% CI: 0.23 to 0.64) to and during pregnancy (OR=0.35; 95% CI: 0.18-0.70) were less likely to be EBF compared to non-smokers.

Table XI: Predictors of exclusive breastfeeding at 4 months postpartum among new Calgarians

Variable	Non-EBF (n=173)	EBF (n=254)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Demographic				
Maternal age at delivery (years)				
19-24	16 (9.5)	13 (5.2)	Ref	0.03
25-34	115 (68.5)	199 (79.6)	2.13 (0.99 to 4.59)	
35 +	37 (22.0)	38 (15.2)	1.26 (0.53 to 2.99)	
Marital status				
Other	14 (8.1)	11 (4.4)	Ref	0.10
Married/Common Law	158 (91.9)	242 (95.6)	1.94 (0.86 to 4.40)	
Education				
High school or less	22 (12.8)	14 (5.5)	Ref	0.03
Some or complete university/college	117 (67.6)	178 (70.4)	2.39 (1.18 to 4.86)	
Some or complete grad school	34 (19.6)	61 (24.1)	2.82 (1.28 to 6.21)	
Ethnicity				
Non-Caucasian/Other	61 (35.7)	72 (28.4)	Ref	0.11
Caucasian/White	110 (64.3)	182 (71.6)	1.40 (0.92 to 2.12)	
Born in Canada				
No	75 (43.3)	94 (37.1)	Ref	0.19
Yes	98 (56.7)	160 (62.9)	1.30 (0.88 to 1.93)	
Income				
< $40,000	32 (19.3)	29 (11.6)	Ref	0.04
$40,000 - $80,000	42 (25.3)	55 (22.1)	1.44 (0.76 to 2.75)	
>$80,000	92 (55.4)	165 (66.3)	1.98 (1.13 to 3.48)	
Parity				
No previous births	101 (58.7)	134 (52.8)	Ref	0.22
Previous birth	71 (41.3)	120 (47.2)	1.27 (0.86 to 1.88)	
Employment Status during pregnancy				
Not working	89 (53.3)	112 (44.5)	Ref	0.08
Working	78 (46.7)	140 (55.5)	1.43 (0.96 to 2.11)	
Home ownership				
Other	68 (39.5)	77 (30.5)	Ref	0.05
Own	104 (60.5)	175 (69.5)	1.49 (0.99 to 2.23)	

Variable	Non-EBF (n=173)	EBF (n=254)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Obstetric				
Feelings about Pregnancy				
Unhappy/not sure	32 (18.7)	30 (12.1)	Ref	0.06
Happy	139 (81.3)	219 (87.9)	1.68 (0.98 to 2.89)	
Method of delivery				
Vaginal	126 (72.8)	195 (76.8)	Ref	0.35
Caesarean	47 (27.2)	59 (23.2)	0.81 (0.52 to 1.26)	
Difficulty obtaining prenatal care				
No	119 (71.7)	195 (77.4)	Ref	0.19
Yes	47 (28.3)	57 (22.6)	0.74 (0.47 to 1.16)	
Pre-pregnancy BMI				
≤ 24.9	106 (64.2)	198 (79.2)	Ref	0.001
≥ 25	59 (35.8)	52 (20.8)	0.47 (0.30 to 0.73)	
Preterm Delivery				
No	159 (91.9)	233 (92.5)	Ref	0.83
Yes	14 (8.1)	19 (7.5)	0.93 (0.45 to 1.90)	
Psychological well-being				
Depression during prenatal period EPDS≥13				
No	143 (82.7)	222 (87.4)	Ref	0.17
Yes	30 (17.3)	32 (12.6)	0.69 (0.40 to 1.18)	
Anxious during prenatal period (STAI > 40)				
No	117 (67.6)	178 (70.9)	Ref	0.47
Yes	56 (32.4)	73 (29.1)	0.86 (0.56 to 1.30)	
Stressed during prenatal period				
No	117 (68.1)	182 (72.5)	Ref	0.32
Yes	55 (31.9)	69 (27.5)	0.81 (0.53 to 1.23)	
Psychological well-being during prenatal period (depression, anxiety, stress)				
Good well-being	99 (57.6)	155 (62.2)	Ref	0.33
Poor well-being	73 (42.4)	94 (37.8)	0.82 (0.55 to 1.22)	
Social support during prenatal period				
Adequate	116 (67.1)	198 (77.9)	Ref	0.01
Inadequate	57 (32.9)	56 (22.1)	0.58 (0.37 to 0.89)	
Optimism				
High optimism	111 (78.7)	172 (79.3)	Ref	0.90
Low optimism	30 (21.3)	45 (20.7)	0.97 (0.57 to 1.63)	

Variable	Non-EBF (n=173)	EBF (n=254)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Parenting morale index				
High parenting morale	139 (80.8)	202 (80.8)	Ref	0.99
Low parenting morale	33 (19.2)	48 (19.2)	1.00 (0.61 to 1.64)	
Self-rated emotional health during prenatal period				
Good	144 (83.2)	221 (87.1)	Ref	0.28
Not good	29 (16.8)	33 (12.9)	0.74 (0.43 to 1.27)	
Self-rated physical health during prenatal period				
Good	129 (74.6)	227 (89.4)	Ref	<0.001
Not good	44 (25.4)	27 (10.6)	0.35 (0.21 to 0.59)	
Satisfaction with family support during prenatal period				
Unsatisfied	2 (1.4)	5 (2.3)	Ref	0.54
Satisfied	140 (98.6)	211 (97.7)	0.60 (0.11 to 3.15)	
Satisfaction with friends' support during prenatal period				
Unsatisfied	3 (2.1)	10 (4.6)	Ref	0.22
Satisfied	138 (97.9)	206 (95.4)	0.45 (0.12 to 1.66)	
Satisfaction with HCP during prenatal period				
Unsatisfied	9 (6.4)	7 (3.3)	Ref	0.16
Satisfied	132 (93.6)	208 (96.7)	2.02 (0.74 to 5.57)	
Behavioural Risk				
History of any abuse				
No	117 (72.2)	191 (76.7)	Ref	0.30
Yes	45 (27.8)	58 (23.3)	0.79 (0.50 to 1.24)	
Smoking 12 months prior to pregnancy				
No	127 (73.4)	223 (87.8)	Ref	<0.001
Yes	46 (26.6)	31 (12.2)	0.38 (0.23 to 0.64)	
Smoking during pregnancy				
No	141 (84.9)	238 (94.1)	Ref	0.03
Yes	25 (15.1)	15 (5.9)	0.35 (0.18 to 0.70)	

*Denominator varies due to missing values for some variables

4.11 Exclusive breastfeeding at 4 months postpartum among new Canadians

4.11.1 Objective

The objective was to quantify the prevalence and odds of exclusive breastfeeding at 4 months postpartum associated with predictors among new Canadians.

4.11.2 Prevalence

The prevalence of EBF at 4 months postpartum among new Canadians was 57.9%.

4.11.3 Bivariate analysis

Table XII presents the estimated percentage, unadjusted odds ratio (OR), 95% confidence intervals and p-values of women new to Canada who exclusively breastfed their infants at 4 months postpartum by select demographic, obstetric, psychological well-being and behavioural risk variables.

4.11.3.1 Demographics

Education and employment status were significant factors of EBF among new Canadian mothers. In comparison to women with less than high school education level, women with some or completed university level education were 3.88 (95% CI: 0.96-15.71) times more likely to be EBF, while women with some or completed graduate school were 4.67 (95% CI: 1.04-21.01) times more likely to be EBF. Women who were working during pregnancy were 2.61 (95% CI: 1.22-5.56) times more likely to be EBF than women who were unemployed during pregnancy.

4.11.3.2 Obstetric

Women who had a pre-pregnancy BMI≥25 were 0.32 (95% CI: 0.13-0.79) times less likely to be EBF compared to women with BMI≤24.9.

4.11.3.3 Psychological well-being

Women new to Canada who reported having inadequate prenatal social support (OR=0.48; 95% CI: 0.23-1.00) and poor physical health during the prenatal period (OR=0.36; 95% CI:0.14-0.89) were less likely to be EBF, compared to those that reported having adequate social support and good self-rated physical health, respectively.

Table XII: Predictors of exclusive breastfeeding at 4 months postpartum among new Canadians

Variable	Non-EBF (n=53)	EBF (n=73)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Demographic				
Maternal age at delivery (years)				
19-24	3 (5.8)	5 (7.0)	Ref	0.96
25-34	35 (67.3)	47 (66.2)	0.81 (0.18 to 3.60)	
35 +	14 (26.9)	19 (29.8)	0.81 (0.17 to 3.99)	
Marital status				
Other	2 (3.9)	3 (4.2)	Ref	0.93
Married/Common Law	50 (96.1)	69 (95.8)	0.92 (0.15 to 5.71)	
Education				
High school or less	8 (15.1)	3 (4.1)	Ref	0.09
Some or complete university/college	33 (62.3)	48 (66.7)	3.88 (0.96 to 15.71)	
Some or complete grad school	12 (22.6)	21 (29.2)	4.67 (1.04 to 21.01)	
Ethnicity				
Non-Caucasian/Other	38 (74.5)	49 (67.1)	Ref	0.38
Caucasian/White	13 (25.5)	24 (32.9)	1.43 (0.64 to 3.18)	
Born in Canada				
No	52 (98.1)	73 (100.0)	Ref	0.24
Yes	1 (1.9)	0	--	
Income				
< $40,000	15 (29.5)	15 (20.6)	Ref	0.36
$40,000 - $80,000	17 (33.3)	22 (30.1)	1.29 (0.50 to 3.36)	
>$80,000	19 (37.2)	36 (49.3)	1.89 (0.77 to 4.69)	
Parity				
No previous births	28 (52.9)	39 (53.4)	Ref	0.95
Previous birth	25 (47.1)	35 (46.6)	0.98 (0.48 to 1.98)	
Employment Status during pregnancy				
Not working	37 (71.1)	35 (48.6)	Ref	0.01
Working	15 (28.9)	37 (51.4)	2.61 (1.22 to 5.56)	
Home ownership				
Other	25 (47.1)	31 (43.1)	Ref	0.65
Own	28 (52.9)	41 (56.9)	1.18 (0.58 to 2.41)	

Variable	Non-EBF (n=53)	EBF (n=73)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Obstetric				
Feelings about Pregnancy				
Unhappy/not sure	8 (15.7)	11 (15.7)	Ref	0.99
Happy	43 (84.3)	59 (84.3)	0.99 (0.37 to 2.69)	
Method of delivery				
Vaginal	36 (67.9)	50 (68.5)	Ref	0.95
Caesarean	17 (32.1)	23 (31.5)	0.97 (0.46 to 2.08)	
Difficulty obtaining prenatal care				
No	35 (67.4)	56 (78.9)	Ref	0.15
Yes	17 (32.6)	15 (21.1)	0.55 (0.24 to 1.24)	
Pre-pregnancy BMI				
≤ 24.9	32 (66.7)	62 (86.1)	Ref	0.01
≥ 25	16 (33.3)	10 (13.9)	0.32 (0.13 to 0.79)	
Preterm Delivery				
No	43 (81.1)	64 (88.9)	Ref	0.23
Yes	10 (18.9)	8 (11.1)	0.54 (0.19 to 1.47)	
Psychological well-being				
Depression during prenatal period EPDS≥13				
No	47 (88.8)	63 (86.3)	Ref	0.69
Yes	6 (11.32)	10 (13.7)	1.24 (0.42 to 3.66)	
Anxious during prenatal period (STAI > 40)				
No	31 (58.5)	49 (69.1)	Ref	0.23
Yes	22 (41.5)	22 (30.9)	0.63 (0.30 to 1.33)	
Stressed during prenatal period				
No	37 (69.8)	51 (71.8)	Ref	0.81
Yes	16 (30.2)	20 (28.2)	0.91 (0.41 to 1.98)	
Psychological well-being during prenatal period (depression, anxiety, stress)				
Good well-being	26 (49.1)	41 (58.6)	Ref	0.29
Poor well-being	27 (50.9)	29 (41.4)	0.68 (0.33 to 1.49)	
Social support during prenatal period				
Adequate	28 (52.8)	51 (69.9)	Ref	0.05
Inadequate	25 (47.2)	22 (30.1)	0.48 (0.23 to 1.00)	
Optimism				
High optimism	31 (72.1)	48 (73.9)	Ref	
Low optimism	12 (27.9)	17 (26.1)	0.91 (0.38 to 2.17)	0.84

Variable	Non-EBF (n=53)	EBF (n=73)		
	n (column %)*	n (column %)*	Unadjusted OR (95% CI)	P-value
Parenting morale index				
High parenting morale	45 (84.9)	59 (84.3)	Ref	0.92
Low parenting morale	8 (15.1)	11 (15.7)	1.05 (0.39 to 2.82)	
Self-rated emotional health during prenatal period				
Good	45 (84.9)	63 (86.3)	Ref	0.82
Not good	8 (15.1)	10 (13.7)	0.89 (0.33 to 2.44)	
Self-rated physical health during prenatal period				
Good	38 (71.7)	64 (87.7)	Ref	0.02
Not good	15 (28.3)	9 (12.3)	0.36 (0.14 to 0.89)	
Satisfaction with family support during prenatal period				
Unsatisfied	0	2 (3.1)	--	0.24
Satisfied	44 (100)	62 (96.9)		
Satisfaction with friends' support during prenatal period				
Unsatisfied	1 (2.3)	5 (7.8)	Ref	0.23
Satisfied	42 (97.7)	59 (92.2)	0.28 (0.031 to 2.49)	
Satisfaction with HCP during prenatal period				
Unsatisfied	2 (4.5)	4 (6.3)	Ref	0.70
Satisfied	42 (95.5)	60 (93.7)	0.71 (0.12 to 4.08)	
Behavioural Risk				
History of any abuse				
No	39 (82.9)	61(85.9)	Ref	0.66
Yes	8 (17.1)	10 (14.1)	0.80 (0.29 to 2.20)	
Smoking 12 months prior to pregnancy				
No	47 (88.7)	70 (95.9)	Ref	0.14
Yes	6 (11.3)	3 (4.1)	0.34 (0.080 to 1.41)	
Smoking during pregnancy				
No	48 (94.1)	68 (94.4)	Ref	0.94
Yes	3 (5.9)	4 (5.6)	0.94 (0.20 to 4.40)	

*Denominator varies due to missing values for some variables

The significant predictors of any breastfeeding (Table XIII) and exclusive breastfeeding (Table XIV) at 4 months postpartum among women residing in Canada/Calgary for >5 years, new Calgarians and new Canadians are shown in Table XIII and Table XIV.

Table XIII: Predictors of any breastfeeding at 4 months postpartum among women residing in Canada/Calgary for >5 years, new Calgarians and new Canadians

Predictor	AOB Cohort (5+ years)†		New Calgarians‡		New Canadians‡	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Common law/married	4.61 (2.01 to 10.57)	<0.001				
Some or complete university/ college Some or complete grad school	1.87 (1.02 to 3.42) 3.08 (1.32 to 7.17)	0.04 0.009				
Income $40,000 -$80,000 Income >$80,000	1.83 (0.78 to 4.2) 2.69 (1.18 to 6.11)	0.16 0.02				
Caucasian/White	0.53 (0.31 to 0.90)	0.02				
Low optimism	0.47 (0.29 to 0.74)	0.001				
Had a preterm delivery	0.43 (0.23 to 0.81)	0.008			0.29 (0.09 to 0.90)	0.03
Poor self-rated prenatal physical health	0.59 (0.35 to 0.99)	0.04	0.37 (0.21 to 0.65)	<0.001		
Home owners			1.88 (1.14 to 3.08)	0.01		
Pre-pregnancy BMI ≥ 25.0			0.46 (0.28 to 0.78)	0.04		
Smoked 12 months prior to pregnancy			0.47 (0.27 to 0.83)	0.008		
Smoked during pregnancy			0.47 (0.23 to 0.97)	0.038		
Anxious during the prenatal period					0.32 (0.12 to 0.86)	0.02

†Results from multivariable analysis
‡Results from bivariate analysis

Table XIV: Predictors of exclusive breastfeeding at 4 months postpartum among women residing in Canada/Calgary for >5 years, new Calgarians and new Canadians

Predictor	AOB Cohort (5+ years)†		New Calgarians‡		New Canadians‡	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Common law/married	3.15 (1.58 to 6.29)	<0.001				
Some or complete university/college Some or complete grad school			2.39 (1.18 to 4.86) 2.82 (1.28 to 6.21)	0.03	3.88 (0.96 to 15.71) 4.67 (1.04 to 21.01)	0.09
Income $40,000-$80,000 Income >$80,000			1.44 (0.76 to 2.75) 1.98 (1.13 to 3.48)	0.04		
Had a preterm delivery	0.41 (0.24 to 0.70)	0.001				
Poor self-rated prenatal physical health	0.45 (0.30 to 0.67)	0.01	0.35 (0.21 to 0.59)	<0.001	0.36 (0.14 to 0.89)	0.02
Multiparous (previous birth)	1.34 (1.00 to 1.80)	0.04				
Caesarean delivery	0.61 (0.43 to 0.87)	0.006				
Pre-pregnancy BMI ≥ 25.0			0.47 (0.30 to 0.73)	0.001	0.32 (0.13 to 0.79)	0.01
Smoked 12 months prior to pregnancy			0.38 (0.23 to 0.64)	<0.001		
Smoked during pregnancy	0.42 (0.27 to 0.66)	<0.001	0.35 (0.18 to 0.70)	0.03		
Inadequate prenatal social support			0.58 (0.37 to 0.89)	0.01		
Employed during pregnancy					2.61 (1.22 to 5.56)	0.01

†Results from multivariable analysis
‡Results from bivariate analysis

Chapter Five: Discussion

5.1 Major findings

The purpose of the study was to identify the prevalence and key predictors of any breastfeeding and exclusive breastfeeding (EBF) at 4 months postpartum in the AOB sample of pregnant women who have been residing in Canada/Calgary for more than 5 years and in two sub-cohorts of women who are new to Calgary and Canada (5 years or less). These latter categories were not mutually exclusive. Overall, any breastfeeding rates were high among all populations and more than 50% of women in each group reported EBF at 4 months postpartum. While there were numerous variables predictive of breastfeeding outcomes, the key factors consistently found to be significant across the different groups and outcomes were prenatal physical health, pre-pregnancy BMI and smoking status prior to and during pregnancy. Other predictors of breastfeeding differed between women who have resided in Calgary/Canada for more than 5 years, new Calgarians and new Canadians. Accompanying the key factors, variables found significant among the larger cohort were optimism, preterm delivery, parity and delivery method in addition to several demographic factors (marital status, education, income and ethnicity). Based on the bivariate analysis, among new Calgarians, education, income, home ownership, social support were also predictors of breastfeeding outcomes, while among new Canadians, education, preterm delivery, prenatal anxiety and employment status during pregnancy were significant predictors. Although certain predictors for breastfeeding duration were similar between the groups, several were dissimilar, suggesting that these groups might benefit from different strategies to optimize breastfeeding outcomes.

5.2 Cohort description

5.2.1 Data sources used for comparisons

The interpretation of findings generated from this cohort will be influenced by the scope of generalizability of the data. The AOB sample is composed of mother-infant dyads that were recruited early during pregnancy. The target population of this cohort is the pregnant and parenting population from urban cities in Canada. Descriptive characteristics of women in the AOB cohort including measures of maternal age, income, ethnicity, method of delivery, and preterm birth were compared to national pregnancy surveys and national and regional statistical sources for representativeness. The national and regional statistical sources used for comparisons were the 2006 Calgary census community profiles and 2010 Alberta perinatal health reports. Data from Statistics Canada are the best available comparative data sources for assessment of representativeness of this sample because the questionnaires used in the AOB study were designed to measure demographic variables similar to Statistics Canada, which allows for comparative analyses between the datasets.

The national pregnancy survey used for comparison of breastfeeding outcomes was the Canadian Maternity Experience Survey (MES). The MES is a cross-sectional survey that collects data on important perinatal health indicators using post 2006 census data of women with singletons births. Women were eligible to participate in the MES if they were 15 years of age or older, and gave birth to a live singleton between specified time frames.[129] A stratified random sample of 8,542 women were selected from the 2006 Canadian Census, of which 8,244 women met the eligibility criteria, and a final sample of 6,421 women responded to the survey.[129] One limitation with using the MES for comparison of representativeness of the AOB study is that the MES employs a different sampling strategy (stratified sampling) than the one used in the AOB

sample (non-stratified sampling) and does not distinguish between women in rural compared to urban regions. However, the wide range of factors assessed in the MES allows for a range of comparisons, beyond socio-demographic characteristics and birth indicators. Other data sources were also used to make comparisons about breastfeeding outcomes, including the Canadian Community Health Survey (CCHS).

5.2.2 Participant characteristics

The AOB study participants were similar in age, income, foreign born status, but had lower rates of caesarean section and preterm delivery in comparison to regional and national statistics. Perinatal health reports from 2010 in Alberta reported the average age of women giving birth in Calgary and Alberta was 30.8 and 29.5 years, respectively.[130] The average age at delivery in the AOB study was 31.4 years (SD=4.3). The cohort was also comparable in income, 54.2% of the cohort reported an annual household income of $100,000 or greater, which is just slightly above the 2010 median income ($97,070) of couple families in Calgary.[131] As reported in the 2006 Calgary census community profile, approximately one-quarter of women in Calgary were foreign-born and one-quarter were a visible minority[132] which is similar to the 24.0% of foreign-born in the AOB cohort. The rates of caesarean section and preterm delivery in the cohort are lower than rates in Calgary.[133]

5.2.3 Prevalence of breastfeeding

The proportion of women in the AOB cohort who initiated breastfeeding (97.9%) and continued to breastfeed for at least 4 months (79.5%) was higher than reported Canadian,[21] Alberta,[21] and Calgary[12] statistics. In Alberta, the proportion of mothers (94.6%) who initiated breastfeeding was above the national average (90.3%) in 2009.[21] Similarly, the prevalence of EBF at 4 months in the cohort was 59.5%, which is higher than the Canadian prevalence of

44.2%.[20] The AOB data largely refers to women with singleton full-term deliveries. These differences in breastfeeding rates between the AOB study and regional/national statistics may arise from different sampling strategies utilized, as mentioned above, differences in study design (cross-sectional vs. longitudinal) and/or variability in definitions and timing of breastfeeding outcomes. Participants of the MES answered a single-phone survey (reflection of the cross-sectional study design), while AOB participants were part of a longitudinal research study. Pregnant women who voluntarily participate in research studies tend to be more health-conscious and may be more likely to recognize the importance of breastfeeding in comparison to women who do not participate in research studies. In addition, MES defines exclusive breastfeeding as the "practice of feeding only breast milk (including expressed breast milk) to babies". The duration of exclusive breastfeeding was derived based on questions about length of breastfeeding and the introduction of liquids or solids at 6 months postpartum in the MES, while EBF was derived from one question that asked about current breastfeeding practices at 4 months postpartum in the AOB study.

5.3 Key predictors of breastfeeding outcomes

Prenatal physical health, pre-pregnancy BMI and smoking status prior to and during pregnancy were consistently found to be significant predictors of any and exclusive breastfeeding at 4 months among the different populations assessed. Women who perceived their prenatal physical health as less than ideal were less likely to still be breastfeeding and EBF at 4 month postpartum. Perceived health is a relative measure and evidence suggests that people assess their health in relation to their circumstances, expectations, and their peers.[134] It is plausible that women who breastfeed may have a healthier lifestyle with optimal dietary intake

and physical activity habits, that likely followed through from pregnancy. Such women may be more aware of the health benefits of breastfeeding, and will ensure that they have a positive breastfeeding experience. Self-perception of physical health during pregnancy has be found to be an accurate indicator of actual health and many women strive to be at their optimal health during pregnancy.[135] In addition, women who report having good or excellent perceived health are likely to be part of close-knit community, and have better support systems.[134]

Similar to prenatal physical health, pre-pregnancy BMI was also another key predictor of any breastfeeding and EBF in the different populations. Among new Calgarians who had a pre-pregnancy BMI≥25 (overweight/obese), 21% reported their prenatal physical health as poor while 14% of women with BMI≤24.9 reported their health as poor. Among new Canadians, 27% with BMI≥25 reported having poor prenatal physical health while this was reported among 16% with BMI≤24.9. Women with pre-pregnancy BMI≥25 were less likely to be breastfeeding at 4 months postpartum, this association was found among both new Calgarians and new Canadians. Similar to this finding, in a population of Caucasian women who lived in rural areas, women who were overweight or obese before conception had a significantly increased risk of failing to initiate breastfeeding successfully.[136] In addition, a study using a nationally representative longitudinal birth cohort found that maternal health status during pregnancy and childbirth may play an important role in an overweight/obese mother's decision to initiate breastfeeding.[137] The authors found that being overweight/obese exerted an independent effect on breastfeeding initiation only among mothers who experienced medical problems during pregnancy or had labor/delivery complications. These women were less likely to initiate breastfeeding compared with those of normal weight even after adjusting for a number of potential confounders.[137] There appears to be a multifactorial biological basis for early breastfeeding cessation among

overweight and obese women, including their lower prolactin response to suckling that compromises the ability to produce milk and over time possibly leads to premature cessation of lactation.[138] Furthermore, overweight/obese women have high levels of progesterone stored in the adipose tissue, and progesterone helps maintain pregnancy and triggers milk production when levels decline after giving birth. However, in these women, excessive progesterone delays milk production. This hypothesis has yet to be confirmed.[138] In addition, there may be other socio-cultural and psychological reasons why overweigh/obese women have lower breastfeed rates.[45] For example, women who are obese are more likely to belong to social groups (lower socio-economic status) who are less likely to breastfeed.[45,95] Obese women may also feel more uncomfortable with the idea of breastfeeding in public.[45,95] The psychological reasons include greater body image dissatisfaction and the increased prevalence of postpartum depression among obese women.[45] Women with increased concern about their body shape or weight are less likely to intend to breastfeed and depressed mothers are less likely to continue breastfeeding than non-depressed mothers.[45]

Finally, smoking prior to pregnancy and during pregnancy were also significant predictors, as it reduced the likelihood of any breastfeeding and exclusive breastfeeding among the populations assessed. The prevalence of smoking during pregnancy among women residing in Canada/Calgary for 5+ years was 13.0% which is higher than the prevalence of pregnant women aged 20-44 that smoked in Canada (9.9%) in 2007[139] and the 2010 maternal smoking rate of 10.1% in Calgary.[133] Fortunately this is a decline from the proportion of women who reported smoking 12 months prior to pregnancy (22.1%) in the cohort. The proportion of new Calgarians that smoked during pregnancy was 9.0% , in comparison to the 18.1% that reported smoking 12 months prior to pregnancy. There may be a biological mechanism for this association: nicotine

may have a negative effect on breast milk supply due to suppression of prolactin levels.[98] This relationship could alternatively be explained by the social behavioural differences between smokers and non-smokers. Amir (2001) reviewed several possible mechanisms by which maternal smoking affects lactation and found stronger evidence for a social mechanism than a physiological mechanism.[140] Women who smoke and women who formula feed appear to share characteristics, as these women tend to be younger, less educated, be of lower income, and were more likely to have unplanned pregnancies. It is possible that women who smoke during pregnancy will continue smoking postpartum and while breastfeeding. In this study, the influence of breastfeeding intention on the association between smoking and breastfeeding could not be investigated, and further research, including the influence of postpartum smoking on breastfeeding is required.

5.4 Other predictors of breastfeeding at 4 months postpartum among women living in Canada/Calgary for 5+ years

Along with demographic factors (marital status, education, income and ethnicity), parity, preterm delivery, method of delivery and optimism were also significant predictors of breastfeeding outcomes based on multivariable analyses. Married women and those in common law relationships were significantly more likely to breastfeed (any or EBF) at 4 months postpartum compared to single women after adjusting for the above mentioned predictors. This finding that women with partners have increased odds of breastfeeding is well supported by the literature.[7,31,38] A partner provides much needed support to a woman having difficulty breastfeeding and who may be at risk of early cessation.[6] Partners may advocate for breastfeeding and provide reassurance and impart confidence to breastfeeding mothers.[7,31]

Moreover, level of education and household income are two constructs that are often used as proxies for socioeconomic status (SES). Women of greater SES (higher education and income levels) were more likely to breastfeed (any or EBF) compared to women of lower SES, a finding consistently supported by the literature.[9,12,31,34] Though, higher income levels are often associated with higher maternal education, both variables were independent predictors of any breastfeeding in this study, indicating the association between income and breastfeeding was not related to education level. According to a review by Dennis *et al.* (2002), this positive relationship between SES and increased breastfeeding has been found in more developed countries, like Canada, whereas an inverse relationship was present in developing countries.[7] In developing countries, higher income women perceive breastfeeding as old-fashioned and a sign of lesser social status and perceive bottle-feeding as modern and Westernized,[7,37] leading to lower rates of breastfeeding. In addition, ethnicity was a significant predictor of any breastfeeding, but not of EBF at 4 months postpartum in this study. Women of non-Caucasian ethnicity were more likely to breastfeed than their Caucasian counterparts. Caucasian women consisted of 78.9% of the cohort, followed by women who identify themselves as Chinese (6.1%), followed by mixed/other (4.7%). Other literature also report similar results of non-Caucasian women more likely to be breastfeeding.[7,7]

Parity was a significant predictor of EBF at 4 months. Women who had given birth previously were more likely to be EBF their current child compared to first-time mothers. This finding is supported by the literature.[7,36] Women with previous children tend to have increased knowledge and self-confidence from earlier breastfeeding experiences compared to first-time mothers who typically have limited contact with other breastfeeding women and have little experience to draw from.[51] Multiparous mothers could have observed the benefits of

breastfeeding in their older children, be able to easily troubleshoot breastfeeding difficulties and are less likely to be discouraged and resort to formula feeding.[7] In addition, they may also be more aware of the resources available to support breastfeeding. However, the AOB data could not determine if multiparous mothers had breastfed other children.

Furthermore, women who delivered a preterm infant were significantly less likely to breastfeed (any or EBF) at 4 months postpartum compared to term deliveries. This is consistent with a study utilizing a nationally representative sample of Australian infants that found preterm infants were less likely to be breastfed at 6 months after adjusting for standard confounding factors.[141] Infants born prematurely and before 40 weeks were at greater risk of being artificially fed than infants born at 40 weeks or later, thus increasing their vulnerability to infection and future ill health.[141] There may be several reasons as to why preterm delivery may be associated with early cessation of breastfeeding. Firstly, the main determining factor for early weaning among premature babies is length of NICU stay.[142,143] The length of hospital stay for preterm infants was longer than for term infants in this study (results not reported). Longer hospitalization results in mother-infant separation, which may lead to delayed onset of oral feeding and in turn higher weaning rates. Infants that were treated longer at hospitals have been found to be formula fed at the time of hospital discharge.[142] Finally, preterm infants have less effective (immature) suckling during breastfeeding compared to term infants which limits breast milk intake.[144] A randomized clinical trial on the measurement of milk intake in the home of 24 mothers of preterm infants found that all mothers had an established milk supply that exceeded infant intake requirements. The infants consumed only 30% of daily intake from the breast during the first week at home, gradually increasing to 52% of daily intake during breastfeeding over the fourth week.[145] The immature sucking of preterm babies and the delayed lactogenesis

are cyclic, as immature sucking further reduces available milk, which in turn, limits infant intake, and which subsequently results in low rates of any and exclusive breastfeeding.[144] However, despite these reasons, the admission of preterm infants to the NICU may have a positive effect on breastfeeding. A study using the pregnancy risk assessment monitoring system (PRAMS) data from 27 states for the years 2000 to 2003 found that mothers of preterm NICU-admitted infants (<32 weeks) were more likely than mothers of non-admitted infants to continue breastfeeding for 4 weeks.[146] The authors suggested that the positive effect of NICU admission on breastfeeding among preterm infants may be partially due to exposure to positive messages and educational interventions promoting breastfeeding.[146] The association between preterm delivery and breastfeeding needs further investigation, with an emphasis on the effect of gestation gradient on breastfeeding outcomes.

In addition, women with vaginal deliveries were more likely to be EBF than women who delivered via caesarean section. Research supports the notion that a woman's obstetrical experience may influence her breastfeeding behaviour.[7] Women become surgical patients when delivery takes place by caesarean section and often remain in hospitals longer after birth compared to women who deliver vaginally (average 3.8 days versus 2.1 days).[21] Length of hospital stay could alter the strength of the relationship between mode of delivery and breastfeeding initiation. The median length of infant hospital stay in this sample for women with caesarean delivery was greater than the median length of infant hospital stay for women with vaginal deliveries (results not reported). Hospital stays longer than 48 hours after delivery was a risk factor for early discontinuation of breastfeeding in a cross-sectional Canadian study.[51] This finding is more common among hospitals who have not established BFHIs. This association was also found among women who had a planned caesarean section.[51] A study conducted in China

(n= 431,704 women) found that women with planned caesarean section were less likely to be EBF and more likely to formula feed than women with planned vaginal deliveries.[147] The correlation between maternal intention to delivery method and feeding warrants further research, as the characteristics of women who elect to have caesarean section may influence breastfeeding outcomes. In addition, women may have other medical conditions during pregnancy that predispose them to having caesarean deliveries, which in turn affect breastfeeding outcomes. On the other hand, it could be argued that women with caesarean deliveries who remain in hospitals longer have more time to work through breastfeeding difficulties with the expertise of nurses and lactation consultatnts.[148] Further research is needed on the potential influence that health service provider practices may have on the association between method of delivery and breastfeeding.

Finally, optimism during pregnancy was also found to be associated with any breastfeeding at 4 months. Women with lower scores on optimism were significantly less likely to breastfeed. One previous study found that the duration of breastfeeding was significantly associated with optimism, that is, the higher the score on dispositional optimism, the longer the duration of breastfeeding.[149] Low optimism may be associated with lower maternal confidence, and women with low confidence in their perceived ability to breastfeed were at a greater risk of discontinuing breastfeeding.[150] Studies evaluating the direct association between optimism and breastfeeding are limited and more research is needed.

5.5 Other predictors of breastfeeding at 4 months postpartum among new Calgarians

In the AOB sample, 34.0% were new Calgarians (≤5 years in Calgary). Among new Calgarians, education, income, home ownership, social support were also predictors of breastfeeding outcomes at 4 months postpartum, based on the bivariate analysis. The impact of

education and income on breastfeeding outcomes were described above. The proportion of women reporting to be home-owners increased with greater levels of incomes and these women had greater odds of any breastfeeding at 4 months. In addition, new Calgarians with inadequate prenatal social support were less likely to be EBF, which is supported by the existing literature.[6,7,87] Social support that increases breastfeeding includes emotional, tangible, and educational components from both informal and formal networks.[89] These networks have the ability to inform a mother's beliefs about the advantages and disadvantages of infant feeding methods[89]. Unlike demographic factors, social support is modifiable. Breastfeeding promotion programs that recognize the role of social support tend to be successful. A Cochrane review of 34 trials (29 385 mother-infant dyads) showed a lower risk of breastfeeding failure when any extra breastfeeding support was offered.[26] Social support is one factor that undoubtedly has a positive effect on breastfeeding rates.

5.6 Other predictors of breastfeeding at 4 months postpartum among new Canadians

In the AOB sample, 10.3% were new Canadians (≤5 years in Canada). The status of new Canadians upon entering Canada varied: 68.3% were refugees, 27.5% entered with student visa/work permit, 2.1% were immigrants and 2.1% were dual citizens. Women new to Canada were all treated as one homogenous group and results were not stratified by refugee/immigrant status at entry. The largest ethnic groups after Caucasians in the sample were Chinese and South Asians. Women from Chinese and South Asian descent come from countries that often have programs that promote WHO's recommendation for breastfeeding and therefore these women may be familiar with the promotion of breastfeeding in hospitals and communities. Among new Canadians, education, employment status during pregnancy, preterm delivery and prenatal

anxiety were significant predictors of breastfeeding at 4 months postpartum. These predictors will be explained within the context of the healthy immigrant effect.[49,151] The well accepted phenomena that new immigrants have significant health advantages relative to the native-born population is referred to as the healthy immigrant effect.[49,151] Three explanations have been proposed to explain this effect: a self-selection process of healthy individuals who are able and motivated to migrant to another country, immigration process in Canada that select the "best" immigrants on the basis of education, language ability and job skills, and favourable habits and behaviours of individuals in the home country prior to migration.[49,151]

Firstly, the protective effect of education on duration of breastfeeding (EBF) for new Canadians was only present for women in the highest education level (some or complete graduate school), while for women residing in Canada/Calgary for 5+ years, any education above high school appears to be associated with increased odds of breastfeeding. In addition, employment status during pregnancy appears to be a strong predictor of EBF among new Canadians. Within the context of the healthy immigrant effect, immigrant self-selection implies that prospective migrants would be more likely to be at the higher end of the income distribution in their home countries.[151] They would be expected to have better health as a result of better diets, access to clean water and sanitation, less exposure to environmental risks and better child/maternal healthcare.[151] These qualities of new immigrants facilitate social and economic integration, such as employment, and are coupled with healthy lifestyles,[49] such as breastfeeding.

Based on the healthy immigrant effect, mental health issues are less prevalent among recent immigrants than the Canadian-born population; however, this advantage diminishes as length of residence in Canada increases. Living in areas with a high density of immigrants may help immigrants retain this advantage.[152] In contrary to the health immigrant effect, anxiety

during the prenatal period was a significant predictor of any breastfeeding only among new Canadians. Women found to be anxious during the prenatal period were less likely to breastfeed at 4 months. A community cohort study found that women with a history of depression and anxiety experience more breastfeeding difficulties which consequently resulted in early cessation.[12] However, a prospective cohort study that examined anxiety during pregnancy found no relationship to breastfeeding initiation, although higher anxiety levels were related to a lower intention to breastfeed, which is known to predict initiation.[153] This study finding may suggest that prenatal anxiety is potential modifiable risk factor for early cessation of breastfeeding. Recognizing the role that prenatal anxiety has on breastfeeding may be helpful in designing public health interventions to target new Canadians at high risk of discontinuing of breastfeeding. The examination of whether trait anxiety is also associated with breastfeeding outcomes should be assessed.

Finally, women who had preterm deliveries were less likely to breastfeed at 4 months, the reasons why preterm delivery may be associated with early cessation of breastfeeding was discussed above. The prevalence of preterm birth (defined as being born before 37 weeks of gestation) was greater among new Canadians (18/129; 14.0%) than among women residing in Canada/Calgary for 5+ years (8.1%). The high rate of preterm birth among new immigrants is supported by a population based Danish study that found immigration had a stronger association with very preterm birth (≤32 weeks) compared to moderate preterm birth (33-36 full weeks). The association between length of residence and preterm delivery was U-shaped, with the highest risk among recent and long-term residents.[154] However, a Canadian study found that recent immigrants (< 5 years) had a lower risk of preterm birth than non-immigrants (4.7% versus

6.2%)[155], which is contrary to current findings. Further research is needed to understand this association among this population.

5.7 Limitations

There were several limitations with the present study. Firstly, the information was based on self-report questionnaires. Information bias may arise from use of self-report questionnaires as socially undesirable answers may tend to be underreported. However, women were assured that responses would be used only for research purposes and would not be linked to their clinical care. Secondly, the possibility that women may remember how they answered past questionnaires when completing subsequent questionnaires was a limitation as standardized scales were repeatedly used each time.[156] Thirdly, since the questionnaires were available only in English, study findings may only be generalizable to women who have adequate language skills to complete the questionnaires in English. However, based on the 2011 Census, only 2.8% of women in Calgary and 1.6% of women in Alberta had no knowledge of either English or French.[157] Fourthly, the longitudinal design of this study leads to attrition and non-response, which affects external and internal validity. Attrition bias, common to all longitudinal studies, can be a possible limitation that affects the external validity (if the women who drop out were systematically different from those who remain in the study) and internal validity (women who remain altered the correlations among variables that are different from the true correlations in the original sample). Although the sample size was relatively large for this kind of study, the sample of women new to Canada and Calgary resulted in the inability to perform multivariable analysis among these two subpopulations, as there were stratums with zero cell size. The nature of sample

may slightly limit the generalizability, as the rates presented in this study may not be representative of these Canadian subpopulations.

The use of depression, anxiety and stress scales as categorical variables was another limitation. It has been argued that the use of cut-offs for continuous variables may be unrealistic from a biological view point as individuals that score closely on a scale but fall on opposite sides of the cut-off will be characterized as having different outcomes.[158] Dichotomization may increase the probability of false positive results (type 1 error). In addition, when the odds increase or decrease directly with another variable of interest, the odds will increase with the number of categories used. When two categories are used, the variation in odds will be underestimated.[158] Overall, categorizing continuous variables may cause information loss and bias. Furthermore, the instrument used to collect information for some variables: Perceived Stress Scale, Life Orientation Test-Revised (LOTR), and Parenting Morale Index (PMI) during the prenatal period do not have guidelines for cut-points and therefore were dichotomized into the upper 75^{th} or the lower 25^{th} percentile of scores. The use of such data-derived "optimal" cut-offs can lead to bias due to the inability to replicate the cut-off in subsequent studies. The mental health and psychosocial variables could not have been used as continuous variables as they were not normally distributed and showed evidence of skewness in the sample, even after data transformations (logarithm). For this reason and given the presence of established cut-offs in the literature for most of the scales, the categorization of variables were used. Furthermore, for the purposes of this study, the use of cut-offs to differentiate between women at risk of mental health offers a binary risk classification and assists in making policy-oriented decision from a clinical point of view and avoids violating linearity assumptions of continuous variables from a statistical point of view.

5.8 Strengths

The prospective nature of this study was a major strength. A prospective study design minimizes recall bias since participants are being asked questions about their present status, not about past events. The use of standardized tools and validated questions decreased other potential sources of bias (i.e. misclassification bias). The rigorous data collection stage and intensive follow-up of the AOB cohort resulted in a high retention rate and a large sample size. A large sample size is required for multivariable analysis and the examination of numerous predictors. Selection bias is minimal as participants were recruited from patient populations at multiple clinical and non clinical settings and through a population based approach with Calgary Laboratory Services such that all women with a rubella screen were eligible to be contacted, which allowed for a citywide and surrounding area sampling approach. Most importantly, the AOB data is very comprehensive and provides information on many important predictors and indicators of pregnancy outcomes.

5.9 Implications

The results of this study will assist health care professionals in identifying women who may be at-risk of early breastfeeding cessation, before 6 months as recommended by WHO[1] and Canadian Paediatric Society.[4] Women often receive information about breastfeeding during the prenatal, birth or postpartum periods, often in clinical settings. Inconsistent information may be a barrier to successful breastfeeding duration. Public health information and educational strategies to achieve better breastfeeding duration should be based on evidence-based practices. Strategies should take into account the predictors identified to influence breastfeeding outcomes, that is, a woman's decision to initiate breastfeeding occurs before pregnancy and the ability to sustain

breastfeeding over time is dependent on attitudes towards breastfeeding and perceived support. Information about breastfeeding is available through written materials and electronically and provides extensive information for expectant and new parents and is used by health authorities in Alberta. Health regions also make use of written materials from national agencies, including PHAC and Dieticians of Canada. These materials are provided to women during prenatal classes, and doctor and clinic visits. Given that information regarding breastfeeding is offered in different formats and settings, it is pivotal that recommendations and practices about breastfeeding be consistent. In addition, it is also vital that this information be offered in a sensitive and positive way, which may influence breastfeeding duration and confidence. Research shows that verbal persuasion from lactation consultants, health care professionals, peer counselors, family/friends can increase mothers' confidence with breastfeeding.[159] Women's breastfeeding confidence is also influenced by exposure to breastfeeding, her perception of being supported, past breastfeeding experiences and physical/mental status of women.[159,160]

The results of this study suggest that numerous factors predicting breastfeeding outcomes including prenatal physical health, pre-pregnancy BMI and smoking status prior to and during pregnancy, are similar between women new to Canada or Calgary and long-term residents. It is also possible that immigrant women may have cultural beliefs about breastfeeding that differ from Western practices. Health care providers need to consider effective ways to integrate both beliefs to develop educational programs relevant to the population group. Informational materials about breastfeeding and prenatal educational classes oriented at pregnant women and new mothers should reflect cultural differences of the communities being served. In addition, health care providers should be culturally competent, that is, have knowledge, attitudes, and skills to support women of different ethnic groups, and with regards to breastfeeding, they should be

aware of the common practices within dominant cultural groups in the region. Cross-cultural training should be promoted among health care staff so that they are sensitive and adaptive to varying cultural norms through both verbal and non-verbal communication. Finally, providing breastfeeding counselling in community settings where immigrant groups who may be at increased risk of early cessation reside could contribute to attaining higher rates.

5.10 Future research

The role of immigration status and acculturation-related variables on breastfeeding deserves exploration in future studies. The risk factors are likely to be quite different in women with refugee status versus those with work permits/student visas at entry and this is worthy of further study. In addition, a larger sample size of recent immigrants will allow for obtaining results of greater generalizabiltiy, thus future studies could oversample vulnerable populations. In order to better evaluate the healthy immigrant effect, a separate analysis of predictors of breastfeeding among foreign-born Canadian citizens who have been residing in Canada for more than 5 years should be conducted and compared to the new Canadians sub-cohort. According to the healthy immigrant effect, the good health of recent immigrants deteriorates over time relative to native-born individuals; this decline has been attributed to persistent barriers to access of health services, environmental factors, and adoption of native-born behaviours relevant to health[32]. Based on this effect, the breastfeeding outcomes of foreign-born Canadian citizens should be more similar to Canadian-born individuals. Future research should also incorporate the role of fathers in providing breastfeeding support and evaluate maternal intention and attitude towards breastfeeding.

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