

Assessing Disparities in Socio-behavioral Perinatal Health Risk Indicators among Immigrants in
Manitoba

By

Roheema O. Ewesesan

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Department of Community Health Sciences
Max Rady College of Medicine
Rady Faculty of Health Sciences
University of Manitoba
Winnipeg

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Abstract

Background: Perinatal risk factors can vary by immigration status. To advance knowledge on socio-behavioral perinatal health risks among childbearing immigrant women, this study compared select psychosocial and behavioral perinatal health risk indicators between immigrant and non-immigrants overall and according to key immigrant characteristics such as refugee status, secondary migration, birth region, and duration of residence.

Methods: A population-based cross-sectional study was conducted among 33,754 immigrant and 172,342 non-immigrant childbearing women residents in Manitoba, Canada, aged 15-55 years, who had a live birth and available data from the universal newborn screen completed within two weeks postpartum, between January 2000, and December 2017. Immigration characteristics were obtained from the Canadian federal government immigration database. Odds Ratios (OR) with 95% confidence intervals (CI) were computed from logistic regression with Generalized Estimating Equations to estimate the associations between immigration characteristics and perinatal health risk indicators, such as social isolation, relationship distress, partner violence, depression, alcohol, smoking, substance use, and late initiation of prenatal care.

Results: More immigrant women reported being socially isolated (12.3%) than non-immigrants (3.0%) (Adjusted Odds Ratio (aOR): 6.95, 95% CI: 6.57 to 7.36) but exhibited lower odds of depression, relationship distress, partner violence, smoking, alcohol, substance use, and late initiation of prenatal care. In analyses restricted to immigrants, recent immigrants (< 5 years) had higher odds of being socially isolated (aOR: 9.04, 95% CI: 7.48 to 10.94) and late initiation of prenatal care (aOR: 1.50, 95% CI: 1.07 to 2.12) compared to long-term immigrants (10 years or more), but lower odds relationship distress, depression, alcohol, smoking and substance use. Refugee status was positively associated with relationship distress, depression, and late initiation of

prenatal care, while secondary migration was associated with lower prevalence of social isolation, relationship distress, and smoking during pregnancy. Relationship distress and behavioral health indicators varied by maternal birth region.

Interpretation: Immigrant childbearing women had a higher prevalence of social isolation but a lower prevalence of other psychosocial and behavioral perinatal health risk indicators than non-immigrants. Among immigrants, there was heterogeneity according to immigrant characteristics. Health care providers may consider the observed heterogeneity in risk to tailor care approaches for immigrant subgroups at higher risk, such as refugees, recent immigrants, and those from certain world regions.

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Chapter 1

Introduction

1.1 Background

Maternal, child, and perinatal outcomes may differ by immigration status.^{1,2} The healthy immigrant effect describes the phenomenon by which immigrants exhibit better health outcomes than the receiving-country population. The phenomenon, which occurs shortly after arrival,³⁻⁵ presumably due to selective migration, has been referred to as an explanation for the favorable outcomes of immigrants. On the other hand, immigrants also exhibit substantial heterogeneity across multiple dimensions of vulnerability,⁶ and the healthy migrant hypothesis may not apply to specific subgroups, such as refugees.⁷ Moreover, mixed results in the literature comparing immigrants and non-immigrants also depend on methodological characteristics, such as different study designs, data sources, population diversity and composition, comparison groups, small sample sizes, and differences in variable definitions.⁸⁻¹¹

Disparities in perinatal outcomes may also be due to differences in risk factors between immigrants and non-immigrants. The migration process can be considered a psychosocial stressor¹² that intersects with immigrant women's socioeconomic marginalization and vulnerability in the new country.¹³ Pregnancy and the perinatal period are sensitive to environmental influences that can trigger and exacerbate complex health risks associated with perinatal psychosocial changes and adjustments.¹⁴ For instance, poor relationship quality or marital stress related to post-migration and acculturation stress¹⁵ may be a risk marker for partner violence.^{16,17} The experience of partner violence or abuse can trigger or worsen depression^{10,18,19} and increase maternal stress levels, strongly influencing adopting unhealthy

coping behaviors, such as smoking and consuming alcohol.^{20,21} Unhealthy behaviors have been reportedly associated with social isolation²² and delayed prenatal care utilization.^{22,23}

Among immigrants, variation in perinatal outcomes and risk factors may be driven by immigrant characteristics.² Unlike primary immigrants, who immigrate directly from their country of birth, secondary immigrants (also referred to as serial migrants) reside in at least one intermediate country before immigrating to their final destination.^{24,25} Secondary (voluntary) immigrants are a highly selected subgroup of immigrants characterized by higher educational credentials and global upward socioeconomic mobility, which are conducive to better health outcomes.²⁶

However, the secondary migration advantage may not apply to refugees who spent long periods of time in refugee camps in intermediate countries.^{7,24} Several studies have documented the erosion of immigrants' initial health advantage with increasing duration of residence,^{4,27,28} although some health outcomes such as depression may improve over time after migration.^{29,30}

Reports examining multiple psychosocial and behavioral perinatal health indicators among immigrant groups are scarce and limited to non-population-based studies with small sample sizes.^{1,31,32} There is a lack of studies assessing psychosocial and behavioral perinatal health outcomes among immigrant subgroups defined according to refugee status, secondary migration, and maternal birth region.

To advance knowledge on the psychosocial and behavioral perinatal health indicators among childbearing immigrant women, we used population-based provincially funded screening data collected in the home by public health nurses, typically within two weeks postpartum, linked to Canadian federal government immigration records. All new permanent residents to Canada, including economic and refugee applicants and their dependents are eligible for the free-of-charge publicly funded universal health care coverage, which includes physician and hospital

services that is provincially administered. Some temporary residents (work permit visas) are also eligible for the provincial health care coverage. A small proportion of refugee claimants (also known as asylum seekers) are not covered by the Manitoba Health Care Insurance Plan but by a federally funded program (i.e., the Interim Federal Health Program) while awaiting resolution of their case. Our objective was to compare select psychosocial and behavioral perinatal health indicators between immigrants to Manitoba, Canada, and non-immigrants overall and according to key immigrant characteristics such as refugee status, secondary migration, maternal birth region, and duration of residence.

1.2 Theoretical framework

The theoretical framework for this study was premised on the life course perspective that is based on the principle that past social contextual factors or experiences may explain later life health outcomes.³³ Within the context of immigration and pivotal to the understanding of the life course perspective, is a second framework (the migration process) that is central to immigrants and broadly divided into three stages (1) pre-migration, 2) migration process, 3) post-migration integration/assimilation/acculturation. The migration process as a framework provides a basis for understanding the relationship between immigration and the health of immigrants.³⁴

1). The pre-migration stage depends on human agency and involves three elements including voluntariness, migration motive, and planned move,^{35,36} all of which can have beneficial or detrimental impact on migratory experiences. The expectation of voluntary immigrants (i.e., primary immigrants or secondary non-refugee immigrants) is to succeed economically in the new country and is usually a significant factor that informs migration decisions.³⁷ Expectations

usually differ for vulnerable groups such as the refugees, whose decision to migrate is usually non-voluntary and mostly unplanned. Aside from the human agency, some determinants of health such as the socioeconomic environment of the place of origin, physical environment, early childhood exposures, language, culture, social norms or values, patriarchal or gender inequality, and traumatic events form the pre-migration experiences of immigrants. These determinants or experiences shape the post-migration life and health outcomes of immigrants.

2). The migration process begins with the events that trigger migration (forced or voluntary) and ends upon arrival to the new destination. The process may be short or long depending on a number of determinants including economic or structural factors. Immigrants that migrate for economic reasons may follow a short geographically direct migration (primary immigrant) or a serial or stepwise migration pattern (secondary immigration), working their way up a hierarchy of destination countries to accumulate sufficient immigrant capital or economic gains.³⁹ The migration process could be long for forced migrants who experience documentation-related structural challenges³⁹ and end up spending long periods of time in refugee camps in intermediate countries (i.e., secondary refugee migrants).^{7,24} Immigrants and refugees may experience migration similarly in some ways. However, their experiences are quite different. Unlike voluntary immigrants, refugees had to flee their home countries because of the imminent threat of persecution or harm posed by political or civil unrest, armed conflict, or natural disasters and during their migration.⁴⁰ They experience several challenges including the need to adapt to a new country, language, and culture.⁴¹ Because of the vulnerabilities created by these circumstances, refugees are more likely at risk of adverse long-term psychological and behavioral problems.^{41,42}

3). The Post-migration stage involves the process of integration, although other concepts such as acculturation/assimilation have been used indistinctively to describe this stage. The integration process begins upon arrival into the host country⁴³ and could be affected by a number of factors. Sociodemographic profile of immigrants and immigration policies of the receiving country (e.g., that favors selective migration of economic immigrants) play significant role in the integration process of voluntary immigrants. Sociodemographic determinant such as a high educational achievement of primary or secondary (voluntary) immigrants seeking upward socio-economic mobility may also likely enhance socio-cultural integration into the host or transition country.^{37,44} Determinants of integration also include access to healthcare and other social programs, which may differ by destination country, labor market insertion, or integration policies of the receiving country. In Canada for instance, accessing provincially administered universal health care services for immigrants who experienced forced migration circumstances (e.g., refugee immigrants including the asylum seekers), present a postmigration integration challenge until their legal immigration status is resolved. Integration process for refugee immigrants into the labor market in Western countries is often challenging and determined by self-sufficiency in language and trade/skills that they acquire overtime in the host country.⁴⁰

Gender disparities can also affect the integration process. Immigrant women's multiple caregiving responsibilities with limited or no social support by their male partner can complicate immigrant women's existing socioeconomic marginalization and vulnerability.^{13,45}

Marginalization from the work force in the form of unemployment can erode sense of identity, self-respect, and confidence among immigrant women. The accumulation of post migration stress during the process of resettlement can affect mental health outcomes, sometimes resulting in increased anxiety and depression.⁴⁶ A few studies have identified integration challenges

within other immigrant contextual characteristics such as birth region. African immigrants were found to face significant post migration health challenges (e.g., partner violence, depression) as refugees.^{35,47}

The migration process as a framework thus provides a basis for understanding the life course perspective which according to Li and Anderson, identified the pre and post-migration stages as distinct stages along the immigrant's life course, positing that health outcomes in the post-migration stage cannot be fully understood unless social trajectories or social exposures in the pre-migration context are considered.³³ Furthermore, according to Ben-Shlomo and colleagues the critical developmental periods, which in the case of this present study is the peripartum period, is also as important as the knowledge of social trajectories (i.e., the immigration process) when understanding the long-term health risks of women.⁴⁸

Chapter 2

Literature Review

2.1 Introduction

This section reviews the literature on psychosocial and behavioral perinatal health risks of immigrant childbearing women within the scope of the research study. Sections include review of the dependent variable (i.e., psychosocial and behavioral perinatal health outcomes), the explanatory variables (i.e., immigrant characteristics such as region of birth, duration of residence, refugee status, and secondary migration), and the associations between dependent and explanatory variables, followed by identification of gaps in the literature.

The main objective of this study is to compare psychosocial and behavioral perinatal health risks between immigrants and non-immigrant childbearing women and among immigrant childbearing women subgroups in Manitoba.

2.2 Dependent variables

2.2.1 Psychosocial perinatal health outcomes

The peripartum period, from preconception and pregnancy up to one year after delivery,⁴⁹ refers to a time in women's lives associated with significant physiological and psychosocial change and adjustment.¹⁴ Pregnancy by itself is a stressful condition with physical, mental, and social consequences. A woman's exposure to psychosocial stressors can become more deleterious, especially when present before pregnancy, accumulate, and persist postpartum.⁵⁰ During the peripartum period, many aspects of childbearing women's health require significant attention as several risks have shown to have an untoward negative influence on their health and their

children's overall health. The risk exposures of women during the peripartum period are complex, and well-documented examples include partner violence or abuse,^{10,21,51,52} depression,^{18,19,53} and lack of social support.⁵⁴⁻⁵⁶ These health risks mentioned, especially those associated with elevated stress levels, have a strong relationship with maternal engagement in various health-damaging behaviors.⁵⁷

Maternal experience of violence or abuse around pregnancy is associated with higher odds of intrauterine growth retardation, antepartum hemorrhage, perinatal death,⁵⁸ preterm birth, and small for gestational age babies.^{59,60} Risk factors for peripartum partner violence include abuse before pregnancy, lower education level, unintended pregnancy,⁶¹ lone mothers, and low-income or financial difficulties.⁵¹ The odds of peripartum partner violence vary with age. Women younger than 20 years have a higher risk compared to older women.^{62,63} The presence of young children contributes to household stress and is linked with a higher partner violence rate. Partner violence and maternal parenting stress are consistent risk factors for child maltreatment (psychological and physical aggression, neglect).⁶⁴ Children exposed to partner violence appear to manifest adverse effects⁶⁵ including “cognitive and emotional responses such as higher levels of internalizing behaviors (anxiety, social withdrawal, depression), fewer interests and social activities; preoccupation with physical aggression, withdrawal and suicidal ideation; externalizing behaviors (aggressiveness, hyperactivity, conduct problems), reduced social competence, school problems, truancy, bullying, excessive screaming, clinging behaviors, speech disorders); and physical symptoms (headaches, bedwetting, disturbed sleeping, failure to thrive, vomiting, and diarrhea)”⁶⁶ and are more likely to be victimized as an adult.⁶⁷ Concerning the timing of abuse or violence, female financial dependency may contribute to the continuation of preexisting violence into the pregnancy period.⁵² Partner violence or abuse rate was

reportedly lower during pregnancy and postpartum than before pregnancy. Rate is also lower among immigrants compared to Canadian native-born.^{51,62} What contributes to pregnancy as protective against partner violence is still less understood. The low rate among immigrants may reflect differences in the perception of violence experience. Often, immigrant women may not consider some acts violent, and culturally, immigrant women may be more reluctant to acknowledge or report violence.⁶²

Often, marital discord or poor relationship quality may degenerate into abuse or other forms of partner violence. There is a dearth of research comparing immigrants' and non-immigrants' relationship quality. However, among immigrants, postmigration sources of stress, patriarchal social norms that dictate gendered behavior, gender inequality, changes in gender relations that affect the power dynamics between men and women post-migration, and financial dependence of women on their spouses increase the risk of marital conflict and partner abuse.^{16,17}

Depression is associated with adverse perinatal, maternal, and child health outcomes. Maternal anxiety, life stress, history of depression, lack of social support, unintended pregnancy, lack of health insurance, lower education and income, smoking, single status, poor relationship quality or marital stress, lack of prenatal care, and cultural factors all increase the risk of both antepartum and postpartum depressive symptoms.^{53,68} Maternal depression before pregnancy is associated with inadequate prenatal care, poor nutrition, a higher risk of preterm birth, low birth weight, pre-eclampsia, and spontaneous abortion.⁶⁹ Maternal depressive symptom during pregnancy is associated with child developmental delay at 18 months.⁷⁰ During pregnancy, depression may be a risk factor, a correlate, or a health consequence of partner violence.^{10,60} The association between partner violence and depression was described as a deadly co-morbidity due to the established risk of homicide and suicide when both conditions are present.⁷¹ The

consequences of maternal postpartum depression on a child are not restricted to infancy but can extend into toddlerhood, preschool, and even school-age manifesting as internalizing and externalizing behavioral problems and low cognitive performance.⁶⁹ A review study by Collins et al.⁵³ reported a postnatal depression prevalence of 42% among immigrant women compared to 10-15% among native-born. Suggestive to increase risk among immigrants are poverty,³⁰ multiple caregiving responsibilities,⁹ and accumulation of daily hassles worsened by limited or no social support.⁴⁵

Unhealthy behavior during pregnancy is still prevalent among Canadian women²³ and can be seen contextually as a coping strategy to deal with negative emotions and stress levels. The risk is higher among women who experience social isolation or receive inadequate support from their partner to process emotional stress,^{22,63} and well documented is its association with delay in prenatal care utilization.^{22,23,72,73} Analysis based on 2005/06 Maternity Experience Survey data and Canadian Community Health Survey data between 2003 and 2011/12 revealed a pregnancy smoking prevalence of 10.5%²³ and 14.3%⁷⁴ respectively. The prevalence of alcohol use during pregnancy, according to MES 2005/06 data, was 10.8%.⁷⁵ Although this may reflect low to moderate rates, provincial rates vary,²³ and are reportedly higher in some provinces than others. Immigrant women are less likely to engage in unhealthy behavior during pregnancy. Recent study findings in Canada,^{22,23,76} the United States,⁷⁷ France²⁰ agree with this finding, reflecting the foreign-born health advantage or the protective cultural strengths that immigrants bring to their host countries or perhaps the positive outcome effect of smoking cessation and other health-promoting antenatal intervention programs in these Western countries. However, a study has reported conflicting findings among immigrant childbearing women living in the United States. In this study, selective migration accounted less for their behavioral risk differences.⁷⁸ A study

conducted in Canada also found that immigrant women compared to non-immigrants had a higher odds of smoking cessation during pregnancy and were also most likely to experience relapse before the child is born.⁷⁹

Inadequate prenatal care is associated with adverse perinatal outcomes such as the increased risk of prematurity, stillbirth, early or late neonatal, and infant death,⁸⁰ low birth weight, small for gestational age, admission to the neonatal intensive care unit, postpartum depressive/anxiety disorders, and short interpregnancy interval to next birth.⁸¹ Several factors may influence prenatal care use among childbearing women. As mentioned earlier, inadequate social support, depression, and engaging in unhealthy behaviors such as smoking or consuming alcohol during pregnancy increase the risk of delayed or inadequate prenatal care. The risk for late prenatal care is higher among multiparous women with prior pregnancies, who are presumed to know more about pregnancy stages. Also associated with prenatal care utilization inequalities are young maternal age (at current and first birth), lone parent, and mother's education less than a high school.^{82,83} Poverty and socioeconomic determinants such as women's need to balance income-generating activities, receipt of income assistance, and residence in rural and low-income neighborhoods have strong influences. Immigrant women may encounter systemic or structural barriers or challenges navigating and accessing prenatal care post-migration⁸³ which increases their odds of inadequate prenatal care. However, medical conditions such as multiple births, hypertensive disorders, antepartum hemorrhage, diabetes, and prenatal psychological distress are reportedly associated with lower odds.⁸²

In other instances, pregnancy-specific events may predict adverse psychosocial or behavioral perinatal risk outcomes. Unwanted pregnancy has increased the risk of continued smoking during pregnancy.²² Bleeding, prenatal diagnosis to investigate potential fetal abnormalities or

malformations could also explain adverse perinatal psychosocial and behavioral outcomes.⁸⁴

The risk for depressive symptoms was higher in mothers of preterm infants than for mothers of healthy term infants.⁸⁵ The risk of partner violence⁶³ and depression has also been reported higher for women who developed a new health problem during pregnancy.^{63,86}

2.3 Explanatory variables (Immigrant characteristics)

The widely held theory is that immigrant women have more favorable perinatal, maternal, and child health outcomes than their non-immigrant counterparts, usually attributed to the healthy immigrant effect. However, research studies over the last decade have established that some immigrant characteristics may explain, to a large extent, certain possible deviations in immigrant health profiles from held expectations. The association between migration and perinatal health outcomes varies by migrant subgroup and depends on defined characteristics and the reference group.⁸⁷ Refugee status, secondary migration, country of birth or race /ethnocultural diversities, and length of stay in the host country /duration of residence are some of the characteristics identified in the current literature by which immigrants are defined.

2.3.1 Refugee status

Migration is a stressful life event and can be voluntary or forced. Over the last two decades, there has been a growing pattern of migration referred to as secondary or geographically indirect migration, where an immigrant's country of last permanent residence differs from the country of birth.^{24,25} Immigrant women are more likely exposed to psychosocial risk factors for adverse perinatal health.⁷ However, subgroups such as refugee immigrants who experience forced migration because of fleeing from persecution, war, or violence from their birth country (primary refugee migrant), particularly those who spend time in refugee camps in a transition country (secondary refugee migrant), are more affected. These groups suffer unusual stress to their health

during the immigration process and are less likely to have robust health compared to their immigrant counterparts,⁸⁸ who may have migrated voluntarily.

2.3.2 Secondary migration

Secondary migration from an industrialized country is associated with better health outcomes among non-refugee immigrant women. This was observed among secondary immigrants who voluntarily transitioned to Canada from an industrialized country and had better perinatal health outcomes than primary migrants from non-industrialized birth countries.⁸⁷ However, cautious interpretation of this study's findings advised that associations may vary among immigrant subgroups. For instance, secondary migration may be detrimental for refugees who experience distinct challenges in transition countries. A follow-up study by Wanigaratne et al.⁷ confirmed this assertion, reporting an opposite effect in the association between secondary migration and perinatal health outcomes of voluntary versus forced migrants. In the same study, secondary refugee migrants compared with primary refugee migrants had greater cumulative odds of short gestation attributable to the cumulative effect of length of migration journey and associated psychosocial stressors.

2.3.3 Birth country/region of birth

Perinatal health outcomes of immigrant women vary by country of origin. Concerning childbirth outcomes, the risk of stillbirth is high for mothers and strongest for couples who had immigrated to Canada from a country with a high stillbirth rate, e.g., Nigeria, Portugal, Jamaica, Guyana, India, and Sri Lanka.⁸⁹ Among immigrant women in the United States and Europe, ethnic and regional differences in birth outcomes exist. Black immigrants compared with United States-born black women, Hispanic compared with Asian and white women had lower odds of delivering preterm babies. On the other hand, Sub-Saharan African, Latin American, and Caribbean women

were at higher odds of delivering low birth weight babies in Europe but not in the United States, and South-central Asians were at higher odds in both continents compared with the native-born populations.⁸⁷ Report on maternal health outcomes reveal that Sub-Saharan African immigrant women compared with other immigrant groups, consistently show a higher risk of severe maternal morbidity using aggregate perinatal health data from three immigrant-receiving countries, namely Australia, Canada, and Denmark.⁹⁰

2.3.4 Duration of residence/length of stay

The duration of residence as a predictor of immigrants' health outcomes has been extensively studied. The argument that the healthy immigrant effect among recent immigrants might be more perceived than real for self-assessed health still holds.⁹¹ At the same time, evidence for the healthy immigrant effect on perinatal health outcomes of immigrant women is well-established, although health outcome specific.⁹² A population-based study in Ontario, Canada, revealed that while recentness of immigration of fewer than five years is associated with a lower risk of preterm birth,^{28,93} the risk of low birth weight deliveries among recent immigrant women increased.⁹³ Also well documented is the length of stay effect on behavioral health outcomes. Most studies agree that as immigrant women become more acculturated into their host country's society, they adopt unhealthy behaviors, including smoking, alcohol consumption, or substance use.^{29,94} With specific birth outcomes, e.g., preterm birth, the longer the length of stay, the greater the diminished effect of maternal place of birth influence on outcome⁹² and increased risk of preterm delivery.^{28,92}

2.4 Associations between dependent and explanatory variables

2.4.1 Perinatal violence/ abuse and immigrant characteristics

A meta-analysis has reported that the most form of violence during pregnancy was emotional abuse (28.4%), followed by physical abuse (13.8%), and sexual abuse (8.0%).⁶¹ Among recent immigrant women to Canada, a high rate of emotional spousal abuse has been reported compared to Canadian-born women.⁹ This may suggest that immigrant women may be more comfortable reporting emotional/psychological abuse than physical or sexual abuse. Whether this finding can be generalized to immigrant women in the peripartum period is still unknown.

There are reported inconsistencies in the association between duration of residence and risk of peripartum violence or abuse. While some studies have reported a higher risk among established or long-term immigrant women compared to recent immigrant women,^{8,11} another study reported that risk increased if an abused woman lived without a partner, was an asylum seeker, and recently migrated < 2 years.⁹⁵

The relationship between perceptions of violence and ethnicity remains inconclusive because of different study populations, different ways of measuring violence, and the different study data collection methods. Cohen, Maclean⁶² suggested that violence may vary by ethnicity. However, domestic violence was not more prevalent among immigrant women of specific racial or cultural groups in Canada.⁹⁶ It should be noted that the use of concepts such as ‘ethnicity’, ‘race’, and belongingness to a specific group is still very much debated because ethnic groups do not refer to homogeneous populations but include broad categories that are useful in acknowledging diversity among groups of people. Such broad categories include age at migration, length of residence, source country or country of birth, knowledge of host country languages, first language and English for speakers of other languages, health status, and health behavior.⁹⁷⁻⁹⁹ One study acknowledging this diversity among immigrant women has identified that the risk of violence differed by country of origin, wherein being born in non-Western countries such as

Asian, African, Central, and South American countries was associated with a higher risk for partner violence.⁸

2.4.2 Perinatal depression, social isolation, and immigrant characteristics

An emotionally supportive partner is crucial and a significant predictor of postpartum depressive symptoms among immigrant women.¹⁰⁰ Mothers are approximately five times more likely to experience postpartum depression if they received minimal to no support after delivery.^{101,102} A case report of a highly anxious and depressed South Asian immigrant pregnant woman in Montreal, Quebec experiencing a high level of migration-related stress is associated with low social support.⁴⁵ The risk of current depression and suicide attempts reduced significantly among women experiencing partner violence, especially when associated with higher social support scores.¹⁰³

Although there are numerous studies on peripartum depression, only a few publications have compared peripartum depression symptomatology among immigrant subgroups or classes. Even with the few studies, findings are divergent. While one study reported a postpartum depression rate of 14.3% among Asylum-seekers, refugees (11.5%), and non-refugee immigrant women (5.1%).¹⁸ A second study identified reported an opposite finding in postpartum depression prevalence of (35.1%) among non-refugee immigrants', asylum seekers (31.1%), and refugee mothers (25.7%). The risk (odds ratio) was highest among refugees (4.80), followed by immigrant non-refugee (4.58) and asylum-seeking (3.06) mothers, respectively.³² There is evidence for region of origin as a strong predictor of depressive symptomatology. Women from the Caribbean, South Asia, Maghreb, Sub-Saharan Africa, and Latin America had the highest prevalence of depressive symptomatology compared to Canadian-born women.³⁰

Inconsistencies in the association between postpartum depression and time since migration have been observed. While one study reported prevalence of postpartum depression independent of time since immigration or duration of residence³⁰, other studies found that recent immigrants were at higher risk.^{18,29} Reports also showed differences by region of origin. Immigrants of non-European origin than Europeans reportedly had higher prevalence rates of depression regardless of their duration of residence in Canada.¹⁰⁴ Conversely, time trends of depression varied across regions. While depression increased among European and Southeast Asian women, a decrease was reported among Maghrebian, Sub-Saharan African, Middle Eastern, and East Asian women, and symptoms fluctuated among Latin American and Caribbean women.³⁰

2.4.3 Perinatal smoking, alcohol, substance/drug use, and immigrant characteristics

Immigrants exhibit foreign-born health advantages, but the characteristic uniformity across different perinatal health behavior is absent¹⁰⁵ and tends to vary by region, country, or place of birth. For instance, among immigrant women in France, the odds of smoking in pregnancy were strongest among women born in North Africa or Europe. The odds of alcohol use were strongest among Sub-Saharan African women. Both risks were associated with being a single parent and experiencing psychological difficulties.²⁰ In the United States, differences in maternal perinatal behavioral risk by race or nativity exist. Black foreign-born immigrant women and black US-born women have an equal risk of prenatal alcohol use and exposure to illicit drugs.¹⁰⁶ Whereas, African-born was protective of smoking or alcohol consumption compared with Caribbean-born women.⁷⁷ Also, among a cohort of mothers with infants in the United Kingdom, there is a significant association between country of birth and current smoking and alcohol use independent of ethnicity and socio-demographic circumstances.¹⁰⁷ These mixed findings thus suggest that the role of immigrant health selectivity and other characteristics that contribute to

more favorable health behaviors or outcomes of immigrant women, especially around the peripartum period, is still vaguely understood.

Research on immigrant health over the years focused on acculturation as a framework to explain the health trajectories of immigrants. Protective cultural strengths are usually short-lived, as studies have shown that immigrants are exposed to new health norms in the receiving country upon arrival.¹⁰⁸ Study findings have shown that a longer duration of residence in the host or receiving country is associated with a high risk of adopting health-damaging behaviors.^{78,109} However, the strength of association in these studies tends to vary by type of health behavior and the host country of study. Among Turkish immigrants in Germany, the chance of being a smoker was significantly higher and associated with a length of stay greater than 20 years compared to within four years.¹¹⁰ In the United Kingdom, mothers were 31% more likely to smoke during pregnancy for every additional five years spent in the United Kingdom, but the study showed no association between length of residency and alcohol consumption.¹¹¹ In the United States, more acculturated Mexican immigrant women of childbearing age were more likely to consume alcohol and smoke cigarettes.⁷⁸

2.5 Gaps in Literature

Reports examining multiple psychosocial and behavioral perinatal health indicators among immigrant groups are limited to non-population-based studies with small sample sizes.^{1,31,32} A qualitative study examined health behaviors (smoking and alcohol use), social support, and stress during pregnancy among seventeen Southeast Asian immigrant women in Montreal, Canada.⁵⁴ The study design and sample size limits generalization of study findings. Aside from a few population-based studies with reported findings by the duration of residence⁷⁶ and nativity,⁷⁷

there is lack of studies assessing psychosocial and behavioral perinatal health outcomes among immigrant subgroups defined according to refugee status, secondary migration and maternal birth region.

Immigrants may exhibit different dimensions of psychosocial and behavioral perinatal health vulnerability based on their migration patterns. Also, given that immigrants are heterogeneous and ethnically diverse, group differences in multiple psychosocial and behavioral perinatal health risks may exist and the understanding of such heterogeneity represents a gap in Canadian perinatal health research.

Chapter 3

Methods

3.1 Research Questions and Objectives

The main objective of the study was to compare select psychosocial and behavioral health risk indicators between immigrants and non-immigrants overall and according to key immigrant characteristics such as secondary migration, refugee status, maternal birth region, and duration of residence. Two research questions were answered:

RQ1- Are there differences in socio-behavioral perinatal health risk indicators among childbearing immigrant women compared to non-immigrant women in Manitoba?

Research objective 1

The objective was to compare the likelihood of psychosocial and behavioral perinatal health risk indicators between immigrants and non-immigrants, adjusting for socio-demographic and family characteristics.

RQ2- Among immigrants to Manitoba, do childbearing women differ in socio-behavioral perinatal health risk indicators according to immigrant characteristics?

Research objective 2

The objective was to compare likelihood patterns for psychosocial and behavioral perinatal health risk indicators among immigrant childbearing women according to immigrant characteristics such as secondary migration, refugee status, maternal birth region and duration of

residence, adjusting for socio-demographic, family characteristics, and knowledge of official Canadian language (English or French).

3.2 Study design, settings, and participants

Research questions were answered using a population-based cross-sectional study design conducted among childbearing women residents in Manitoba. The rationale for using a cross-sectional design was because the multiple outcomes examined were events that occurred around pregnancy and the early postpartum period, and because this is a descriptive study assessing disparities across several outcomes. Furthermore, the descriptive nature of the study allows us to correlate outcomes (i.e., psychosocial, and behavioral perinatal health indicators) and immigrant characteristics as a first step to identifying and describing patterns without making assumptions about causal pathways.

Participants included were immigrant and non-immigrant women who had a live birth between January 1, 2000, to December 31, 2017, and had Baby First or Family First screening data, a universal newborn screen completed within two weeks postpartum.

3.3 Data source, databases, and datasets

The study used the Manitoba Population Research Data housed at the Manitoba Center for Health Policy (MCHP) repository. The Repository contains de-identified linkable administrative, registry, survey, and other database information of all Manitoba residents. The information available in the databases is divided into six major domains (Figure 3.1). Only four domains were accessed for use in this study, and they include Health (Hospital/Discharge abstract, Medical services, Midwifery Summary System), Social (Families First Screening, Baby's first screening, Social Allowance Management Information Network Data), Justice (The Prosecutions Information Systems Management Incidents Data), and Registries (Manitoba Health Insurance

Registry, Immigration, Refugees, Citizenship Canada Permanent Resident Database). The lists of databases, years of data availability, variables, and role of the variables in data manipulation and analysis are detailed in Table 3.1

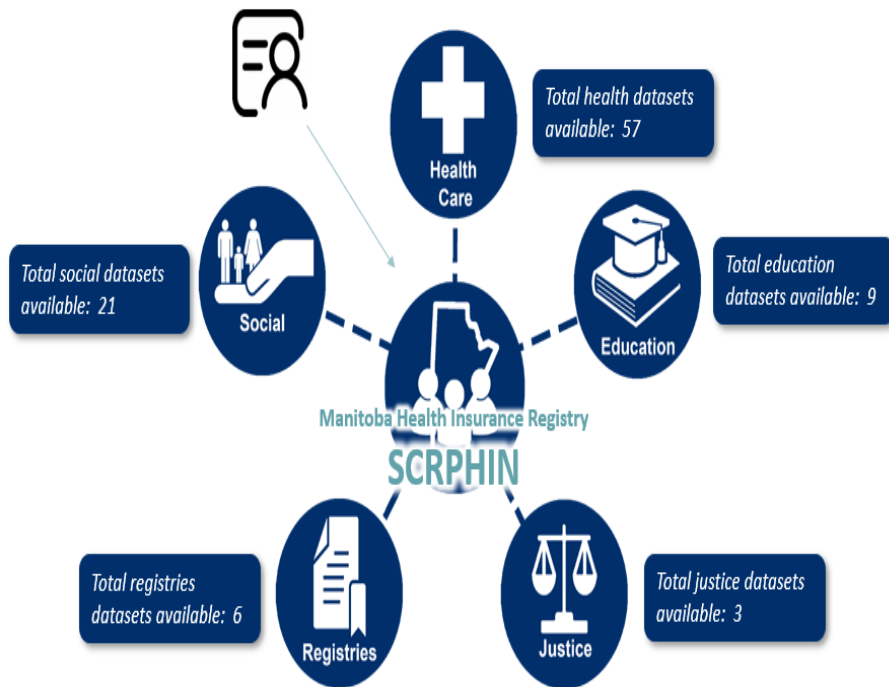


Figure 3.1: Manitoba Population Research Data Repository

Image credit: Dave Towns, March 2, 2022. MCHP research forum: Documenting the Manitoba Population Research Data Repository

Table 3.1: Lists of databases, years of data availability, variables, and role of the variables in data manipulation and analysis.

Database	Years of Data*	Variables	Values	Role in Data Analysis
Family First Screening	2003-2017	Depressed mother (including postpartum), Social isolation, Relationship distress, Current/history of violence between parenting partners, Alcohol use during pregnancy, Smoking during pregnancy, Substance use during pregnancy, Late initiation of pregnancy care/ First prenatal, visit \geq 28 weeks gestation	Yes/No/Missing	Cohort creation, variable definition, dependent variables
Baby First Screening	2000-2002			
		Low education	Less than grade 12/Grade 12 and up/Missing	
Discharge Abstract Database	1994/95-2015/16	Baby's Birthdate	Numeric/integer value	Cohort creation
		live/still birth	Yes/No	
		Depression, alcohol use in pregnancy, smoking during pregnancy, substance use during pregnancy, Revised-Graduated Prenatal care utilization Index (R-GINDEX)	Yes/No/Missing	Alternative dependent variables
		Mother's age at birth of index child	Numeric/integer value (years)	Covariate
Midwifery Summary System	2001/02-2017	Baby Birthdate	Numeric/integer value	Cohort creation
		live birth/still birth	Yes/No	
Medical Services	1970/71-2018/19	Depression, alcohol use in pregnancy, smoking during pregnancy, substance use during pregnancy, Revised-Graduated Prenatal care utilization Index (R-GINDEX)	Yes/No/Missing	Alternative dependent variables

Database	Years of Data*	Variables	Values	Role in Data Analysis
Immigration, Refugees, Citizenship Canada (IRCC) Permanent Resident System	1985-2017	Immigrant	Yes/No	Cohort creation, variable definition, Explanatory/Independent variables
		Refugee		
		Primary immigrant	Primary/Secondary/Missing	
		Birth region	IRCC_COUNTRY_OF_BIRTH_CD	
		Duration of residence	Numeric/integer value	
		Knowledge of official Canadian languages (English/French)	Yes/No	
Social Allowances Management Information Network Data	1995/96-2015/16	Receipt of Employment and Income Assistance (EIA) one year before birth to 2 weeks after	Yes/No	Covariates
Census Data	2001-2016	Urban	Urban/Rural	
		Neighborhood Household Income Quintile	(Q1, Q2, Q3, Q4, Q5)	
Manitoba Health Insurance Registry	1970/1971-2019	Family size	Numeric/integer value (0-19 years)	

*Years of data required = span of the study period (January 1, 2000, to December 31, 2017)

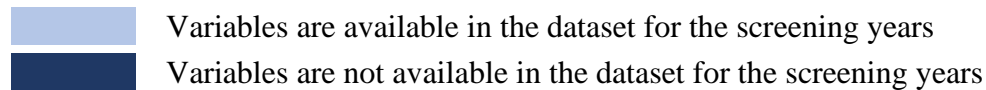
(Some of the datasets are truncated at months other than April 1st- March 31st, which is not consistent with the Manitoba Health Seniors and Active Living (MHSAL) data organization)

3.3.1 Baby First Screening and Family First Screening datasets

The primary data sources were the Baby First and Family First screening (BFS/FFS) data. The study utilized datasets for screening years 2000-2002 (BFS) and 2003-2017 (FFS). The BFS/FFS screenings were designed to collect data on biological, social, and demographic risk factors of childbearing women in Manitoba. ¹¹² Using the screening form, visiting public health nurses attempt to assess all families with newborns at home within a week of discharge from the hospital. This universal, although not mandatory, newborn screening program provides valuable information for determining appropriate resources and services for the family and population-level surveillance. Over the years, some modifications to the screening form included new variables. For example, data on the current history of violence and alcohol use in pregnancy were unavailable from 2000 to 2002 (BFS) but added from 2003 (FFS). Figure 3.2 highlights years of data available for each variable accessed from the screening data.

Figure 3.2: Years of data availability and variables accessed from Baby First and Family First Screening datasets

Socio-behavioral risk factor variables	BFS (2000-2002)	FFS (2003-2017)
Single parent/ lone parent		
Depression Mother		
Mother’s Anxiety		
Social isolation		
Relationship distress		
Current history of violence		
Alcohol use in pregnancy		
Smoking during pregnancy		
Substance use during pregnancy		
First prenatal care ≥ 28 weeks		



The BFS/FFS data were linked to the Manitoba Health Insurance Registry (MIHR), which contains family and individual-level demographic information. The Immigration, Refugees, and Citizenship Canada Permanent Resident (IRCC-PR) database provides information on the immigration characteristics of all permanent residents that arrived in Canada from January 1985 to December 2017 and was linked to the MIHR with a 96% linkage rate.¹¹³ Additional linked databases used to collect demographic and clinical information related to pregnancy and birth were the Discharge Abstract Database from the Canadian Institute for Health Information (for hospital births), the Midwifery Summary System (for home births), and the Medical Services datasets used to determine receipt of prenatal care. The Social Allowances Management

Information Network (SAMIN) database was used to determine receipt of Employment and Income Assistance (EIA). Small area census data was used to assign neighborhood income quintiles and rural residence.

3.4 Ethical considerations

The study received research ethics board approval from the University of Manitoba Health Research Ethics Board (HREB) HS24346 (H2020:446), the Manitoba Health Seniors and Active Living Health Information Privacy Committee HIPC 2020/2021-50 (now Provincial Health Research Privacy Committee), and data use approvals from Immigration, Refugees, and Citizenship Canada (IRCC), Manitoba Justice, and the Department of Families. Following research ethics approval, a data analyst at the MCHP completed data linkage and extraction of variables from databases. Privacy and confidentiality of participants' information were ensured per HREB, HIPC, and MCHP policies. A de-identified flat-file dataset was created using a scrambled personal health identification number (SCRPHIN). Data access and all analyses took place in the MCHP highly secured environment.

3.5 Cohort creation and data cleaning

The study period was between January 1, 2000, and December 31, 2017. Birth records from the Discharge Abstract Database and the Midwifery Summary System were used to create a cohort (n=269,543) of eligible mothers. The cohort included all maternity records in the study periods. The unit of analysis is the maternity, defined as a pregnancy resulting in live birth(s), irrespective of the number of children born. Women can have more than one maternity in the study period. Multiple birth records (n= 3,369) in the case of twins, triplets, or more were reduced to one record per maternity, and n=266,174 were retained. Maternity records, 59,219 (22.2%) not linkable to the BFS/FFS dataset were excluded. These were primarily births in which the mother

did not participate in the screening due to not being contacted or refusal to participate, and a smaller number of stillbirths and births resulting in neonatal death. Further excluded were births to mothers aged <15 years or >55 years (n=293), those with missing values in demographic variables, e.g., unknown neighborhood income quintile (n=541) and unknown urban/rural residence (n=151). Immigration records were complete for country of birth, date of entry, or landing dates in Canada. Details of the cohort creation and data cleaning process are illustrated in Figure 3.3.

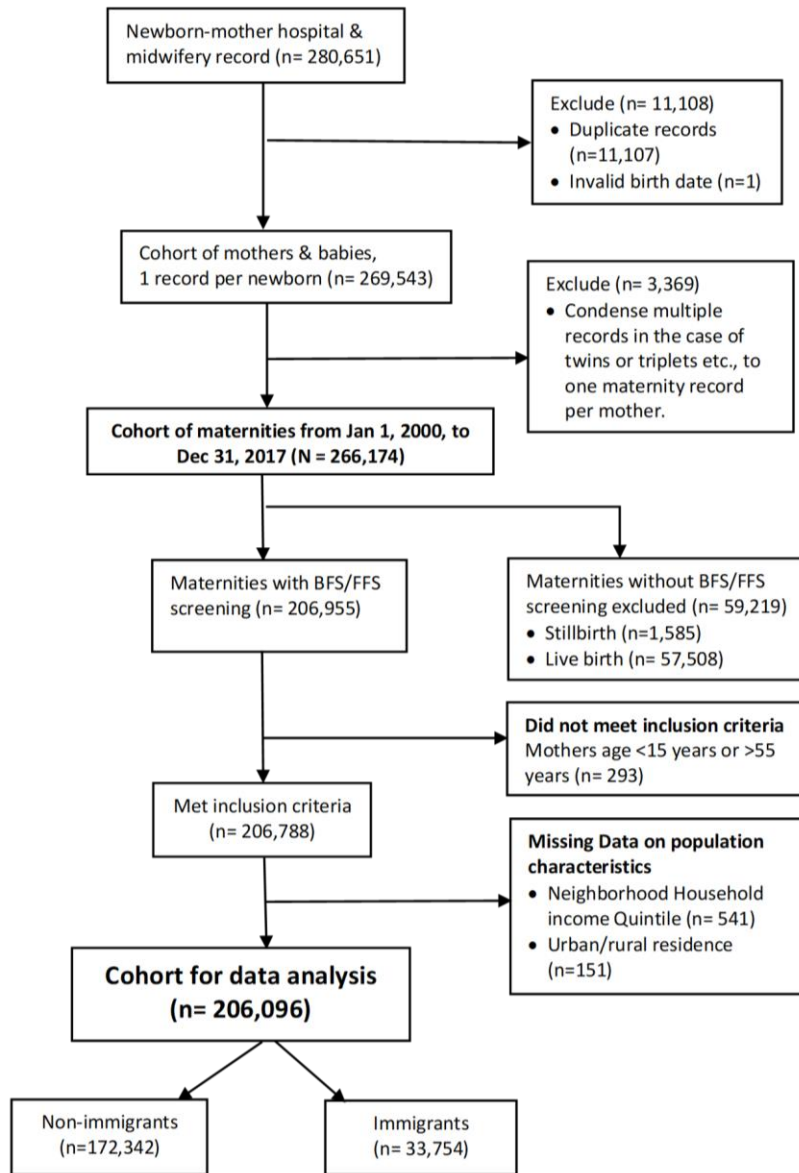


Figure 3.3: Flowchart cohort selection

3.6 Variables and Measures

3.6.1 Dependent variables

Eight socio-behavioral indicators, conceptualized as psychosocial and behavioral, were measured based on nurse-recorded information collected from mothers during the Baby First and Family First Screening. This study also explored other data sources for variables that measure similar outcomes, bearing in mind the possibility of missing data from non-response to some questions (i.e., outcome variables) during the screening. The outcomes examined and their definitions obtained in the screening tool or MCHP online concept dictionary are described below.

3.6.1.1 Psychosocial Outcomes

Maternal depression: as defined in the screening tool, was self-reported depression during pregnancy until the postpartum interview (yes, no). Based on previous work defining depression in Manitoba using administrative data, a new variable termed depression, mood, and anxiety disorders (yes, no) was created combining self-reported anxiety and depression (yes, no) from BFS/FFS.

Depression (yes, no) obtained from the Discharge Abstract Database and Medical Services data was explored as an alternative variable intended to complete missing values of depression from BFS/FFS and for sensitivity analysis but this variable was not used in the main analyses.

Social isolation: as defined in the screening tool, was a lack of social support or isolation related to culture, language, or geography (yes, no).

Relationship distress: as defined in the screening tool, was self-reported distress or conflict between parenting partners (e.g., separations, frequent arguments) (yes, no).

Partner violence: as defined in the screening tool, was self-reported current or history of violence between parenting partners (yes, no).

Spousal violence (yes, no) obtained from Prosecutions Information Systems Management (PRISM) Incidents Data was explored as an alternative variable intended to complete missing values of partner violence from BFS/FFS but this variable was not used in the main analyses.

3.6.1.2 Behavioral Outcomes

Mothers' alcohol use during pregnancy: as defined in the screening tool, was self-reported consumption of alcoholic beverages during pregnancy (yes, no).

Prenatal alcohol use during the gestation period (yes, no) obtained from the Discharge Abstract Database and Medical Service data was explored as an alternative variable intended to complete missing values of alcohol use during pregnancy from BFS/FFS but this variable was not used in the main analyses.

Smoking during pregnancy: as defined in the screening tool, was self-reported smoking during pregnancy (yes, no).

Prenatal smoking (yes, no) if the mother was admitted to the hospital during the gestation period obtained from the Discharge Abstract Database and Medical Service data was explored as an alternative variable intended to complete missing values of smoking during pregnancy from BFS/FFS but this variable was not used in the main analyses.

Substance use during pregnancy: as defined in the screening tool, was self-reported illicit drug or substance use during pregnancy (yes, no).

Mother's substance use (e.g., illegal drugs) during her pregnancy (yes, no) obtained from the Discharge Abstract Database and Medical Service data was explored as an alternative variable

intended to complete missing values from BFS/FFS but this variable was not used in the main analyses.

Late initiation of prenatal care: as defined in the screening tool, was prenatal care that began after the first trimester of pregnancy (i.e., more than 13 weeks gestation) (yes, no).

An alternative variable to late initiation of prenatal care explored for sensitivity analysis was Inadequate prenatal care (R-GINDEX), obtained from outpatient visits. The Revised-Graduated prenatal care utilization Index (R-GINDEX) measures the adequacy of prenatal care received by a healthcare provider using knowledge of three birth-related outcomes (i.e., gestational age of the infant, trimester during which prenatal care began, and the total number of prenatal visits during pregnancy).¹¹⁴ R-GINDEX divides prenatal care into six categories of adequacy: adequate, intermediate, intensive, inadequate, no care, and missing. For this study, all six categories were combined into two levels of measurement (yes, no) as adapted from Haeman et al.¹¹⁵ The “yes” represents combined categories of adequate, intermediate, and intensive care, while the “no” represents combined categories of inadequate and no care.

3.6.2 Explanatory variables

International Immigrants were identified by having a record in the IRCC-PR database. Women not in the IRCC-PR database and not having a record in the Registry indicating that they came from another country were classified as Non-immigrant (Canadian-born). A very small portion of immigrants who arrived before 1985, when immigration was less common, may have been misclassified as non-immigrants.

Secondary immigrants were defined as immigrants to Canada whose last country of permanent residence differed from their country of birth. Those whose countries of birth and last permanent residency were the same were classified as primary immigrants.

Refugees were protected persons in Canada or dependent abroad of a protected person in Canada. They include all refugee categories (i.e., Syrian, Government-Assisted Refugees, Privately Sponsored Refugees, and Blended Visa Office-Referred refugees).

Birth region was based on the country where the woman was born. Countries were grouped into world regions of birth based on the United Nations classification,¹¹⁶ and regrouped where sample sizes are small as Southeast Asia, South & Rest of Asia, Western Europe, Eastern Europe, Rest of Europe, West Africa, East Africa, Rest of Africa, North America & Oceania, Latin America & Caribbean.

Duration of residence was estimated as the length of time from the date of obtaining permanent residence in Canada to the birth of the child and grouped into <5 years, 5-9 years, and ≥ 10 years. Some immigrants may have held temporary resident status and had birth events before obtaining permanent residence.

3.6.3 Covariates

A Directed Acyclic Graph would have provided the best approach to identify a minimally sufficient set of covariates for confounding control. However, given that sufficient knowledge may not be enough to identify all risks factors and because the objective of the study was to describe patterns in outcomes rather than establish causal associations, covariates associated with outcomes in the period during pregnancy and within the first two weeks after birth were selected based on published literature. Measured covariates included socio-demographic variables such as

mother's age at birth of index child regrouped into five-level categories of 5 interval scale (Below 20 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, and 40-55 years) obtained from the MHIR data. Urban/rural residence, neighborhood income quintiles from lowest to highest (Q1, Q2, Q3, Q4, and Q5) were obtained from small area census data. Two variables from BFS/FFS data measured mothers' education: reported mothers' low education (yes, no) and mothers' education completed <12th grade (yes, no). A new variable named low education or mother's education <12th grade (yes, no) was created by combining both education variables. Receipt of EIA, one year before birth to 2 weeks after (yes, no), was obtained from the SAMIN data. Family factor variables were family size, i.e., the number of dependents <18 years in the same family as index child (none, at least one) obtained from the MHIR data, and lone mother (yes, no) from BFS/FFS data. In analyses restricted to immigrants, knowledge of official Canadian languages (English/French, none) was from the IRCC-PR database.

Refer to (Appendix I) for the list of all variables and variable-related information as described in the MCHP online concept dictionary.

3.7 Data Analysis

All statistical analyses were conducted using SAS V9.4 (SAS Institute Inc., Cary, NC). The first step involved creating a sample frame that included only those that met the inclusion criteria and describing population characteristics using descriptive statistics such as frequencies, percentages, means, and standard deviations. This was followed by assessment for selection bias, since not all women participated in the BFS/FFS. The final step then involved data manipulation to answer research questions.

3.7.1 Selection bias

Although universal, the screening is not mandatory, and some women were not screened. These were women who had live births but did not participate in the screening and a small number of women who had stillbirths or births resulting in neonatal death (refer to Figure 3.3 above) The exclusion of these maternities (n=22%) from analysis indicated selection bias, which could mean that those who were screened differ from those who were not. ¹¹⁷

A standardized difference of proportions was computed to assess whether those who had screening systematically differed from those who did not. Baseline demographic data (i.e., measured covariates) were compared between screened and unscreened immigrants . Comparisons were also done between screened and unscreened non-immigrants (Appendix II). Computation of differences in socio-demographic characteristics (education and lone mother variables) between screened and unscreened immigrants and non-immigrants were dropped because both variables were from the BFS/FFS data. Moreover, except for the very small number that did not meet the age inclusion criteria, i.e., <15years or >55years (refer to Figure 3.3 above), those without screening will have no data on education and lone mother variables for comparison with those who had screening.

Standardized differences greater than 0.1 (10%) were considered significant. There were no standardized differences in sociodemographic, family, and immigrant characteristics between screened and unscreened immigrants greater than 0.1 (10%). However, screened, and unscreened non-immigrants differed significantly in neighborhood income quintile, area of residence, and age characteristics. The striking finding was that unscreened non-immigrants in the lowest neighborhood income quintile (Q1) were twice the proportion of those screened (44.76% versus 20.76%), and the standardized difference was 0.53. Also, unscreened non-immigrants were

overrepresented among teenagers, and the proportion living in the rural area was 23% higher than the screened with standardized difference of 0.47 (Appendix II).

Significant differences in sociodemographic characteristics between screened and unscreened non-immigrants confirmed selection bias. Given the characteristic determinants of poor perinatal health outcomes among non-immigrants without screening, it is possible that they more likely experience some of the perinatal health indicators examined, and their under-representation could underestimate overall prevalence among non-immigrants.

For RQ1 (comparison between immigrants and non-immigrants), outcome prevalence may be overestimated among immigrants, and results comparing risk likelihood between both groups may be biased. However, for RQ2 (comparisons restricted to immigrant subgroups defined according to various immigrant characteristics) there is not strong evidence of selection bias according to levels of the covariates, since standardized differences were below 0.1 (Appendix II). Therefore, results (i.e., risk likelihood) comparing immigrant subgroups may be deemed more trustworthy.

3.7.2 Missing data

3.7.2.1 Missing data on the dependent variables

There were missing values in the dependent (i.e., outcome) variables. Missing rates ranged from 4.6% for smoking during pregnancy to 32.4% for partner violence (Appendix IV). There is no perfect approach to handling missing data. My approach was to retain observations with complete BFS/FFS outcome data and explore the potential impact on the study results.

A workaround approach that I tried to handle missing data from the BFS/FFS was to try to complete missing outcome information by linkage with other administrative data sources where data is fairly complete. For example, complete missing values on maternal depression, mood & anxiety disorder, pregnancy smoking, alcohol, and substance use from the Discharge Abstract Database and Medical Service data, and missing values in partner violence completed from the Prosecutions Information Systems Management (PRISM) Incidents dataset. However, these data sources did not contribute substantial additional information as prevalence estimates for partner violence, alcohol use, smoking, and substance use during pregnancy were lower than estimates from BFS/FFS data and the combined prevalences were not substantially higher than those based on the BFS/FFS data only, with the exceptions of depression and inadequate prenatal care (Appendix III).

These data sources were less useful not because the datasets were inadequate but likely because they captured more severe cases that reflect treatment for injuries (e.g., domestic/partner violence), treatment for alcohol, smoking, or substance use cessation and may have missed many mild cases. Particularly for depression, the decision to not use this data source was based on two considerations. First, the depression from the Discharge Abstract Database and Medical Service data is diagnostic, not self-reported like in the BFS/FFS data. Moreover, depending on the trajectory of the depression, the diagnosis will vary by type and severity,¹¹⁸ which may not be comparable to self-reported depression from BFS/FFS. Second, combining this data with BFS/FFS could also bias estimates away from the null than the actual effect, i.e., overestimating self-reported depression, especially if a woman had a history of depression that did not just begin in the current pregnancy.

Since other data sources were less helpful in completing missing, I sought to observe missing patterns by immigrant status. Interestingly, non-immigrants had higher rates of missing values than immigrants for all perinatal health indicators except depression, mood, and anxiety disorder. Standardized differences in missing rates between groups were significant, i.e., greater than 10% but only for social isolation, partner violence, alcohol, and substance use during pregnancy (Appendix IV). When missing rates among immigrant subgroups were compared, primary immigrants had higher missing rates than secondary immigrants (Appendix VI) and standardized differences in missing rates were only significant for social isolation, relationship distress, partner violence, alcohol, and substance use during pregnancy (Appendix VIII). Refugee immigrants had higher missing rates than non-refugees (Appendix VI) and standardized differences in missing rates were only significant for relationship distress, partner violence, substance use during pregnancy and late initiation of prenatal care (Appendix VIII). There were also differences among birth regions (Appendix VII) and standardized differences in missing rates were significant for all perinatal health indicators except depression and smoking during pregnancy (Appendix VIII). Although significant differences between groups suggest an association between exposure variables (immigration status and immigrant characteristics) and missing values which may bias comparisons, there may be other sources of bias.

Social desirability bias was considered a possibility for relationship distress, partner violence, alcohol consumption, and substance use during pregnancy and the explanation for this was that irrespective of immigration status, social desirability may affect whether data are missing for these outcomes, given the lower likelihood of disclosing these outcomes for fear of stigmatization. I also explored whether missing values in the dependent variables differed by immigration status according to the levels of the covariates. Results revealed higher rates among

immigrant mothers than non-immigrants who were older than 30 years, who were not lone mothers, had higher education, received no EIA, had at least one child in the family, resided in an urban area, and represented in the lowest neighboring income quintile Q1 (Appendix V).

My approach excluded from the analysis records with missing data in the dependent variables. Hence, the final sample size varied for each outcome (See Table 4.2 in results). By excluding missing outcome information, I assume that missingness is not substantially different between those who answered yes or no to an outcome, an assumption that may not hold true.

Unfortunately, due to the absence of a validation study on the screening data, it is impossible to anticipate the magnitude and direction of the potential bias. However, despite potential bias in the outcome rates, comparisons between immigrants and non-immigrants may only be affected if missingness is differential according to immigration status. If not, then compensating bias will be the case.

To sum up, for RQ1 (comparisons between immigrants and non-immigrants), missingness may have biased the results, given that missingness was differential by immigration status and much higher among non-immigrants. Similarly, for RQ2 (comparisons restricted to immigrants and according to immigrant characteristics), missing may have biased results, given that missing was differential by birth region, secondary and refugee immigrant status and much higher among primary and refugee immigrants. It is expected that due to missingness, associations with adverse outcomes for immigrants and immigrant subgroups may be overestimated. On the other hand, social desirability may have underestimated prevalence and associations among immigrants and immigrant subgroups for relationship distress, partner violence and some behavioral indicators like alcohol consumption and substance use during pregnancy. Overall, the potential impact of

missing on the magnitude of associations is uncertain, but the direction of the associations may hold for most of the outcomes.

3.7.2.2 Missing data on the independent variables

There were no missing values in the main independent variables (i.e., immigration variables), but there were in two covariates. These variables were low education/mother's education <12th grade and lone mother with 11.6% and 3% missing rates, respectively (see Table 4.1 in results). To reduce sample size loss, missing data in these covariates were recoded as a dummy category with a value "unknown".¹¹⁹

3.7.3 Logistic regression analysis

Assumptions of Logistic Regression

Logistic regression assumptions: linearity, and independent observations were tested.

Linearity assumption: Logistic regression does not require that the dependent and independent variables are linearly related, but it assumes that independent continuous variables must be linearly related to their log odds.¹²⁰ Although all main independent variables in this study were categorical, the presence of two continuous covariates (family size and mother's age) required testing this assumption. Using the Box-Tidwell approach,¹²⁰ an interaction term (i.e., cross-product) of each continuous covariate and their natural logarithm were included concurrently in logistic regression models for each dependent and the explanatory variables. Both covariates violated the linearity of logit assumption in all models with statistically significant interaction terms. Categorical forms of the variables were then created instead of transforming them into other forms to interpret results more meaningfully. Mothers' ages were regrouped into five-level

categories on a five-interval scale (below 20years, 20-24years, 25-29years, 30-34years, 35-39years, and 40-55years), and family size regrouped into two-level categories (“none” and “1 or more”).

Independent assumption: Logistic regression requires that observations are independent, i.e., the observations should not come from repeated measurements.¹²⁰ The BFS/FFS data violated this assumption where some women had more than one maternity over the study period (Table 3.2). Logistic regression models with generalized estimating equations (GEE) based on an independent correlation structure, which is the default in SAS¹²¹ were used to account for the dependency of observations between multiple maternities to the same woman over the study period.

Once the assumptions of logistic regressions were tested and satisfied, crosstabulations were completed for all dependent variables and covariates to identify covariates that may contribute low variability to the outcome effect. None of the covariates had cell size <6 in any of the categories. Statistical analyses were then computed. Measures of association were computed as odds ratio estimates with their 95% confidence intervals.

Table 3.2: Number of maternities per mother over the study period

Maternity count**	n (%)*
1	69190 (47.66)
2	48663 (33.52)
3	17007 (11.72)
4	5965 (4.11)
5	2454 (1.69)
6	1133 (0.78)
7	459 (0.32)
8	190 (0.13)
9	67 (0.05)
10	26 (0.02)
11+	10 (0.00)

*Frequencies expressed as n (%)

**Maternity count >1 = multiple maternities to the same woman over the study period

3.7.4 Research Questions and Analytic strategies

RQ1- Are there differences in socio-behavioral perinatal health risk indicators between immigrant and non-immigrant childbearing women in Manitoba?

Hypothesis: Immigrants will have a higher likelihood of psychosocial but lower likelihood of behavioral perinatal health risk indicators compared to non-immigrants after adjusting for sociodemographic and family characteristics.

To test this hypothesis, simple bivariate logistic regressions with GEE was used to compute unadjusted odds ratio estimates for the associations between each of the eight outcome variables (depression, social isolation, partner violence, relationship distress, alcohol, smoking, substance

use during pregnancy, late initiation of prenatal care), and the explanatory variable (immigration status). The objective was to compare the likelihood of outcomes between immigrants and non-immigrants, specifying non-immigrants as the reference group.

In the adjusted analysis, multivariable logistic regressions with GEE was used to compute the adjusted odds ratio estimates for the associations between all dependent and explanatory variables mentioned above. Covariates entered in the model were selected a priori, based on the literature and availability in the data. Before entering covariates in the model, all covariates (i.e., mothers age group, lone mother, low education/mother's education <12th grade, neighborhood income quintile, urban residence, received employment & income assistance, and family size) were verified to be statistically significant in the bivariate analysis with each of the dependent/outcome variables. Only the covariate family size did not meet the statistically significant value $p < 0.05$ in the bivariate analysis when modeled with smoking ($p = 0.34$), depression ($p = 0.09$), and social isolation ($p = 0.43$). Because several outcomes were examined, this covariate was retained in the adjusted model regardless of statistical performance in the bivariate analysis to keep the numbers of all covariates entered in the adjusted model consistent for all outcomes. Moreover, there is statistical evidence that variables can be included in models regardless if there was a theoretical reason to do so. Unadjusted and adjusted odds ratio estimates were computed as outlined in the model example below:

Unadjusted Analysis

Logit (Depression) = $B_0 + B_1$ (Immigrant status i.e., international vs. Non-immigrant)

Adjusted Analysis: Adjusted for sociodemographic and family factor variables

Logit (Depression) = $B_0 + B_1$ (Immigrant status) + B_2 (Mother's age group) + B_3 (low education) + B_4 (neighborhood income quintile) + B_5 (urban residence) + B_6 (lone mother) + B_7 (EIA) + B_8 (family size)

RQ2- Among immigrants to Manitoba, do childbearing women differ in socio-behavioral perinatal health risk indicators according to immigrant characteristics? (e.g., refugee status, secondary migration, maternal birth region, duration of residence).

Hypothesis: Psychosocial and behavioral perinatal health risk indicators among immigrant childbearing women will vary according to immigrant characteristics such as refugee status, secondary migration, maternal birth region, duration of residence after adjusting for sociodemographic, family characteristics, and knowledge of official Canadian language (English or French).

Analysis was restricted to immigrants to test this hypothesis. Unadjusted and adjusted analyses were completed, similar to RQ1. Internal comparison groups with the lowest risk of adverse outcomes based on the literature were specified as reference categories for each immigrant exposure characteristic. Primary immigrants were used as the reference group to assess associations by secondary migration, based on studies that found higher rates of psychological distress among secondary immigrants.¹²² Similarly, non-refugees were the reference group for analysis that examined associations by refugee status, based on higher rates of psychosocial risk factors among women of refugee background.¹²³ Western Europeans were the reference group for associations by birth region based on their low rates of adverse birth outcomes among European-born women,^{87,90} and for being more ethnically alike to the Canadian-born population.

Given that the association of duration of residence and adverse birth outcomes produced mixed results,²⁸ ten or more years of residence was used as the reference group because of the documented convergence of health status of immigrants with that of the non-immigrant population.

Odds ratio estimates were computed as outlined in the model example below:

Unadjusted Analysis

Model 1 : Logit (Depression) = $B_0 + B_1$ (Secondary vs. Primary immigrant)

Model 2 : Logit (Depression) = $B_0 + B_1$ (Refugee vs. Non-refugee)

Model 3 : Logit (Depression) = $B_0 + B_1$ (Duration of residence: reference=10+ years)

Model 4 : Logit (Depression) = $B_0 + B_1$ (Maternal birth region: reference= Western Europe)

Adjusted Analysis:

Model 5: Included all immigrant exposure variables in the model, adjusting for sociodemographic, family, and immigrant factor variables

Logit (Depression) = $B_0 + B_1$ (Secondary vs. Primary immigrant) + B_2 (Refugee vs. Non-refugee) + B_3 (Duration of residence) + B_4 (Maternal birth region) + B_5 (Mother's age group) + B_6 (low education) + B_7 (neighborhood income quintile) + B_8 (urban residence) + B_9 (lone mother) + B_{10} (EIA) + B_{11} (family size) + B_{12} (knowledge of Canadian official languages)

3.7.5 Models' goodness of fit

To my knowledge, there are no established or widely accepted summary statistics for assessing the adequacy of the fitted marginal logistic regression model to data using generalized estimating

equations.¹²⁴ Moreover, in the adjusted analysis, covariates entered in the logistic regression models were not data driven but selected apriori. Assessing models' goodness of fit to data would therefore be counterintuitive, given that predictive accuracy of the models may be affected.

3.7.6 Sensitivity Analysis

3.7.6.1 Exploration for the potential effect of selection bias on observed results

Standardized differences between screened and unscreened non-immigrants indicated selection bias that could potentially bias comparisons between immigrants and non-immigrants (refer to section 3.6.1, Appendix II and IV). To observe the possible effect of selection bias, alternative dependent/outcome variables to those from BFS/FFS data, obtained from other administrative data sources, e.g., the Discharge Abstract Database and Medical Service data and Prosecutions Information Systems Management (PRISM) Incidents datasets were used to test the effect of changing data on robustness of primary findings.

From the Discharge Abstract Database and Medical Service data, only inadequate prenatal care (R-GINDEX) variable (alternative to late initiation of prenatal care) proved helpful. Supporting the use of this variable was based on prevalence estimates that were higher than estimates from BFS/FFS data (Appendix III), reflecting the strength of the Discharge Abstract Database and Medical Service data claims data source to capture widely prenatal care services received at different pregnancy stages.

Unadjusted and adjusted odds ratio estimates were computed following logistic regression steps outlined in section 3.6.4. Selection bias was not anticipated for RQ2 (i.e., analysis restricted to

only immigrants) since there were no differences in population characteristics between those with screening and those without screening (see Appendix II). Therefore, analysis was completed only for RQ1 (i.e., objective comparing immigrants and non-immigrants overall). These analyses followed three steps, first, for those that met the inclusion criteria (i.e., those with screening), second, for those without screening and those who did not meet the age inclusion criteria, and third, for all maternities (Appendix IX).

The data sources mentioned above were explored to examine the potential impact of selection bias on results of other outcomes, but they proved less useful because prevalence estimates were lower than estimates from BFS/FFS (Appendix III). Moreover, these data sources capture more severe cases that reflect treatment for injuries (e.g., domestic/partner violence), treatment for alcohol, smoking, or substance use cessation, and depression which may not be comparable to self-reported outcomes on BFS/FFS data that are more likely to be mild cases. Another limitation was that psychosocial outcomes like social isolation and relationship distress were unavailable from these data sources. Although testable methods such as propensity score weighting^{125,126} may be helpful to observe changes in outcome effects attributable to selection bias from using the BFS/FFS data, this technique was beyond the scope of this study.

3.7.6.2 Exploration for the potential impact of missing data on observed results

The exclusion of missing in outcome variables from the analysis could affect prevalence estimates and associations. To explore the possible impact of this exclusion on main results, missing values in the outcome variables were dummy coded “unknown” to create a three-level category for each of the outcomes (i.e., yes, no, and unknown). Multinomial logistic regressions with GEE was then used to estimate odds ratios following the steps outlined in section 3.6.4 for

RQ1, i.e., objective comparing immigrants and non-immigrants overall (sensitivity analyses shown in Appendix X), and RQ2, i.e., analysis restricted to only immigrants (sensitivity analyses shown in Appendices XII & XIII).

Also, for RQ1, a second sensitivity analysis (logistic regression with GEE) was completed only for depression using the Discharge Abstract Database & Medical Services data. This was based on prevalence estimates that differed substantially for immigrants (i.e., lower in the screening data than the administrative data (Appendix III) and for the purpose of exploring the effect of changing data on observed results from the screening data (sensitivity analysis shown in Appendix XI).

Chapter 4

Results

4.1 Cohort characteristics

Cohort created from all birth records included n=269,543 childbearing women. Eligible maternities after reducing multiple records (n= 3,369) in the case of twins, triplets, or more to one record per maternity were (n=266,174), out of which n=59,219 maternities without BFS/FFS screening records were excluded, and n=206,955 retained. The final sample size, after further exclusion of births to mothers who did not meet the age inclusion criteria <15 years or >55 (n=293) and those with missing values in demographic variables, e.g., unknown neighborhood income quintile (n=541) and unknown urban/rural residence (n=151), was n=206,096, for cohort included in the analysis (refer to figure 3.3 in the previous chapter) and n= 59,010 for cohort excluded (Appendix II).

Maternities that did not meet the inclusion criteria were n=5,005 immigrants and n=54,005 non-immigrants. Immigrant women were older with an average age in their early thirties, whereas non-immigrants were slightly younger with an average age in their late twenties and were overrepresented (44.8%) in the lowest neighborhood income quintile compared to 29.9% among immigrants. Most immigrants (82.6%) lived in the urban area, while non-immigrants (65.3%) lived in the rural area. The stillbirth/infant death rate among immigrants (4.4%) was twice the rate among non-immigrants (Appendix II).

4.2 Characteristics of maternities with screening record

The cohort for data analysis included 172,342 non-immigrants and 33,754 immigrants (Table 4.1). Immigrant women were slightly older, their average age in the early thirties, and only about

4% were lone mothers compared to 12% among non-immigrants. About 79.3% had higher education or had completed more than high school education, and the majority (78.6%) lived in an urban area. Immigrants were overrepresented (29.9%) in the lowest neighborhood income quintile, but only 4% received employment and income assistance, compared to 16% among non-immigrants. Excluding the index child, 61% of immigrant families had one or more other dependent(s) less than 18 years. Most immigrant participants originated from Asia, while for other regions, the proportion ranged from 3.25% for West Africa to 8.61% for Eastern Europe (Table 4.1).

Table 4.1: Characteristics of maternities in Manitoba, Canada, with BFS/FFS records
(n=206,096)

	Non-immigrant	Immigrant
	172,342 (83.62%)	33,754 (16.38%)
Sociodemographic characteristics		
Mothers' age at birth of index child – mean (SD)*	28.20± (5.61)	30.48 ± (5.33)
Mothers' age at birth of index child – Category		
Below 20 years	11,437 (6.64)	537 (1.59)
20-24 years	34,745 (20.16)	4145 (12.28)
25-29 years	53,935 (31.30)	9786 (28.99)
30-34 years	48852 (28.35)	11489 (34.04)
35-39 years	19958 (11.58)	6243 (18.50)
40-55 years	3415 (1.98)	1554 (4.60)
Lone mother		
Yes	20116 (11.67)	1280 (3.79)
No	145045 (84.16)	31854 (94.37)
Unknown	7181 (4.17)	620 (1.84)
Low education†		
Yes	31974 (18.55)	3362 (9.96)
No	118781 (68.92)	26766 (79.30)
Unknown	21587 (12.53)	3626 (10.74)
Neighborhood Income Quintile		
Q1 (lowest)	35783 (20.76)	10089 (29.89)
Q2	35820 (20.78)	6887 (20.40)
Q3	34772 (20.18)	6453 (19.11)
Q4	3 598 (20.08)	5822 (17.25)
Q5 (Highest)	31369 (18.20)	4503 (13.34)
Urban/ Rural residence		
Rural	72881 (42.29)	7224 (21.40)
Urban	99461 (57.71)	26530 (78.60)
Received Employment & Income Assistance one year before birth to 2 weeks after		
Yes	27104 (15.73)	1402 (4.15)
No	145238 (84.27)	32352 (95.85)
Pregnancy & family-related characteristics		
Family size (Number of dependents <18 years in the same family as index child)		
None	73876 (42.87)	13080 (38.75)
At least one	98466(57.13)	20674 (61.25)
Immigrant characteristics		
International Immigrant		
Primary	--	27362 (81.11)
Secondary		6374 (18.89)
Refugee		
Yes	--	4123 (12.22)
No	--	29613 (87.78)
Knowledge of official Canadian languages (English or French)		
Yes	--	22074 (65.43)
No	--	11662 (34.57)
Duration of residence		
Before Permanent Residence	--	--

	Non-immigrant	Immigrant
<5years	--	18497 (54.83)
5-9years	--	8782 (26.03)
10 above years	--	6457 (19.14)
Maternal Birth Region		
Southeast Asia	--	9622 (28.51)
South Asia & Rest of Asia	--	10303 (30.52)
Eastern Europe		2907 (8.61)
Western Europe	--	1356 (4.02)
Rest of Europe	--	1293 (3.83)
East Africa	--	1958 (5.80)
West Africa	--	1097 (3.25)
Rest of Africa	--	1422 (4.21)
North America & Oceania	--	1207 (3.58)
Latin America & Caribbean	--	2589 (7.67)

Frequencies expressed as n (%) unless otherwise specified

**SD = Standard Deviation*

†Low education = reported mothers' low education or completed <12th grade

4.3 Sample size, prevalence, and odds ratio estimates of outcomes (immigrants versus non-immigrants)

This section provides the answer to the RQ1.

Table 4.2 presents sample sizes for outcomes, prevalences, and the unadjusted and adjusted odds ratios comparing immigrants to non-immigrants. Missing data in the outcome variables ranged from 4.6% for smoking during pregnancy to 32.4% for partner violence (Appendix IV). Hence, the sample size varied for each outcome. Only social isolation was more prevalent among immigrants, and the association became stronger after adjustment. Conversely, immigrants had a lower prevalence of the other indicators before and after adjusting for sociodemographic and family factors.

Table 4.2: Sample size, prevalence, and GEE odds ratio estimates of perinatal health indicators between immigrant and non-immigrant childbearing women in Manitoba, Canada

	International Immigrants		Non-immigrants		International immigrants versus Non-immigrants	
	N	n (%)	N	n (%)	OR (95% CI)*	aOR (95% CI)**
Psychosocial indicators						
Social isolation (n= 161666) [†]	29428	3605 (12.25)	132238	4013 (3.03)	4.46 (4.24, 4.69)	6.95 (6.57, 7.36)
Relationship distress (n= 182438) [†]	29971	642 (2.14)	152467	9155 (6.00)	0.34 (0.31, 0.37)	0.72 (0.66, 0.78)
Partner violence (n= 139234) [†]	24686	126 (0.51)	114548	2716 (2.37)	0.21 (0.18, 0.25)	0.51 (0.42, 0.62)
Depression, Mood & Anxiety Disorder (n= 181189) [†]	29256	1522 (5.20)	151933	28022 (18.44)	0.24 (0.23, 0.26)	0.26 (0.25, 0.29)
Behavioral indicators						
Alcohol use during pregnancy (n= 164723) [†]	29983	868 (2.89)	134740	19069 (14.15)	0.18 (0.17, 0.19)	0.23 (0.21, 0.25)
Smoking during pregnancy (n= 196623) [†]	32547	584 (1.79)	164076	32123 (19.58)	0.08 (0.07, 0.08)	0.11 (0.10, 0.12)
Substance use during pregnancy (n= 163898) [†]	29867	66 (0.22)	134031	6377 (4.76)	0.04 (0.03, 0.06)	0.09 (0.07, 0.11)
Late initiation of prenatal care >13 weeks(n=194202) [†]	32261	301 (0.93)	161941	3544 (2.19)	0.42 (0.37, 0.48)	0.84 (0.74, 0.95)

Frequencies expressed as n (%)

*OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models

**aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models, adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, and employment & income assistance

Bold values = Significant association (p<0.05)

[†]Total excludes missing values for outcomes where (n=)

Frequencies missing for outcomes: (Depression, mood & anxiety disorder n=24907; social isolation n= 44430; Relationship distress n= 23658; Partner violence n= 66862; Alcohol use during pregnancy n= 41373; Smoking during pregnancy n= 9473; Substance use during pregnancy n= 42198; Late initiation of prenatal care >13 weeks n= 11894- refer to Appendix III & IV for the different missing proportions by immigrant status)

4.4 Prevalence and odds ratio estimates of outcomes among international immigrants

This section provides the answer to the RQ2.

Prevalences and odds ratio estimates for outcomes restricted to international immigrant childbearing women are presented in Tables 4.3 to 4.6. Secondary compared to primary immigrants had a higher prevalence of social isolation, but this association reversed after adjustment (Tables 4.3 & 4.5). Being a secondary immigrant was also negatively associated with relationship distress. Refugees had higher prevalences and odds of social isolation, relationship distress, depression, mood, and anxiety disorder than non-refugees (Tables 4.3 & 4.5). The high odds of social isolation and became marginally significant, while partner violence became non-significant in the adjusted analysis. Compared to Western Europe, women from all birth regions had higher prevalence and odds of social isolation, except for women from North America and Oceania, who had a lower prevalence, although not statistically significant. Only women from West Africa had higher odds of relationship distress in both unadjusted and adjusted analyses. Women from African regions had higher odds of partner violence. The association was attenuated and non-significant in the adjusted analysis but remained high among women from West Africa (Tables 4.5). Those from North & South Europe, North America & Oceania, Latin America & the Caribbean had higher prevalences and odds of depression, mood & anxiety disorder (Tables 4.4 & 4.5). Recent immigrants had nine times the odds of being socially isolated than those with ten or more years of residence but lower odds of relationship distress and depression than long-term immigrants (Table 4.5).

Only smoking during pregnancy was lower among secondary immigrants compared to primary immigrants (Table 4.6). Refugees had higher prevalences of smoking and substance use, but the

associations became non-significant after adjustment. Refugees had higher odds of late initiation of prenatal care compared to non-refugees. Compared to Western Europeans, pregnancy smoking and alcohol consumption were higher among North & South Europe women in the adjusted analysis. Women from Eastern Europe, North America & Oceania, and Latin America & the Caribbean had higher adjusted odds of consuming alcohol but not of smoking. Those from Africa had lower adjusted odds of smoking but not of alcohol consumption, while those from South & Rest of Asia had significantly lower odds of smoking and alcohol use. Odds ratios estimate for substance use by birth regions was not reported because the cell count for the internal comparison group (Western Europeans) was less than six. Late prenatal care initiation did not exhibit significant variation by region of birth after adjustment (Table 4.6). The prevalence of consuming alcohol, smoking, and substance use during pregnancy increased with increasing duration of residence (Table 4.3). Recent immigrants had lower odds of consuming alcohol, smoking, or substance use during pregnancy but had 50% higher odds of late initiation of prenatal care compared to long-term immigrants (Table 4.6).

Table 4.3: Prevalence of outcomes among immigrant childbearing women in Manitoba, Canada, by duration of residence, secondary vs. primary immigrants, and refugee vs. non-refugees

Psychosocial indicators	Immigrants		Refugees		Duration of residence		
	Secondary	Primary	Refugee	Non-refugee	<5years	5-9years	10 years+
Social isolation (n=29428) [†]							
Yes	832 (14.23)	2773 (11.76)	565 (16.25)	3040 (11.71)	2964 (18.26)	488 (6.40)	153 (2.75)
No	5013 (85.77)	20810 (88.24)	2912 (83.75)	22911 (88.29)	13272 (81.74)	7136 (93.60)	5415 (97.25)
Relationship distress (n=29971) [†]							
Yes	92 (1.56)	550 (2.28)	206 (5.84)	436 (1.65)	280 (1.70)	183 (2.34)	179 (3.15)
No	5802 (98.44)	23527 (97.72)	3322 (94.16)	26007 (98.35)	16186 (98.30)	7644 (97.66)	5499 (96.85)
Partner violence (n=24686) [†]							
Yes	24 (0.46)	102 (0.53)	39 (1.39)	87 (0.40)	62 (0.46)	39 (0.60)	25 (0.54)
No	5243 (99.54)	19317 (99.47)	2763 (98.61)	21797 (99.60)	13541 (99.54)	6420 (99.40)	4599 (99.46)
Depression, mood & anxiety disorder (n=29256) [†]							
Yes	259 (4.60)	1263 (5.35)	281 (7.95)	1241 (4.83)	597 (3.74)	414 (5.43)	511 (9.03)
No	5372 (95.40)	22362 (94.65)	3255 (92.05)	24479 (95.17)	15374 (96.26)	7213 (94.57)	5147 (90.97)
Behavioral indicators							
Alcohol use during pregnancy (n=29983) [†]							
Yes	140 (2.36)	728 (3.03)	118 (3.33)	750 (2.84)	349 (2.11)	193 (2.49)	326 (5.74)
No	5791 (97.64)	23324 (96.97)	3425 (96.67)	25690 (97.16)	16212 (97.89)	7554 (97.51)	5349 (94.26)
Smoking during pregnancy (n=32547) [†]							
Yes	83 (1.34)	501 (1.90)	123 (3.13)	461 (1.61)	220 (1.23)	136 (1.61)	228 (3.66)
No	6109 (98.66)	25854 (98.10)	3802 (96.87)	28161 (98.39)	17637 (98.77)	8320 (98.39)	6006 (96.34)
Substance use during pregnancy (n=29867) [†]							
Yes	9 (0.15)	57 (0.24)	17 (0.48)	49 (0.19)	9 (0.05)	20 (0.26)	37 (0.66)
No	5905 (99.85)	23896 (99.76)	3504 (99.52)	26297 (99.81)	16488 (99.95)	7714 (99.74)	5599 (99.34)
Late initiation of prenatal care >13 weeks (n=32261) [†]							
Yes	83 (1.35)	218 (0.83)	74 (1.92)	227 (0.80)	188 (1.06)	61 (0.72)	52 (0.84)
No	6050 (98.65)	25910 (99.17)	3782 (98.08)	28178 (99.20)	17488 (98.94)	8365 (99.28)	6107 (99.16)

Frequencies expressed as n (%)

[†]Total excludes missing values for outcomes where (n=)

Frequencies missing for outcomes: (Depression, mood & anxiety disorder n=4498; social isolation n= 4326; Relationship distress n= 3783; Partner violence n= 9068; Alcohol use during pregnancy n= 3771; Smoking during pregnancy n= 1207; Substance use during pregnancy n= 3887; Late initiation of prenatal care >13 weeks n= 1493- refer to Appendix VI for the different missing proportions by immigrant characteristics)

Table 4.4: Prevalence of outcomes by birth region among immigrant childbearing women in Manitoba, Canada

Psychosocial indicators	Maternal birth region									
	SEA**	S & RA**	EE**	WE**	RE**	EA**	WA**	RA**	NA&O**	LA&C**
Social isolation (n=29428)†										
Yes	700 (8.55)	1389 (15.16)	335 (13.12)	54 (4.26)	70 (6.65)	282 (16.27)	141 (13.89)	262 (21.15)	35 (3.49)	337 (15.21)
No	7489 (91.45)	7772 (84.84)	2219 (86.88)	1214 (95.74)	982 (93.35)	1451 (83.73)	874 (86.11)	977 (78.85)	967 (96.51)	1878 (84.79)
Relationship distress (n=29971)†										
Yes	169 (2.02)	116 (1.28)	28 (1.05)	20 (1.54)	20 (1.70)	69 (4.01)	49 (5.09)	66 (5.33)	13 (1.18)	92 (3.87)
No	8214 (97.98)	8927 (98.72)	2639 (98.95)	1278 (98.46)	1155(98.30)	1653 (95.99)	913 (94.91)	1172(94.67)	1090(98.82)	2288 (96.13)
Partner violence (n=24686)†										
Yes	32 (0.48)	26 (0.35)	10 (0.44)	6 (0.49)	6 (0.67)	15 (1.02)	12 (1.53)	11 (1.09)	6 (0.67)	9 (0.47)
No	6658 (99.52)	7477 (99.65)	2258 (99.56)	1228 (99.51)	900 (99.34)	1452 (99.98)	773 (98.47)	1000(98.91)	891 (99.33)	1916 (99.53)
Depression, mood & anxiety disorder (n=29256)†										
Yes	290 (3.50)	332 (3.76)	125 (4.87)	58 (4.87)	126 (10.89)	64 (3.82)	36 (3.86)	78 (6.37)	157 (14.63)	256 (11.09)
No	8005 (96.50)	8496 (96.24)	2444 (95.13)	1132 (95.13)	1031(89.11)	1613 (96.18)	897 (96.14)	1147(93.63)	916 (85.37)	2053 (88.91)
Behavioral indicators										
Alcohol use during pregnancy (n=29983)†										
Yes	246 (2.92)	100 (1.07)	123 (4.75)	43 (3.37)	82 (7.69)	37 (2.08)	19 (1.84)	29 (2.30)	66 (6.53)	123 (5.56)
No	8169 (97.08)	9246 (98.93)	2465 (95.25)	1232 (96.63)	985 (92.31)	1740 (97.92)	1013(98.16)	1230(97.70)	944 (93.47)	2091 (94.44)
Smoking during pregnancy (n=32547)†										
Yes	122 (1.32)	69 (0.69)	70 (2.49)	32 (2.45)	104 (8.33)	28 (1.50)	7 (0.66)	18 (1.31)	42 (3.59)	92 (3.66)
No	9146 (98.68)	9866 (99.31)	2736 (97.51)	1275 (97.55)	1145(91.67)	1833 (98.50)	1059(99.34)	1355(98.69)	1128(96.41)	2420 (96.34)
Substance use during pregnancy (n=29867)†										
Yes	13 (0.16)	8 (0.09)	10 (0.39)	*	8 (0.75)	*	*	*	*	11 (0.50)
No	8363 (99.84)	9314 (99.91)	2570 (99.61)	1273 (99.92)	1052(99.25)	1762 (99.77)	1023(99.61)	1251(99.68)	1002(99.70)	2191 (99.50)
Late initiation of prenatal care >13 weeks (n=32261)†										
Yes	86 (0.94)	65 (0.66)	34 (1.21)	9 (0.68)	11 (0.89)	23 (1.26)	12 (1.15)	23 (1.72)	8 (0.69)	30 (1.20)
No	9088 (99.06)	9785 (99.34)	2770 (98.79)	1307 (99.32)	1231(99.11)	1798 (98.74)	1035(98.85)	1318(98.28)	1151(99.31)	2477 (98.80)

Frequencies expressed as n (%) ; * = Suppressed for cell frequencies <6

†Total excludes missing values for outcomes where (n=)

Frequencies missing for outcomes: (Depression mood & anxiety disorder n=4498; social isolation n= 4326; Relationship distress n= 3783; Partner violence n= 9068; Alcohol use during pregnancy n= 3771; Smoking during pregnancy n= 1207; Substance use during pregnancy n= 3887; Late initiation of prenatal care >13 weeks n= 1493- refer to Appendix VII for the different missing proportions by birth regions)

**SEA= Southeast Asia; S & RA= South & Rest of Asia; EE= Eastern Europe; WE= Western Europe; RE= Rest of Europe; EA= East Africa; WA= West Africa; RA= Rest of Africa; NA&O= North America & Oceania; LA&C= Latin America & Caribbean

Table 4.5: Unadjusted and adjusted GEE odds ratio estimates for psychosocial perinatal health indicators among immigrant childbearing women in Manitoba, Canada

International immigrants n =33754	Social isolation (n =29428) [†]		Relationship distress (n = 29971) [†]		Partner violence (n = 24686) [†]		Depression, mood & anxiety disorder (n = 29256) [†]	
	OR (95% CI) [*]	aOR (95% CI) ^{**}	OR (95% CI) [*]	aOR (95% CI) ^{**}	OR (95% CI) [*]	aOR (95% CI) ^{**}	OR (95% CI) [*]	aOR (95% CI) ^{**}
Immigrants								
Primary	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Secondary	1.25 (1.13, 1.37)	0.76 (0.68, 0.85)	0.68 (0.54, 0.86)	0.73 (0.55, 0.97)	0.87 (0.55, 1.36)	0.84 (0.50, 1.43)	0.85 (0.73, 1.00)	0.98 (0.82, 1.18)
Refugees								
Non-refugee	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Refugee	1.46 (1.32, 1.62)	1.17 (0.99, 1.38)	3.70 (3.09, 4.42)	1.39 (1.02, 1.90)	3.54 (2.37, 5.28)	1.02 (0.52, 1.98)	1.70 (1.46, 1.98)	1.37 (1.11, 1.70)
Maternal birth region								
Western Europe	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Southeast Asia	2.10 (1.50, 2.95)	1.76 (1.21, 2.56)	1.31 (0.79, 2.19)	1.21 (0.68, 2.16)	1.48 (0.52, 4.20)	1.04 (0.35, 3.03)	0.71 (0.51, 0.98)	0.71 (0.49, 1.04)
South & Rest of Asia	4.02 (2.88, 5.61)	3.03 (2.10, 4.36)	0.83 (0.49, 1.40)	1.28 (0.73, 2.26)	1.07 (0.37, 3.08)	1.12 (0.38, 3.30)	0.76 (0.55, 1.06)	0.93 (0.65, 1.34)
Eastern Europe	3.39 (2.38, 4.84)	2.95 (2.01, 4.33)	0.68 (0.36, 1.28)	0.99 (0.50, 1.95)	1.36 (0.41, 4.49)	1.54 (0.44, 5.34)	0.99 (0.69, 1.45)	1.08 (0.72, 1.61)
Rest of Europe	1.60 (1.06, 2.42)	2.01 (1.30, 3.10)	1.11 (0.57, 2.13)	1.06 (0.53, 2.10)	1.02 (0.23, 4.57)	0.85 (0.18, 4.07)	2.39 (1.65, 3.44)	2.06 (1.39, 3.07)
East Africa	4.37 (3.07, 6.23)	2.45 (1.62, 3.69)	2.67 (1.54, 4.61)	1.12 (0.57, 2.21)	3.18 (1.05, 9.58)	0.86 (0.22, 3.34)	0.77 (0.51, 1.17)	0.62 (0.38, 1.00)
West Africa	3.63 (2.50, 5.27)	2.59 (1.71, 3.92)	3.43 (1.93, 6.08)	2.03 (1.02, 4.02)	4.77 (1.50, 15.16)	1.92 (0.54, 6.90)	0.78 (0.48, 1.27)	0.76 (0.45, 1.30)
Rest of Africa	6.03 (4.21, 8.63)	3.59 (2.40, 5.38)	3.60 (2.08, 6.23)	1.51 (0.77, 2.96)	3.38 (1.05, 10.91)	0.75 (0.20, 2.91)	1.33 (0.90, 1.95)	1.10 (0.70, 1.73)
North America & Oceania	0.81 (0.50, 1.34)	0.65 (0.38, 1.09)	0.76 (0.37, 1.58)	0.82 (0.38, 1.77)	1.38 (0.34, 5.52)	1.25 (0.32, 4.85)	3.35 (2.32, 4.82)	3.46 (2.33, 5.14)
Latin America & Caribbean	4.03 (2.84, 5.74)	3.21 (2.20, 4.69)	2.57 (1.51, 4.39)	1.48 (0.83, 2.64)	1.44 (0.44, 4.70)	0.63 (0.19, 2.14)	2.43 (1.73, 3.42)	2.14 (1.47, 3.11)
Duration of residence								
<5years	7.90 (6.61, 9.45)	9.04 (7.48, 10.94)	0.53 (0.44, 0.65)	0.68 (0.53, 0.87)	0.84 (0.52, 1.36)	1.22 (0.71, 2.10)	0.39 (0.34, 0.45)	0.46 (0.39, 0.53)
5-9 years	2.42 (1.99, 2.95)	2.64 (2.15, 3.24)	0.74 (0.59, 0.91)	0.84 (0.66, 1.08)	1.12 (0.67, 1.86)	1.32 (0.75, 2.32)	0.58 (0.50, 0.67)	0.65 (0.56, 0.75)
10 years and more	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)

*OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models

**aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models, adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, employment & income assistance, and knowledge of official Canadian languages

Bold values = Significant association (p<0.05)

[†]Total excludes missing values for outcomes where (n=)

Frequencies missing for outcomes: (Social isolation n= 4326; Relationship distress n= 3783; Partner violence n= 9068; Depression, mood & anxiety disorder n=4498)

Table 4.6: Unadjusted and adjusted GEE odds ratio estimates for behavioral perinatal health indicators among immigrant childbearing women in Manitoba, Canada

International immigrants n = 33754	Maternal alcohol use during pregnancy (n = 29983) [†]		Maternal smoking during pregnancy (n = 32547) [†]		Maternal substance use during pregnancy (n = 29867) [†]		Late initiation of Prenatal care (n = 32261) [†]	
	OR (95% CI) [*]	aOR (95% CI) ^{**}	OR (95% CI) [*]	aOR (95% CI) ^{**}	OR (95% CI) [*]	aOR (95% CI) ^{**}	OR (95% CI) [*]	aOR (95% CI) ^{**}
Immigrants								
Primary	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Secondary	0.77 (0.64, 0.94)	0.94 (0.75, 1.17)	0.70 (0.53, 0.93)	0.71 (0.52, 0.97)	0.64 (0.31, 1.30)	0.81 (0.37, 1.78)	1.63 (1.25, 2.13)	1.32 (0.97, 1.78)
Refugees								
Non-refugee	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Refugee	1.18 (0.96, 1.46)	0.95 (0.72, 1.25)	1.98 (1.54, 2.53)	1.20 (0.85, 1.71)	2.60 (1.43, 4.76)	0.94 (0.40, 2.19)	2.43 (1.86, 3.17)	1.59 (1.07, 2.36)
Maternal birth region								
Western Europe	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	(-)	(-)	1.0 (Reference)	1.0 (Reference)
Southeast Asia	0.86 (0.60, 1.23)	1.02 (0.66, 1.60)	0.53 (0.34, 0.82)	0.63 (0.36, 1.11)	(-)	(-)	1.37 (0.65, 2.92)	1.88 (0.82, 4.30)
South & Rest of Asia	0.31 (0.21, 0.45)	0.45 (0.28, 0.71)	0.28 (0.17, 0.45)	0.40 (0.23, 0.72)	(-)	(-)	0.96 (0.45, 2.08)	1.23 (0.54, 2.82)
Eastern Europe	1.43 (0.98, 2.09)	1.96 (1.27, 3.04)	1.02 (0.64, 1.62)	1.53 (0.89, 2.62)	(-)	(-)	1.78 (0.79, 4.00)	1.77 (0.75, 4.17)
Rest of Europe	2.39 (1.58, 3.60)	2.10 (1.31, 3.39)	3.62 (2.28, 5.74)	3.57 (2.10, 6.07)	(-)	(-)	1.30 (0.51, 3.30)	1.54 (0.58, 4.07)
East Africa	0.61 (0.38, 0.97)	0.83 (0.46, 1.49)	0.61 (0.35, 1.05)	0.41 (0.20, 0.86)	(-)	(-)	1.86 (0.81, 4.26)	1.06 (0.40, 2.76)
West Africa	0.54 (0.29, 1.01)	0.63 (0.31, 1.27)	0.26 (0.11, 0.61)	0.25 (0.09, 0.65)	(-)	(-)	1.68 (0.67, 4.22)	1.48 (0.53, 4.15)
Rest of Africa	0.68 (0.41, 1.12)	0.84 (0.46, 1.51)	0.53 (0.27, 1.04)	0.35 (0.14, 0.87)	(-)	(-)	2.53 (1.10, 5.81)	1.40 (0.55, 3.60)
North America & Oceania	2.00 (1.31, 3.05)	2.47 (1.52, 4.02)	1.48 (0.83, 2.65)	1.64 (0.85, 3.20)	(-)	(-)	1.01 (0.37, 2.74)	1.04 (0.37, 2.93)
Latin America & Caribbean	1.69 (1.15, 2.47)	1.74 (1.10, 2.74)	1.51 (0.95, 2.41)	1.14 (0.66, 1.99)	(-)	(-)	1.76 (0.78, 3.96)	1.31 (0.56, 3.05)
Duration of residence								
<5years	0.35 (0.30, 0.41)	0.43 (0.35, 0.52)	0.33 (0.27, 0.40)	0.46 (0.36, 0.60)	0.08 (0.04, 0.17)	0.07 (0.03, 0.16)	1.26 (0.93, 1.72)	1.50 (1.07, 2.12)
5-9 years	0.42 (0.35, 0.51)	0.52 (0.42, 0.64)	0.43 (0.34, 0.54)	0.58 (0.45, 0.75)	0.39 (0.23, 0.68)	0.44 (0.25, 0.78)	0.86 (0.59, 1.25)	0.94 (0.64, 1.40)
10 years and more	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)

*OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models

**aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models, adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, employment & income assistance, and knowledge of official Canadian languages

Bold values = Significant association (p<0.05)

(-) = unreportable (n < 6 for internal comparison group)

[†]Total excludes missing values for outcomes where (n=)

Frequencies missing for outcomes: (Alcohol use during pregnancy n= 3771; Smoking during pregnancy n= 1207; Substance use during pregnancy n= 3887; Late initiation of prenatal care >13 weeks n= 1493)

4.5 Sensitivity analysis

4.5.1 *Exploration of the potential effect of selection bias on observed results*

The exploration of the possible effect of selection bias on the main results compared three cohorts using alternative indicator variables from other administrative data sources. The first cohort was maternities with screening records, the second was maternities without screening and those who did not meet the age inclusion criteria, and the third accounted for all maternities. This exploration was completed only for the prenatal care variable because only inadequate prenatal care (R-GINDEX) variable (alternative to late initiation of prenatal care) proved helpful. This was based on prevalence estimates that were higher than estimates from BFS/FFS data (Appendix III), reflecting the strength of the Discharge Abstract Database and Medical Service data source to capture widely prenatal care services received at different pregnancy stages.

In the analysis restricted to maternities with screening records, the adjusted odds of inadequate prenatal care was higher among immigrants compared to non-immigrants but lower among those without screening and those who did not meet the age inclusion criteria. For all maternities, the adjusted odd of inadequate prenatal care was close to the result among those with screening but 29% lower (Appendix IX).

Compared with the primary finding from BFS/FFS data where the effect size was closer to the null and immigrants had lower odds of late initiation of prenatal care compared to non-immigrants, sensitivity analysis results for maternities with screening and all maternities showed significant changes in the magnitude and direction of association which was further away from the null while the magnitude and direction of the association for maternities without screening

and those who did not meet the age inclusion criteria was lower and comparable to the main results.

A possibility that explains the immigrant disadvantage in the sensitivity analysis compared to the main results from the screening data may be a low indication for selection bias among immigrants. This was observed in the prevalence estimates, which changed significantly for non-immigrants (from 8.0% to 12.7%) but not as much for immigrants (from 7.2% to 7.8%) when analysis accounted for those without screening and those who did not meet the age inclusion criteria (Appendix IX). Another possibility that could explain this discrepancy, is differences in how variables are measured in the two datasets. The measure of inadequate prenatal care from Discharge Abstract Dataset and Medical Services data used in this study considers prenatal care inadequacy for all pregnancy stages, whereas, the BFS/FFS measures prenatal care inadequacy in the third trimester (i.e., after 28 weeks).

4.5.2 Exploration of the potential impact of missing data on observed results

4.5.2.1 Comparison between immigrants and non-immigrants

For RQ1, the unknown/missing category was added as another level to all outcome variables with the purpose of observing the magnitude and direction of association in the unknown/missing category compared with the main results and to explore the possible impact of missing exclusions on the main results. For this sensitivity analysis, multinomial logistic regressions with GEE were completed.

Also for RQ1, a second sensitivity analysis (logistic regression with GEE) was completed only for depression using the Discharge Abstract Database & Medical Services data based on

prevalence estimates that differed substantially for immigrants (i.e., lower in the screening data than the administrative data) and to explore the effect of changing data on observed results from the screening data.

Associations were positive and significant for both unadjusted and adjusted analyses in the unknown categories for all outcomes. However, compared to the lower odds in the main results, associations were stronger and the direction further away from the null i.e., higher odds, for depression, mood and anxiety disorder, relationship distress, and late initiation of prenatal care (Appendix X), which suggest that the main results may be underestimated. Because standardized differences in missing rates by immigrant status were not significant for these three outcomes (Appendix IV), the direction of association may hold if missing were reassigned to either the yes or no categories. For partner violence, alcohol, and substance use during pregnancy where the odds in the unknown and main results are comparable, the direction of association may hold. But associations may still be biased because there were statistically significant differences in missing rates by immigrant status except for pregnancy smoking (Appendix IV). For social isolation, the direction of association may also hold, given the strong observed association in the main result, except that the potential impact of missing on the magnitude of associations for all outcomes is uncertain.

The result of a second sensitivity analysis for depression did not show any change in the direction of association from the main results (low odds) but did show a slight change in magnitude (Appendix XI). Hence, one can conclude based on the direction of association that the main results of depression from the screening data is robust.

4.5.2.2 Analysis restricted to immigrants

For RQ2, the unknown category was added as another level to all outcome variables to examine the magnitude and direction of association in the unknown/ missing category compared with the main results and to explore the possible impact of missing exclusions on observed results among immigrant subgroups. Regression analysis was computed similarly to RQ1.

For psychosocial outcomes (Appendix XII), compared with the main results where women from North America and Oceania compared to Western Europe had lower adjusted odds of social isolation, higher adjusted odds were observed in the unknown category among women from this birth region in the sensitivity analysis. In the main results, only women from West Africa compared to Western Europe had higher odds of relationship distress in both unadjusted and adjusted analyses. Whereas in the sensitivity analysis, women from West Africa and those from Southeast Asia and South & Rest of Asia compared to Western Europe had higher unadjusted and adjusted odds of relationship distress in the unknown categories. Although lower odds for partner violence among secondary compared to primary immigrants in the unknown category were comparable to the main results, this association was not statistically significant in the main results. Compared with the main results, where the odds for partner violence were higher only among Africans, adjusted odds of partner violence in the unknown categories were statistically significantly higher among women from all birth regions except East Africa compared to Western Europe. Adjusted odds for depression in the unknown categories were statistically significantly lower among women from North & South Europe, North America & Oceania, Latin America & the Caribbean compared to higher odds in the main results. Sensitivity analysis also found statistically significant lower adjusted odds for depression that was not statistically

significant in the main results among Southeast Asia, Eastern Europe, and East Africa compared to Western Europe (Appendix XII).

For behavioral outcomes (Appendix XIII), statistically significant lower adjusted odd was found only for pregnancy smoking among secondary compared to primary immigrants in the main result. Whereas in the sensitivity analysis, similar findings were observed for pregnancy alcohol and substance use in the unknown categories among secondary compared to primary immigrants, in addition to the above findings. In the sensitivity analysis, the adjusted odds for pregnancy alcohol consumption in the unknown categories were higher than the main results among women from Eastern Europe, Rest of Europe, North America & Oceania, Latin America & the Caribbean compared to Western Europe. Statistically significant higher adjusted odds in the unknown categories were also observed among Southeast Asia, South & Rest of Asia, and Rest of Africa compared to lower adjusted odds in the main results. As in the main results, women from Rest of Africa compared to Western Europe had statistically significant lower adjusted odds for pregnancy smoking in the unknown category. Those from North America & Oceania compared to Western Europe had statistically significant lower adjusted odds for pregnancy smoking in the unknown category, which was higher but not statistically significant in the main result. While prenatal care did not vary by birth region in the main results, statistically significant lower adjusted odds for late initiation of prenatal care was observed in the unknown category among women from Latin America & the Caribbean compared to Western Europe (Appendix XIII).

For psychosocial and behavioral indicators among immigrants, higher odds in the unknown categories compared to lower odds in the main results for some outcomes may suggest underestimation of risks. By and large, the potential impact of missing on the magnitude of

associations is uncertain for all outcomes. However, for results of missing categories that are comparable to the main results, one can assume that the direction of the associations may hold if missing were reassigned either to the yes or no categories only if missing proportions between comparison groups do not statistically significantly differ. Associations will be biased if missing proportions among immigrant subgroups statistically significantly differ except for outcomes with strong associations in the main result.

Chapter 5

Discussion

5.1 Objective 1— Comparisons between immigrant and non-immigrants

5.1.1 Main findings

The population-based study compared eight socio-behavioral perinatal health indicators between immigrants and non-immigrants. Immigrants had a higher prevalence and odds of social isolation than non-immigrants but a lower prevalence and odds of other perinatal health indicators.

The hypothesis that immigrants will have a higher likelihood of psychosocial perinatal health risks than non-immigrants was only supported for social isolation but not for other psychosocial outcomes. However, findings from the study supported the hypothesis that immigrants will have a lower likelihood of behavioral perinatal health risks than non-immigrants.

5.1.2 Interpretation (psychosocial perinatal health risk indicators)

Immigrants had a lower prevalence of depression, relationship distress and partner violence than non-immigrants, except for social isolation. These findings are consistent with many studies^{18,19,30,51,62,63} except for a few on depression.¹¹⁸ Most studies on depression have reported higher prevalence rates among immigrants.^{18,19,30} There is a dearth of research on marital relationships among immigrants compared with their host country counterparts. Study findings related to each outcome are discussed as follows beginning with social isolation as the most significant finding for the first research objective.

Social isolation

The prevalence of social isolation in this study (12.3%) was close to the estimate (10.9%) reported in a sample of German adults.¹²⁷ The higher odds among immigrants agree with

findings from the same study. The major strength of this study over past studies ¹²² is the assessment of prevalence during critical periods in the lives of women, i.e., during pregnancy and postpartum, that may be associated with a higher perception and likelihood of social isolation. Most studies on perinatal health outcomes of women examine social isolation as a risk associated with other health morbidities e.g., depression. ⁵⁶ Therefore, it is possible that the difference in prevalence in this current study compared to past studies may reflect methodological differences.

One possible explanation for the higher odds among immigrants could be the loss of culturally relevant support often enjoyed in home countries after migration-related family separation. ¹²⁸ Socioeconomic barriers such as low educational attainment and household income may hinder success at rebuilding social support networks, which even when built, may not be well-established in Western countries post-migration. ¹²⁹ The current study found strong association between the experience of social isolation and the socioeconomic position of immigrants, such as maternal education below high school, low neighborhood income quintile (Q1), and receipt of employment and income assistance (data not shown), consistent with past studies ^{127,128} that found a higher prevalence in low socioeconomic status. Another possibility identified in the literature that could explain the high odds among immigrants is the environmental barrier in Western countries, which promotes brief infrequent encounters among people. ¹²⁸

A sensitivity analysis that assessed the impact of missing data on observed results by including missing in the analysis found lower odds of social isolation in the missing category (Appendix X). Reassigning missing to either the yes or no category will impact results but the extent of changes to the magnitude of association is uncertain. Although statistically significant differences in the proportion of missing values (missing higher among non-immigrants) may bias

comparisons between immigrants and non-immigrants (Appendix IV), the direction of the associations may hold for social isolation, given the strong observed associations in the main results.

Depression

Many studies have reported a high prevalence of depression among immigrants compared to non-immigrants.^{18,19,30} This study's findings aligned with a few other studies that found lower prevalence,¹¹⁸ consistent with the healthy migration hypothesis. However, it is possible that subjective understanding of depression, which may be misconstrued as a feeling of boredom or tiredness, as highlighted in one qualitative study,¹³⁰ may influence a negative response to a depression question during the screening, consequently underestimating prevalence.

Furthermore, immigrants' negative perception of the disclosure of mental health issues as stigmatizing¹³⁰ could also explain the low odds observed in this study.

My study assessed the robustness of the main results of depression based on two sensitivity analyses. The first sensitivity analysis assessed the impact of missing data on observed results by including missing in the analysis. The odds of depression among immigrants compared to non-immigrants were high in the missing category compared to the lower odds in the main result (Appendix X). This finding only suggested that the main results may be underestimated. It is possible that reassigning missing will impact results, however, the potential effect on the magnitude of the association is uncertain. For the true association, a significant change in the direction of association is not expected even if missing were reassigned to the yes or no categories, because the standardized differences in the proportion of missing values according to immigration status was not statistically significant for depression (Appendix IV).

The second sensitivity analysis used a different data source, the Discharge Abstract Database & Medical Services data. An interesting observation was the substantial difference in the prevalence of depression which was higher in the Discharge Abstract Database & Medical Services data than the BFS/FFS among immigrants but very close in the two datasets for non-immigrants (Appendix III). However, missing did not seem to explain the differences in prevalence rates observed for both data sources as the result of sensitivity analysis was consistent with the main findings (low odds). The direction of association remained unchanged, but the magnitude changed (Appendix X & XI). Given this consistency in results, one can conclude based on the direction of association that the main results from the screening data are robust.

The differences in prevalence estimates observed for both data sources may be related to the different ways that variables were measured. The prevalence of depression from the screening data is based on self-report. Interviewer or self-report bias may underestimate prevalence. Again, the low prevalence in the screening data may reflect health access inequality among immigrants or lack of awareness of depression symptomatology at the time of screening. Whereas, the prevalence of depression from the Discharge Abstract Database & Medical Services data is based on confirmed diagnoses of more severe cases.

Relationship distress

This study found an overall low prevalence of relationship distress among immigrants compared to non-immigrants. The few studies on marital relationships among immigrants are qualitative¹⁵⁻¹⁷ with no comparative results for non-immigrants. The low prevalence among immigrants may be due to social desirability or stigma associated with reporting this outcome in a new country. It may also be possible that recent immigrants were over-represented, and the lower odds reflect the selective migration of couples in harmonious relationships.

A sensitivity analysis that assessed the impact of missing data on observed results by including missing in the analysis revealed higher odds of relationship distress among immigrants compared to non-immigrants in the missing category compared to low odds in the main results (Appendix X). This result only suggested that the odds of relationship distress in the main result may be underestimated among immigrants. It is possible that reassigning missing will affect results, but the potential impact on the magnitude of the association is uncertain. However, the direction of association may hold if missing were reassigned to either the yes or no categories because the proportion of missing values according to immigration status did not statistically significantly differ for relationship distress (Appendix IV). Unfortunately, there was no alternative variable for relationship distress in the administrative data to further assess the robustness of the main results.

Partner violence

Consistent with past studies,^{51,62,63} this study found a lower prevalence of partner violence among immigrants than non-immigrants, which may be related to differences in the perception of violence. Some immigrant women may not consider some acts violent, may be reluctant to acknowledge or report violence, or encounter structural barriers to navigating help within a complex immigration system.¹³¹ Under-reporting of cases may be due to cultural or social pressures on women and financial dependency on spouses that cause them to tolerate abuse in silence.¹³²

Like in the main results, a sensitivity analysis that included missing in the analysis observed lower odds of partner violence in the missing category (Appendix X). Therefore, one can assume that the direction of association may hold if missing were reassigned to either the yes or no categories based on similarities in the main results and in the unknown category. However,

because immigrants differed substantially from non-immigrants in missing rates, where missing was higher among non-immigrants (Appendix IV), comparisons between immigrants and non-immigrants for partner violence may be biased. The potential impact of missing on the magnitude of association is uncertain.

Further exploration compared the prevalence of partner violence from the screening data with estimate from the Prosecutions Information Systems Management (PRISMS) Incidents dataset (Appendix III). The overall prevalence the in PRISMS dataset was lower than BFS/FFS and was less helpful in completing a sensitivity analysis that explored the effect of changing data on the main results. Even an overlap in prevalence from combining PRISMS and screening data also did not contribute additional information. Missing only increased the proportion of ‘no’ responses but did not add significantly to the ‘yes’ response (Appendix III). However, an interesting observation in the PRISMS dataset was that the low prevalence for partner violence observed among immigrants in the screening data was not confirmed. Instead, immigrants had a higher prevalence than non-immigrants.

A possible explanation for this finding may be related to severity levels of outcome measured by both datasets. The PRISMS data was more reflective of severe cases (e.g., treatment of injuries), whereas the screening data captured self-reported experiences of partner violence which may be prone to self-report bias.

5.1.3 Interpretation (behavioral perinatal health risk indicators)

Consistent with past studies, immigrants had a lower prevalence than non-immigrants in all outcomes, associations confirmed by sensitivity analyses, except for prenatal care.

Alcohol, Smoking & Substance use during pregnancy

Study findings of lower behavioral odds of alcohol, smoking and substance use during pregnancy are consistent with studies conducted in Canada,^{22,23,76} the United States,⁷⁷ and France²⁰ that have shown that immigrants were less likely to engage in unhealthy behaviors such as alcohol, smoking, and substance use during pregnancy compared to non-immigrants, which may be related to protective cultural strengths that immigrants bring with them from their countries of origin.⁹² Protective cultural strength among immigrants is a common plausibility discussed in many literatures. However, the current study observed inequalities in the foreign-born health advantage for smoking during pregnancy that was strongest among women from South & Rest of Asia and West Africa, consistent with a study from the United Kingdom where mothers from these birth regions were less likely to smoke during pregnancy.¹³³ The foreign-born health advantage for both pregnancy smoking and alcohol use was weakest among women from Rest of Europe (i.e., North & South Europe) who may have had prolonged cultural or historical exposure to these unhealthy behaviors. Study findings thus provide evidence for a cautious interpretation of results of immigrants' behavioral risk assessment that is based heavily on protective cultural strengths because this explanation may not be generalizable to all immigrants.

The differences in vulnerabilities observed in this study confirm immigrant heterogeneity, and an indication that the low odds among immigrants cannot be attributed to a single factor (i.e., protective cultural strength) but must consider other vulnerability dimensions such as immigrants' socioeconomic profiles or characteristics. According to Alba and Nee, 2003 as reported by Jackson et al.,¹³³ such characteristics as maternal educational attainment, conditions or process of migration, among other pre-migration factors, are important determinants of behavioral risk outcomes. Dominant findings in past studies have associated unfavorable

socioeconomic situations of immigrants, such as low education, with high risk substance use outcomes (i.e., smoking and alcohol use).⁷⁴ On the other hand, selective migration of economic immigrants, whose higher educational attainment may inform uptake of healthier choices against smoking, alcohol or substance use, may explain the low risk observed in this current study.¹³⁴

In the sensitivity analysis that included missing in the analysis, the direction of association remained unchanged for pregnancy alcohol, smoking, and substance use (i.e., lower odds like in the main results) but a change in magnitude was observed (Appendix X). For pregnancy smoking, because differences in the missing proportion by immigrant status did not statistically significantly differ (Appendix IV) and because odds were comparable (main result vs. unknown category), the direction of association may hold if missing were reassigned to either the yes or no categories. The direction of association may also hold for pregnancy alcohol and substance use, but comparisons between immigrants and non-immigrants may be biased given that standardized differences in missing proportions by immigrant status were statistically significant (Appendix IV). The potential impact of reassigning missing on the magnitude of association for pregnancy alcohol and substance use is also uncertain.

Late initiation of prenatal care

Past studies have demonstrated a higher odds of late initiation of prenatal care among immigrants compared to non-immigrants.¹³⁵⁻¹³⁸ Rather, this study found lower odds which may partly be due to selection bias and may mean that immigrants who participated in the screening may be more committed to prenatal care than those who did not. On the other hand, it may be that not including missing in the analysis for this outcome may have contributed to this low result. Again, it may also be possible that recent immigrants were underrepresented in the screening since a longer duration of residence was associated with lower odds of late initiation of prenatal care.

Perhaps access to universal health care and the opportunity to choose from several available care providers such as family physicians, obstetricians, and midwives is protective for late initiation of prenatal care among immigrants to Manitoba.

A sensitivity analysis to assess the potential impact of selection bias on the main findings confirmed selection bias. Among the screened, adjusted odds of inadequate prenatal care was higher among immigrants compared to non-immigrants. Immigrants compared to non-immigrants without screening had lower odds of inadequate prenatal care and accounted for 29% reduction in odds when the analysis included all maternities (Appendix IX). The lower odds among those without screening suggest that those without screening were also committed to prenatal care. A possible explanation for the immigrant disadvantage in the sensitivity analysis (i.e., the screened compared to the main results) may be that selection bias is not happening as much among immigrants as it was among non-immigrants since prevalence only changed substantially for non-immigrants but not for immigrants when analysis accounted for those without screening and who did not meet the age inclusion criteria (Appendix IX). The immigrant disadvantage may also reflect differences in variable measure for the two datasets compared (i.e., screening data vs. the Discharge Abstract Database and Medical Services data). The differences in variable measure and potential implications are explained as follows.

The BBF/FFS measures the first prenatal care sought after six to seven months of pregnancy. In contrast, the measure of inadequate prenatal care obtained from the Discharge Abstract Database and Medical Services data is a dichotomized category (yes, no) where a “yes” includes response categories of No-care and inadequate prenatal care in the first, second, and third trimesters. From the Discharge Abstract Database and Medical Service data, only inadequate prenatal care in the third trimester appears comparable to care sought after six to seven months of pregnancy from

the BFS/FFS. Hence, the sensitivity analysis results may reflect an overestimate in risk contributed by maternities to those women who received no care and care in their first and second trimesters.

Exploration of the potential impact of missing on observed results by including missing in the analysis revealed higher odds of late initiation of prenatal care among immigrants compared to non-immigrants in the unknown category compared to lower odds in the main result (Appendix X). This result only suggested that the odds of late initiation of prenatal care among immigrants in the main results may be underestimated. While the potential impact of missing on the magnitude of the association is uncertain, the direction of association may hold even if missing were reassigned either to the yes or no categories because differences in the missing proportions by immigrant status did not statistically significantly differ for late initiation of prenatal care (Appendix IV).

Recall bias that could be contributing to low prevalence of late initiation of prenatal care is a possibility that cannot be ruled out. Also, given that selection bias is not happening as much among immigrants, and having considered the impact of missing data on the direction of association and the potential impact that differences in variable measure can have on estimates, I will consider the direction of association of the main results from the screening data as robust.

5.2 Objective 2 — Differences according to immigrant characteristics

5.2.1 Main findings

This population-based study compared eight socio-behavioral perinatal health indicators among immigrants according to key immigrant characteristics, such as refugee status, secondary migration, birth region, and duration of residence. Psychosocial and behavioral perinatal health indicators varied by immigrant characteristics; refugee status was strongly associated with relationship distress, depression, and late initiation of prenatal care; recent immigration with social isolation and late initiation of prenatal care, and certain maternal birth regions with social isolation, relationship distress, depression, smoking, and/or alcohol use during pregnancy.

Study findings supported the hypothesis of differences in psychosocial and behavioral perinatal health risks among immigrant subgroups.

5.2.2 Interpretation (psychosocial perinatal health risk indicators)

Refugee immigrants had higher odds of relationship distress and depression than their non-refugee counterparts, consistent with past studies.^{16,18,32,139,140} Maternal birth regions were strongly associated with social isolation, relationship distress, and depression as recency of immigration was with social isolation. These findings are consistent with many literatures. Study findings related to each outcome are discussed as follows.

5.2.2.1 Social isolation

Consistent with past studies,^{31,144} immigrant childbearing women from all birth regions experienced higher odds of social isolation except those from North America & Oceania.¹⁴⁵

Culturally relevant support often enjoyed in home countries may be lost after migration-related

family separation¹²⁸ or not well-established in Western countries post-migration,¹²⁹ which could explain their higher odds. Being native English speakers may explain the lower odds among those from North America & Oceania and a possible explanation among secondary immigrants who had lower odds. The explanation for secondary immigrants may sound counterintuitive given that many secondary immigrants are also likely refugees. For clarity, secondary immigration is not exclusive to refugees. Secondary, particularly voluntary immigrants are a highly selected subgroup of immigrants characterized by higher educational credentials and global upward socioeconomic mobility, which are conducive to better health outcomes. These characteristics of secondary immigrants put them at an advantage in building and maintaining new social networks during their transit period,¹⁴⁶ and may explain their lower odds in this study. Another possibility that explains the lower odds among secondary immigrants may be that the refugee proportion of secondary immigrants captured in this study are those with low risk outcomes. However, the current study did not make the distinction between secondary refugee or secondary non-refugee immigrants during data analysis to substantiate these assumptions.

This study found that recent immigrants had nine times the odds of being socially isolated than long-term immigrants. The result is unsurprising given that time is needed to integrate into a new environment and rebuild social networks. Establishing multiple networks over time may improve access to appropriate information that promotes positive health behaviors or minimizes stressful situations¹⁴⁷ and possibly explains the drastic reduction that the study observed after five years of residence. Although an improvement in the risk overtime looks promising, the implications for newcomer immigrants are important, given that social isolation strongly predicts other morbidity risks, and its persistence can rapidly erode immigrants' initial health advantage.

A sensitivity analysis that explored the potential impact of missing exclusions on main results revealed a strong association and higher adjusted odds of social isolation among women from North America & Oceania compared to lower odds in the main result (Appendix XII). This result suggests that the risk for social isolation may be underestimated in the main results among this birth region compared to Western Europe. Given the dissimilar results, particularly with stronger association in the unknown category, and the difference in missing proportions which statistically significantly differ between North America & Oceania and Western Europe, bias in the direction and magnitude of association is expected. For comparisons between all other regions and Western Europe, the direction of the associations may hold if missing were reassigned to the yes or no categories because the odds were similar in the main results and in the unknown categories.

5.2.2.2 Relationship distress

This study found high odds of experiencing relationship distress among refugees and African immigrant women, consistent with a few qualitative studies.^{16,139,140} Although the findings reported in these studies were specific to immigrants from East Africa, this does not preclude the likelihood among women from West Africa based on this study's findings. Unlike economic immigrants, refugees' forced migration may exacerbate disagreements between couples in terms of perceptions and expectations regarding life post-migration. Their disadvantaged social status stemming from loss of identity from resettling in another country, unemployment, or low-profile jobs,^{148,149} may create financial hardship, triggering conflict where females depend more on their spouses financially. Interestingly, covariate adjustment revealed a strong association between low neighborhood income quintiles (Q1), receipt of employment and income assistance, and relationship distress (data not shown).

Possibly explaining the higher odds among Africans is gender role reversal. African men have reportedly shown low involvement and support towards home care or responsibilities.¹³⁹

Acculturation stress and gender role reversal^{15,140} can trigger conflict, where women's new financial power threatens their partner's authority¹⁵⁰ and women combine home care with work demands. The higher odds among those from Africa may also reflect awareness and greater understanding of the law and individual rights¹⁵⁰ to resist marital oppression, and recognize and report potential red flags for impending partner violence as they spend more time in Western countries.

The low prevalence among secondary immigrants is consistent with reported better health outcomes among secondary immigrants who voluntarily transitioned to Canada from an industrialized country compared to primary migrants from non-industrialized birth.²⁴ A plausible explanation is selective migration of couples pursuing upward global social mobility,²⁴ that may have gained more economic advantage,²⁶ reducing stressors accompanying their transit.¹²² Similarly, selective migration of couples in harmonious relationships may explain the lower odds among recent immigrants.

In the sensitivity analysis that examined the potential impact of missing exclusions on relationship distress, there was variability only according to birth regions. In the main results, only women from West Africa compared to Western Europe had higher unadjusted and adjusted odds of relationship distress. Whereas, in the sensitivity analysis, those from Southeast Asia and South & Rest of Asia compared to Western Europe also had higher unadjusted and adjusted odds of relationship distress in the unknown categories (Appendix XII). These results suggest that the risk for relationship distress may be underestimated among immigrant women from these two

birth regions. If missing values were reassigned to either the yes or no categories, the direction of the associations may hold for these birth regions, given the similarities in odds (main results vs. unknown categories). However, the magnitude of the association will be biased given that missing proportions among these birth regions statistically significantly differ except for West Africa which showed a strong association in the main result (Appendix VIII).

5.2.2.3 Partner violence

Among immigrants, missingness for partner violence was substantial and may have affected comparisons among immigrant subgroups (Appendix VIII & XII). Individuals experiencing partner violence are less likely to respond to screening questions on partner violence for fear of stigmatization or police involvement. Under-reporting of cases may be due to differences in the perception of violence. Some immigrant women may not consider some acts violent, may be reluctant to acknowledge or report violence, or encounter structural barriers to navigating help within a complex immigration system.¹³¹ In other instances, cultural or social pressures on women and financial dependency on spouses may cause them to tolerate abuse in silence.¹³² On the other hand, missing may also be related to specific instructions on the screening form for public health nurses conducting the screening that prevent them from asking questions related to partner violence when both partners are present.

Although there were no statistically significant associations for partner violence according to all immigrant characteristics examined, of significant interest was the high odds among women from Africa, particularly those from West Africa. This association was very strong but was no longer significant after adjustment, explained partially by control variables and partially by a relatively small subgroup size. This result was highlighted based on reported high rates and risk of physical abuse/partner violence among Africans.^{8,150} Normalization of violence may be due to

stigma or fear, particularly among women from regions where women have subordinate roles and are disempowered. ¹⁵¹

In the sensitivity analysis that examined the potential impact of missing exclusions on partner violence, differences were observed among secondary immigrants and across birth regions. Like in the main results, secondary compared to primary immigrants had lower adjusted odds of partner violence in the unknown category. Given that odds are comparable (main results vs. unknown), reassigning missing to either the yes or no categories may not change the direction of the association. However, there is a high likelihood that comparisons between secondary and primary immigrants will be biased in magnitude, given the statistically significant differences in the proportion of missing values according to secondary immigrant characteristics (Appendix VIII).

In the main results, the odds of partner violence were high only among Africans compared to Western Europe. In the sensitivity analysis, compared to Western Europe, statistically significant higher adjusted odds of partner violence were observed among women from all birth regions except East Africa in the unknown categories (Appendix XII), which suggests that the risk for partner violence may be underestimated among immigrant women from these birth regions.

Given the statistically significant differences in the proportion of missing values for all birth regions compared to Western Europe (Appendix VIII), the direction of associations for partner violence and the potential impact of missing on the magnitude of association, although uncertain, is expected to be biased.

5.2.2.4 Depression

Study findings align with other studies from the United States¹⁵² and Canada¹¹⁸ that found lower odds of depression among recent immigrants, consistent with the healthy immigrant hypothesis. Conversely, other studies have reported a high risk among recent migrants^{18,29} and risk regardless of time since migration.¹¹⁸ The higher odds of depression among refugees align with past findings.^{18,32} Unlike economic immigrants driven by upscale social mobility and selected for migration, refugees are displaced people who did not seek to migrate.⁷ Refugee women's experience of migration and resettlement, which is usually stress accompanied, may increase their vulnerability to mental health issues such as depression during pregnancy or around birth.¹³⁰ The result also agrees with the reportedly high risk among women from Europe and,¹⁵³ Latin America and the Caribbean.^{30,154} Social support is protective against depression,^{100,103} and we found that immigrant women were more socially isolated. Being socially isolated may underlie depression among these birth regions, particularly refugees, due to loss of homeplace practices related to childbirth and support post migration.¹⁵⁵

In the sensitivity analysis that examined the potential impact of missing exclusions on main results of depression, women from Southeast Asia, Eastern Europe, and East Africa had statistically significant lower adjusted odds in the unknown category than those from Western Europe. Regardless of the statistically significant findings in the unknown categories for these birth regions, the odds of depression are similar to the main results. Hence, one can assume that the direction of the association will hold if missing were reassigned to either the yes or no categories. Compared to the high odds in the main results, sensitivity analysis showed lower adjusted odds of depression in the unknown categories among those from North & South Europe, North America & Oceania, Latin America & the Caribbean (Appendix XII). While the potential impact of missing on the magnitude of associations for depression across all birth regions is

uncertain, the direction of association may hold for North & South Europe, North America & Oceania, Latin America & the Caribbean if missing were reassigned to either the yes or no categories because of the strong association observed in the main results for these birth regions. Bias in results is also unlikely given that standardized differences comparing missing proportions between each of these birth regions with Western Europe did not statistically significantly differ (Appendix VIII).

5.2.3 Interpretation (behavioral perinatal health indicators)

Refugee immigrants had higher odds of late initiation of prenatal care than non-refugees. Also, recency of migration was strongly associated with late initiation of prenatal care. The prevalence of alcohol, smoking, and substance use during pregnancy increased with increasing duration of residence. Secondary immigrants had lower odds of smoking compared with primary immigrants and smoking, and/or alcohol use during pregnancy varied according to maternal birth regions. These findings are consistent with many literatures. Study findings related to each outcome are discussed below.

5.2.3.1 Alcohol, Smoking & Substance use during pregnancy

Secondary immigrants had lower odds of smoking during pregnancy than primary immigrants. This finding echoes past studies^{24,87} that have reported low adverse birth outcomes among secondary immigrants, although these depend on whether the country of emigration to Canada was industrialized or not. Possibly explaining the lower odds in this study is the selective migration of economic immigrants with higher educational achievements that may inform

healthier behavioral choices. Another plausible explanation is perhaps the health system utilization advantage secondary immigrants likely gained during transit.²⁶

The study also observed a low prevalence of pregnancy alcohol, smoking, and substance use among immigrants, which increased with a longer duration of residence, consistent with a study in the United Kingdom that reported low smoking prevalence that increased for every five-year additional length of stay.¹¹¹ Protective cultural strengths have been referred to as the explanation for the low risk among recent immigrants, although usually short-lived. Upon arrival, immigrants are exposed to new health norms in the receiving country,¹⁰⁸ and as they acculture, they tend to adopt unhealthy behaviors.

Conversely, high-risk patterns for consuming alcohol were observed among East Europe, North America & Oceania, and Latin America & the Caribbean, in addition to smoking among North & South Europe, consistent with a Swedish population-based study that found high pregnancy smoking prevalence among immigrant women.¹⁵⁶ Longer historical exposure to cultural acceptance of smoking and alcohol and more gender equality may explain the high prevalence among immigrants from these Westernized regions compared to regions where women do not traditionally drink or smoke, as is the case for South & Rest of Asia and Africa.

In the sensitivity analysis that examined the potential impact of missing exclusions on the main result of perinatal behavioral health indicators, secondary compared to primary immigrants had statistically significant lower adjusted odds for pregnancy alcohol, smoking, and substance use in the unknown categories (Appendix XIII). Whereas, in the main results, only pregnancy smoking was lower. Regardless of the statistically significant associations in the sensitivity analysis, since the adjusted odds in the unknown categories for all three behavioral indicators are comparable to

the main results, one can assume that the direction of the associations may hold if missing were reassigned either to the yes or no categories. However, except for pregnancy smoking where the missing proportion did not statistically significantly differ between secondary and primary immigrants (Appendix VIII), associations comparing pregnancy alcohol, and substance use between the two groups may be biased. The potential impact that reassigning missing will have on the magnitude of association is uncertain.

Among birth regions, there were regional variations in the adjusted analysis for alcohol consumption during pregnancy. The odds for pregnancy alcohol use among women from Eastern Europe, Rest of Europe, North America & Oceania, Latin America & the Caribbean although higher in the unknown categories, were comparable to the main results (Appendix XIII). Given the similarities in odds, the direction of the associations may hold for pregnancy alcohol consumption among women from these birth regions if missing were reassigned to either the yes or no categories. However, results may be biased, given that the missing proportions statistically significantly differed between each of these birth regions and Western Europe (Appendix VIII). Furthermore, statistically significant higher adjusted odds in the unknown categories were observed among those from Southeast Asia, South & Rest of Asia, and Rest of Africa compared to lower odds in the main results. Although results suggest that risks may be underestimated among women from these birth regions, the direction of association may hold only for South & Rest of Asia given that the proportion of missing values did not statistically significantly differ between them and Western Europe (Appendix VIII). However, associations comparing pregnancy alcohol use between Southeast Asia, and Rest of Africa with Western Europe may be biased.

Sensitivity analysis also showed regional variation in adjusted odds for pregnancy smoking (Appendix XIII). Like in the main results, women from Rest of Africa had statistically significant lower adjusted odds for pregnancy smoking in the unknown category. Based on similarities in odds, the direction of association may hold if missing were reassigned to either the yes or no categories for this birth region. Results also showed that those from North America & Oceania had statistically significant lower adjusted odds of pregnancy smoking in the unknown category, which was high but not significant in the main result. Regardless of these differences, given that there were no statistically significant differences in the proportion of missing values between these birth regions and Western Europe, the direction of the associations may hold for pregnancy smoking if missing were reassigned.

By and large, the potential impact of reassigning missing on the magnitude of associations for alcohol use and smoking during pregnancy for these birth regions is uncertain.

5.2.3.2 Prenatal care

Higher odds of late initiation of prenatal care among refugees¹⁵⁷ and recent immigrants^{135,158} were observed, consistent with past studies. Plausible explanations for these findings may be less familiarity with the country's health care system and language barriers.¹⁵⁸ Narrative synthesis of immigrant women's experiences of maternity care in Canada has identified barriers in accessing and utilizing services. Significant barriers include lack of information, insufficient support to access services, and discordant expectations between the women and their service providers.¹³

In the sensitivity analysis that examined the potential impact of missing exclusions on the main results of late initiation of prenatal care, the adjusted odds in the missing category were lower but statistically significant only among women from Latin America & the Caribbean (Appendix

XIII). As in the main results, the outcome did not vary by birth region, likely due to the wide sample size margins (i.e., Western Europeans having the lowest prevalence of late initiation of prenatal care and missing proportions than other birth regions). On a general note, the potential impact of missing on the magnitude of associations is uncertain. However, the direction of associations may hold if missing were reassigned either to the yes or no categories for all birth regions except East Africa and Rest of Africa where differences in missing proportions statistically significantly differed between them and Western Europe (Appendix VIII). Hence associations comparing late initiation of prenatal care between these two regions and Western Europe may be biased.

5.3 Strengths and Limitations

A major strength of this study was a novel linkage of the BFS/FFS data with the immigration data. Another strength is the population-based nature of the study, including a large and ethnically diverse sample. However, the study had some limitations.

First, there is selection bias. Although the BFS/FFS is provincially funded and was conceived to be a universal program, not all women in province have access to it. Although public health nurses attempt to screen every woman in Manitoba, those living on-reserve (i.e., indigenous rural communities e.g., First Nations, Metis women) are not screened because they fall under the federal jurisdiction unless they are off-reserve at the birth or delivery of their child. Recall that about 1/5th (22%) were excluded from the study because they did not participate in screening, of which non-immigrants were over-represented in the lowest neighborhood income category and living in the rural area (Appendix II). These demographics provide strong evidence of selection bias, and a good rationale to hypothesize that indigenous (First Nations and Metis) non-

immigrant women living on-reserve may be over-represented among the unscreened non-immigrants. The inability to characterize the ethnic diversity of unscreened non-immigrant population presents another study limitation.

Selection bias may thus contribute to an underestimation of the protective effect estimates of comparing immigrants and compared to non-immigrants in this study. The sociodemographic characteristics and identity of the excluded non-immigrants have strong associations with increased perinatal health risks. Excluding these subsets could underestimate risks among non-immigrants and bias comparisons between immigrants and non-immigrants. Effects could be overestimated among immigrants, who may appear more likely to experience the outcome because non-immigrants who may be more at risk were underrepresented. Furthermore, excluding women without screening data (i.e., who gave birth to stillborn or children who died in the early neonatal period or had a live birth but did not participate in the screening) implies that findings may not be generalizable to these special cases. Study findings apply to permanent residents and cannot be generalized to temporary residents not covered by the provincial health insurance plan, such as asylum seekers. The measure of duration of residence may also underestimate exposure to the Canadian environment among those who became permanent residents long after being temporary residents.

Although selection bias is a possibility that could partly explain the small effect sizes observed for most indicator variables comparing immigrants to non-immigrants, ascertaining selection bias from the current data is difficult because the association between exposure and outcome is unknown in non-participants.¹¹⁷ Unfortunately, attempting to assess the impact of selection bias from other data sources was not feasible for most outcomes except for prenatal care.

Nevertheless, standardized differences in proportions between non-immigrants who had screening and those without screening greater than 10% (Appendix II) in neighborhood income quintile, area of residence, and age characteristics partly supported the selection bias hypothesis. This study acknowledges selection bias, and the impact may be greater for RQ1, given that non-immigrants without screening were more different than those who were screened. However, selection bias is less of an issue among immigrants for RQ2.

Second, another limitation that could explain the small effect sizes is the differential misclassification. Since the IRCC-PR database begins in 1985, a very small portion of immigrants who obtained permanent residence before 1985, when immigration was less common, may have been misclassified as non-immigrants.

Third, the BFS/FFS data had varying degrees of missing data in the dependent variables. There were no statistically significant differences in the proportion of missing values according to immigration status for depression, relationship distress, smoking during pregnancy, and late initiation of prenatal care. However, missing values for social isolation, partner violence, alcohol, and substance use may have affected comparisons between immigrants and non-immigrants, given that missingness was higher among non-immigrants than immigrants. On the other hand, social desirability may have underestimated the prevalence of some behavioral indicators such as alcohol and substance use during pregnancy. Similarly, individuals experiencing partner violence are less likely to respond to this question for various reasons, including fear of police involvement. Although some outcomes may be underreported, associations may only be biased if the underreporting is differential according to immigration status. Overall, the potential impact of missing on the magnitude of associations is uncertain, but the direction of the associations may hold for most of the outcomes.

Fourth, given that the public health nurses complete the BFS/FFS based on their assessment and the information provided by the mother, interviewer bias cannot be ruled out. Although some recall bias may occur, it is likely minimal because of the short time frame between the birth and the completion of the BFS/FFS.

Fifth, residual confounding due to unmeasured factors or non-detailed measurements, such as the number of cigarettes per day for smoking or frequency and amount of alcohol consumed, may have affected the associations and efficiency of adjustment. Likewise, the data did not distinguish specific forms of partner violence: physical (assault, battery), sexual, verbal abuse, psychological aggression, or control (financial, emotional, coercion).¹³²

Sixth, gender inclusiveness was a limitation of the screening data. The screening data has a binary categorization of individuals (sex at birth) that may not reflect their gender identity. Therefore, gender-diverse mothers are not represented or misrepresented in these data.

Last, associations by maternal birth region could not be measured for substance use due to very small sample sizes for certain birth regions.

5.4 Study implications

This study is not the first to use the BFS/FFS data for population health studies in Manitoba. The effectiveness of the Family First home visiting program has been described in population studies to improve child health outcomes, such as child development at school entry, completion of childhood immunizations for children in care, reduction of maltreatment risk, and hospitalization for maltreatment injury.¹⁵⁹⁻¹⁶¹ However, this study is the first to combine information from the Immigration, Refugees, Citizenship Canada (IRCC) Permanent Resident database with the

Family First screening to expand knowledge on immigrant childbearing women's perinatal health where multiple socio-behavioral perinatal health indicators and immigrant characteristics were correlated.

Study findings build upon the life course perspective, and results support knowledge that immigration is a social pathway that can lead to differential health exposures and health trajectories for immigrant women at certain critical periods. The current study also supports evidence that contextual factors other than individual determinants of health play an essential role in the overall health trajectory of women.

Findings from this study present important practice implications for health care providers.

Results support recommendations for a holistic approach to prenatal and postnatal care management for immigrant women. The approach must be well-grounded by service providers' knowledge and awareness of the heterogeneity of the immigrant population and immigrant subgroups at higher and lower risk for psychosocial and behavioral perinatal health outcomes that may be helpful in the continuum of care. For instance, a physician's knowledge of perinatal behavioral risks among certain birth regions may inform proactive interrogation and probes for other psychosocial risks during prenatal care visits, referrals to appropriate resources, and follow-up measures to improve pregnancy and postnatal maternal and child health outcomes.

Findings from the study raise critical thoughts related to the BFS/FFS as a surveillance tool to determine appropriate resources and services. Despite numerous settlements and other resources available within the province for immigrants' successful integration or rehabilitation, the high risk for social isolation among recent immigrants, multiple perinatal psychosocial risks among refugee immigrants, and other high-risk patterns in behavioral outcomes among particular birth

regions remain a concern. Perhaps these findings reflect immigrants' lack of awareness of these resources, expectation mismatch, or unmet needs across the range of currently available services. For instance, concerning unmet needs, an overview of the range of services across the province, specifically in women's health, revealed a high concentration of available resources in Winnipeg, an urban area, and only a few representations in Brandon and Thompson rural areas. One may argue that this distribution is expected, given that about 80% of immigrants settle in Winnipeg. However, the potential health outcome implication for the 20% residing in the rural areas missing from these opportunities is equally important because this could contribute to an overshoot in risks.

Although the study observed no differences in population characteristics of immigrants who participated in the screening compared to those who did not, it may be interesting to understand factors that underlie why some immigrants are not taking up BFS/FFS screening. The participation rate of immigrants in the BFS/FFS program, where participation to non-participation over the 16-year follow-up period was 2:1 (i.e., 16.4% versus 8.6%), may reflect a lack of awareness of resources or expectation mismatch.

A high potential for underreporting partner violence, alcohol, smoking, and substance use during pregnancy was not unexpected due to stigma and social desirability. Nevertheless, study findings trigger questions about missing values in outcomes related to screening non-response, although it is not clear if non-response was related to social desirability for these outcomes. Notably, the distribution of missing outcomes across measured covariates (Appendix V) may provide valuable information in framing relevant theoretical questions related to specific outcomes in future studies and inform screening design methods. Pertinent questions about cultural

competency among visiting public health nurses during data collection are future considerations that may help identify problems associated with non-participation or even missing data.

Identifying these problems can inform creative thinking on the best recruitment strategies to improve participation rates and data quality.

From a social justice standpoint, findings from this study call for further research into exploring and identifying unmet needs across current or existing support programs for immigrant childbearing women. Much attention should focus on the growing diversity of immigrants, particularly recent and refugee immigrants.

5.5 Knowledge translation

Part of the requirement for the use of data is to share research findings with ethics approver bodies and other data providers. As a first step, findings from this study will be shared with the MHSAL HIPC (now Provincial Health Research Privacy Committee), Immigration, Refugees, and Citizenship Canada (IRCC), the Department of Justice, and the Department of Families.

Knowledge sharing with broader research communities through scientific journals and conferences has been initiated. An abstract of this research has been accepted for presentation at an international conference. A manuscript has also been peer reviewed and accepted for publication in a journal. If possible, the MCHP media and communications unit will be explored as another avenue to reach the general audience. Valuable tools will include infographics to communicate research findings through social media handles. Other target audiences that may be considered are health clinics, community organizations and settlement camps for refugee immigrants to Manitoba. Information sharing is intended to increase the general public's

awareness of the social experiences of immigrant women and their multiple health exposure risks and bring to the spotlight subgroups at higher risk.

5.6 Future directions

The current study examined health disparities according to secondary immigrant status, which may overlap with refugee status. Both secondary (i.e., voluntary) and refugee immigrants share distinct characteristics and health outcome adversities.^{7,24,26} Future research should consider distinguishing between secondary refugee and secondary non-refugee immigrants to better understand psychosocial and behavioral perinatal risk patterns for these groups.

Because of the small subgroup sample sizes in this study, nationality differences among immigrant subgroups with high-risk patterns for multiple indicators could not be explored. It is possible that some degree of heterogeneity may exist among countries that are classified within the same birth region. Where possible, future research should consider country-level analysis of immigrant subgroups identified with high-risk psychosocial and/or behavioral perinatal health risk patterns.

The use of the BFS/FFS as a surveillance tool for the assessment of partner violence is problematic. On one hand, specific instructions on the screening form prevents public health nurses from asking screening question related to partner violence when both partners are present, and on the other hand is social desirability for reporting this outcome among participants.

Although the assumption is that the screening captured mild cases of partner violence, forms of violence experienced may differ among populations. There is some evidence that the most reported form of violence among immigrants is emotional abuse.⁹ A more practical approach to

data collection for this outcome is imperative. Furthermore, future explorative research would be informative to understand the typologies of perinatal partner violence among immigrant subgroups to inform health-specific interventions.

The findings from this study, although correlational, are descriptive, and the cross-sectional study design limits any causal inferences. While temporal or reverse causation does not appear as an issue between the perinatal health indicators examined and immigrant variables, which come first, there is evidence of bidirectional association between outcomes. For instance, social isolation increases the risk for morbidity and mortality outcomes, particularly depression, which could also precede social isolation.^{22,63} Relationship distress may also lie in the causal pathway for partner violence. Furthermore, covariate selection for this study was not data-driven but selected a priori and may have affected the models' predictive accuracy. Several other factors or covariates that were not explored in this study, and the complex relationship between outcomes should be explored in future causal studies.

5.7 Conclusion

Immigrant childbearing women had a higher prevalence of social isolation but a lower prevalence of other psychosocial and behavioral perinatal health indicators than non-immigrants. Among immigrants, there was heterogeneity according to refugee status, recency of immigration, secondary migration, and maternal birth region.

For RQ1 (comparisons between immigrants and non-immigrants), missingness in some dependent variables (social isolation, partner violence, alcohol, and substance use) may have biased comparisons between immigrants and non-immigrants, given that missingness was higher among non-immigrants than immigrants. Also, for RQ2 (comparisons restricted to immigrants

and according to immigrant characteristics), differential missing may have biased results. On the other hand, social desirability may have underestimated the prevalence of some behavioral indicators such as alcohol and substance use during pregnancy. Similarly, individuals experiencing partner violence are less likely to respond to screening questions on partner violence for various reasons, including fear of police involvement.

By and large, although missingness in some dependent variables may have affected comparisons, for the results of unknown categories that are comparable to the main results, the direction of the associations may hold only if missing proportions between comparison groups did not statistically significantly differ. Associations will be biased if missing proportions between comparison groups statistically significantly differ, except for outcomes with strong associations in the main results. The potential impact of reassigning missing on the magnitude of associations is uncertain for all outcomes.

In conclusion, the novel linkage of the BFS/FFS data with the immigration data advanced knowledge on immigrant perinatal health, where it contributed to a greater understanding of the complexity of socio-behavioral perinatal health risks of immigrant childbearing women. The study identified risk patterns for multiple psychosocial and behavioral perinatal health indicators and highlighted subgroups at higher and lower risk of potential adverse perinatal health outcomes.

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Appendix I: List of databases, variables, variable definition, values/codes, and measures

Database	Variable name	Variable description/definition	Values/corresponding codes	Scale/Measure
Baby First/Family First Screening	Depression	Depression including postpartum depression in mother	Yes/No/Missing	Categorical (Yes/No)
Hospital abstract and Physician claims			ICD-9-CM 311	
Baby First/Family First Screening	Anxiety	Anxiety disorder of mother	Yes/No/Missing	
Baby First/Family First Screening	Social isolation	Inadequate social support	Yes/No/Missing	
Baby First/Family First Screening	Relationship distress	Distress or conflict between parenting partners (e.g., separations, frequent arguments)	Yes/No/Missing	
Family First Screening; *	Partner violence	Current or history of violence between parenting partners; partner violence	Yes/No/Missing	
Prosecutions Information Systems Management (PRISM) Incidents & Disposition Data		Domestic violence	Yes/No/Missing	
Family First Screening	Alcohol use	Alcohol use by mother during pregnancy	Yes/No/Missing	
Hospital/ Discharge abstract & Medical Services / Physician Claims	Alcohol use	Alcohol use by mother during pregnancy	ICD-9-CM 291 Alcohol-induced mental disorders, ICD-9-CM: 303 Alcohol dependence syndromes, ICD-9-CM: 305.0 Alcohol abuse, ICD-9-CM: 760.71 Noxious influences	Categorical (Yes/No)

Database	Variable name	Variable description/definition	Values/corresponding codes	Scale/Measure
			affecting a fetus or newborn via placenta or breast milk-Alcohol, ICD-10-CA F10 Mental and behavioral disorders due to use of alcohol, ICD-10-CA P04.3 Fetus and newborn affected by maternal use of alcohol, ICD-10-CA Z72.1 Alcohol use, ICD-10-CA Q86.0 Fetal alcohol syndrome (dysmorphic),	
Family First ScreeningHospital/ Discharge abstract & Medical Services / Physician Claims	Smoking	Maternal smoking during pregnancy	Yes/No/Missing	
Hospital/ Discharge abstract & Medical Services / Physician Claims	Smoking	Maternal smoking during pregnancy	ICD-9-CM: 305.1 Tobacco use disorder, ICD-10-CA F17 Mental and behavioral disorders due to use of tobacco, ICD-10-CA P04.2 Fetus and newborn affected by maternal use of tobacco ICD-10-CA Z72.0 Tobacco use	Categorical (Yes/No)
Baby First Screening	Substance/illicit drug use	Alcohol or Substance use during pregnancy	Yes/No/Missing	
Family First Screening	„	Substance use during pregnancy	Yes/No/Missing	Categorical (Yes/No)
Hospital/ Discharge abstract & Medical	„	„	ICD-9-CM: 292 Drug-induced mental disorders,	

Database	Variable name	Variable description/definition	Values/corresponding codes	Scale/Measure
Services / Physician Claims			<p>ICD-9-CM: 304 Drug dependence,</p> <p>ICD-9-CM: 305 Nondependent abuse of drugs (exclude 305.0, 305.1 where possible),</p> <p>ICD-9-CM: 760.72 Noxious influences affecting a fetus or newborn via placenta or breast milk – Narcotics</p> <p>ICD-9-CM: 760.73 Noxious influences affecting a fetus or newborn via placenta or breast milk - Hallucinogenic agents</p> <p>ICD-9-CM: 760.75 Noxious influences affecting a fetus or newborn via placenta or breast milk – Cocaine</p> <p>ICD-9-CM: 779.5 Drug withdrawal syndrome in newborn</p> <p>ICD-10-CA F11-19 Mental and behavioral disorders due to use of (opioids, cannabinoids, sedatives or hypnotics, cocaine, and other stimulants, including caffeine, hallucinogens, volatile solvents</p>	
Baby First/Family First Screening	Late initiation of prenatal care	Late initiation of pregnancy care, Prenatal care after 13weeks	Yes/No/Missing	Categorical (Yes/No)
Baby First/Family First Screening	Low education	Women giving birth with less than a grade 12 education	Less than grade 12/Grade 12 and up /Missing	
Baby First/Family First Screening	Low education	Women giving birth with low education*	Yes/No/Missing*	
Baby First/Family First Screening	Lone parent	Family structure/Single parent mother identifies	Yes/No/Missing	

Database	Variable name	Variable description/definition	Values/corresponding codes	Scale/Measure
		herself as the sole primary caregiver for the child. Includes unmarried, separated, widowed, divorced, or a common-law relationship of less than one year.		Categorical (Yes/No)
Social Allowances Management Information Network database (SAMIN)	Receipt of Employment and Income Assistance (EIA)	Financial assistance for people who need help to meet basic personal and family need	Employed full-time, employed part-time, employed seasonal/casual, retired, self-employed, unemployed	
Hospital/ Discharge abstract and Medical Services / Physician Claims	Inadequate prenatal care	Revised-Graduated Prenatal care utilization Index (R-GINDEX)	Adequate 1 st trimester, intermediate 1 st trimester, intermediate 2 nd trimester, intensive 1 st trimester, intensive 2 nd trimester, intensive 3 rd trimester, inadequate 1 st , inadequate 2 nd , inadequate 3 rd trimester, no care, and missing	
Immigration, Refugees, Citizenship Canada Permanent Resident (IRCC-PR) Database	Immigrant	Immigrant	Yes/No	
Immigration, Refugees, Citizenship Canada Permanent Resident (IRCC-PR) Database	Refugee	Include values for Syrian refugees and all other refugee variables (i.e., Government-Assisted Refugees- GARs, Privately Sponsored Refugees, and Blended Visa Office-Referred -BVOR	Yes/No	

Database	Variable name	Variable description/definition	Values/corresponding codes	Scale/Measure
		refugees) Extra note: For Landing datasets, corresponding values in legacy landing datasets were extracted for the above-listed refugee variables.		
Immigration, Refugees, Citizenship Canada Permanent Resident (IRCC-PR) Database	Knowledge of official Canadian languages	Knowledge of official Canadian languages (English/French)	Yes/No/Missing	
Immigration, Refugees, Citizenship Canada Permanent Resident (IRCC-PR) Database	Birth region	Maternal country of birth/regions/sub-regions/macro regions	IRCC_COUNTRY_OF_BIRTH_CD	Categorical (Southeast Asia, South & Rest of Asia, Western Europe, Eastern Europe, Rest of Europe, West Africa, East Africa, Rest of Africa, North America & Oceania, Latin America & Caribbean)
Immigration, Refugees, Citizenship Canada Permanent Resident (IRCC-PR) Database	Primary immigrant	Primary/Secondary immigrant	P/S/Missing	Categorical (P/S)
Immigration, Refugees, Citizenship Canada	Duration of residence	Years from first coverage or landing date to the child's birthdate		

Database	Variable name	Variable description/definition	Values/corresponding codes	Scale/Measure
Permanent Resident (IRCC-PR) Database & Manitoba Health Insurance Registry				Numeric/integer value (years)
Hospital/ Discharge abstract & Manitoba Health Insurance Registry	Mothers age	Mother's age at birth of index child		
Manitoba Health Insurance Registry	Family size	Number of dependents <18years in the same family registry as child	0-19	
Census Data	Urban	Individuals living in Winnipeg or Brandon have an urban residence. Individuals living elsewhere in Manitoba have a rural residence	Urban/Rural	Categorical (Rural/Urban)
Census Data	Income	Neighborhood Household Income Quintile: A measure of neighborhood socioeconomic status that divides urban (Winnipeg and Brandon) and rural (other Manitoba areas) populations into five income groups (from lowest income to highest income)	U1-U5, R1-R5	Categorical (Q1, Q2, Q3, Q4, Q5)

ICD-9-CM= International Classification of Diseases, Ninth Revision, Clinical Modification

ICD-10-CA= International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Canada

Appendix II: Characteristics of maternities in Manitoba, Canada with BFS/FFS records (n=206,096) compared to maternities without BFS/FFS records (n=59,010)¶ 2000-2017

	Immigrant Women			Non-immigrant Women		
	Screened 33,754 (16.38)	Unscreened 5,005 (8.43)	Screened vs. Unscreened	Screened 172,342 (83.62)	Unscreened 54,005 (91.57)	Screened vs. Unscreened
	n (%)	n (%)	Std Diff†	n (%)	n (%)	Std Diff†
Sociodemographic characteristics						
Mothers' age at birth of index child – mean (SD)*	30.48 ± (5.33)	30.64 ± (5.30)		28.20± (5.61)	26.19 ± (6.16)	
Mothers' age at birth of index child – Category						
Below 20 years	537 (1.59)	115 (2.30)	0.0512	11,437 (6.64)	8525 (15.79)	0.2931
20-24 years	4145 (12.28)	537 (10.73)	0.0486	34,745 (20.16)	14651 (27.13)	0.1646
25-29 years	9786 (28.99)	1343 (26.83)	0.0481	53,935 (31.30)	14250 (26.39)	0.1085
30-34 years	11489 (34.04)	1840 (36.76)	0.0570	48852 (28.35)	11000 (20.37)	0.1867
35-39 years	6243 (18.50)	961 (19.20)	0.0180	19958 (11.58)	4689 (8.68)	0.0962
40-55 years	1554 (4.60)	209 (4.18)	0.0209	3415 (1.98)	890 (1.65)	0.0250
Lone mother						
Yes	1280 (3.79)	2 (0.04)		20116 (11.67)	121 (0.22)	
No	31854 (94.37)	1 (0.02)		145045 (84.16)	27 (0.05)	
Unknown	620 (1.84)	5002 (99.94)		7181 (4.17)	53857 (99.73)	
Low education†						
Yes	3362 (9.96)	*		31974 (18.55)	151 (0.28)	
No	26766 (79.30)	0		118781 (68.92)	*	
Unknown	3626 (10.74)	5002 (99.94)		21587 (12.53)	53850 (99.71)	
Neighborhood Income Quintile						
Q1 (lowest)	10089 (29.89)	1497 (29.91)	0.0004	35783 (20.76)	24172 (44.76)	0.5288
Q2	6887 (20.40)	1047 (20.92)	0.0127	35820 (20.78)	11961 (22.15)	0.0332
Q3	6453 (19.11)	955 (19.08)	0.0009	34772 (20.18)	6749 (12.50)	0.2088
Q4	5822 (17.25)	847 (16.92)	0.0086	3 598 (20.08)	6845 (12.67)	0.2010
Q5 (Highest)	4503 (13.34)	659 (13.17)	0.0051	31369 (18.20)	4278 (7.92)	0.3087
Urban/ Rural residence						
Rural	7224 (21.40)	869 (17.36)	0.1023	72881 (42.29)	35257 (65.28)	0.4740
Urban	26530 (78.60)	4136 (82.64)	0.1023	99461 (57.71)	18748 (34.72)	0.4740

	Immigrant Women			Non-immigrant Women		
	Screened 33,754 (16.38)	Unscreened 5,005 (8.43)	Screened vs. Unscreened	Screened 172,342 (83.62)	Unscreened 54,005 (91.57)	Screened vs. Unscreened
	n (%)	n (%)	Std Diff†	n (%)	n (%)	Std Diff†
Received Employment & Income Assistance one year before birth to 2 weeks after						
Yes	1402 (4.15)	254 (5.07)	0.0439	27104 (15.73)	8029 (14.87)	0.0239
No	32352 (95.85)	4751 (94.93)	0.0439	145238 (84.27)	45976 (85.13)	0.0239
Pregnancy & family-related characteristics						
Family size (Number of dependents <18 years in the same family as index child)						
None	13080 (38.75)	2089 (41.74)	0.0609	73876 (42.87)	21237 (39.32)	0.0720
At least one	20674 (61.25)	2916 (58.26)	0.0609	98466(57.13)	32768 (60.68)	0.0720
Immigrant characteristics						
International Immigrant						
Primary	27362 (81.11)	3955 (79.02)	0.0522	--	--	
Secondary	6374 (18.89)	1050 (20.98)	0.0522	--	--	
Refugee						
Yes	4123 (12.22)	648 (12.95)	0.0522	--	--	
No	29613 (87.78)	4357 (87.05)	0.0522	--	--	
Knowledge of official Canadian languages (English or French)						
Yes	22074 (65.43)	3351 (66.95)	0.0325	--	--	
No	11662 (34.57)	1654 (33.05)	0.0325	--	--	
Duration of residence						
Before Permanent Residence	--	--		--	--	
<5years	18497 (54.83)	2677 (53.49)	0.0225	--	--	
5-9years	8782 (26.03)	1343 (26.83)	0.0204	--	--	
10 above years	6457 (19.14)	985 (19.68)	0.0078	--	--	
Maternal Birth Region						
Southeast Asia	9622 (28.51)	1383 (27.63)	0.0194	--	--	
South Asia & Rest of Asia	10303 (30.52)	1569 (31.35)	0.0178	--	--	
Eastern Europe	2907 (8.61)	382 (7.63)	0.0359			
Western Europe	1356 (4.02)	209 (4.18)	0.0080	--		
Rest of Europe	1293 (3.83)	162 (3.24)	0.0322	--	--	

	Immigrant Women			Non-immigrant Women		
	Screened 33,754 (16.38)	Unscreened 5,005 (8.43)	Screened vs. Unscreened	Screened 172,342 (83.62)	Unscreened 54,005 (91.57)	Screened vs. Unscreened
	n (%)	n (%)	Std Diff [†]	n (%)	n (%)	Std Diff [†]
East Africa	1958 (5.80)	307 (6.13)	0.0141	--	--	
West Africa	1097 (3.25)	196 (3.92)	0.0358	--	--	
Rest of Africa	1422 (4.21)	230 (4.60)	0.0186	--	--	
North America & Oceania	1207 (3.58)	198 (3.96)	0.0200	--	--	
Latin America & Caribbean	2589 (7.67)	369 (7.37)	0.0113	--	--	

Frequencies expressed as n (%) unless otherwise specified

* = Suppressed for cell frequencies <6

**SD = Standard Deviation

[†]Std Diff= Standardized difference; **Bold values = Significant difference (value >0.1 or 10%)**

^{††}Low education = reported mothers' low education or completed <12th grade

[‡]Excluded cohort (n= 59,010) ≠ Total excluded (n=59,219) because observations with unknown neighborhood income quintile and area of residence are not included

Appendix III: Prevalence of perinatal health indicators by immigrant status (BFS/FFS data compared to other data sources)
n=206,096**

	Baby First/Family First Screening (BFS/FFS)		Other data sources		Overlap in prevalence (BFS/FFS & other data sources combined)	
	Manitoban (Non-immigrant) 172,342 (83.62)	International Immigrant 33,754 (16.38)	Manitoban (Non-immigrant) 172,342 (83.62)	International Immigrant 33,754 (16.38)	Manitoban (Non-immigrant) 172,342 (83.62)	International Immigrant 33,754 (16.38)
Psychosocial indicators			Discharge Abstract Database (DAD) & Medical Services (MS)		(BFS/FFS) & DAD/MS	
Depression, mood & anxiety disorder						
Yes	28,022 (16.26)	1522 (4.51)	29,899 (17.35)	4897 (14.51)	46,816 (27.16)	5,929 (17.57)
No	123,911 (71.90)	27,734(82.17)	142,443 (82.65)	28,857 (85.49)	125,526 (72.84)	27,825 (82.43)
Missing	20,409 (11.84)	4,498 (13.33)	--	--	--	--
Social isolation						
Yes	4,013 (2.33)	3603 (10.68)	NA	NA	NA	NA
No	128,225 (74.40)	25,823 (76.50)	NA	NA	NA	NA
Missing	40,104 (23.27)	4326 (12.82)	NA	NA	NA	NA
Relationship distress						
Yes	9,155 (5.31)	642 (1.90)	NA	NA	NA	NA
No	143,312 (83.16)	29,329 (86.89)	NA	NA	NA	NA
Missing	19,875 (11.53)	3783 (11.21)	NA	NA	NA	NA
Partner violence			Justice data (PRISM)		(BFS/FFS) & Justice data (PRISM)	
Yes	2,716 (1.58)	126 (0.37)	120 (0.07)	34 (0.10)	2,810 (1.63)	153 (0.45)
No	111,832 (64.89)	24,560 (72.76)	172,222 (99.93)	33,720 (99.90)	169,532 (98.37)	33,601 (99.55)
Missing	57,794 (33.53)	9068 (26.86)	--	--	--	--
Behavioral indicators			Discharge Abstract Database (DAD) & Medical Services (MS)		(BFS/FFS) & DAD/MS	
Alcohol use during pregnancy						
Yes	19,069 (11.06)	868 (2.57)	450 (0.26)	*	19,333 (11.22)	869 (2.57)
No	115,671 (67.12)	29,115 (86.26)	171,892 (99.74)	33,753 (100.00)	153,009 (88.75)	32,885 (97.43)
Missing	37,602 (21.82)	3771 (11.17)	--	--	--	--
Smoking during pregnancy						
Yes	32,123 (18.64)	584 (1.73)	239 (0.14)	*	32,184 (18.67)	585 (1.73)
No	131,953 (76.56)	31,963 (94.69)	172,103 (99.86)	33,752 (99.99)	140,158 (81.33)	33,169 (98.27)
Missing	8,266 (4.80)	1207 (3.58)	--	--	--	--
Substance use during pregnancy						
Yes	6,377 (3.70)	66 (0.20)	1866 (1.08)	18 (0.05)	7,485 (4.34)	83 (0.25)
No	127,654 (74.07)	29,801 (88.29)	170,476 (98.92)	33,736 (99.95)	164,857 (95.66)	33,671 (99.75)
Missing	38,311 (22.23)	3887 (11.52)	--	--	--	--

	Baby First/Family First Screening (BFS/FFS)		Other data sources		Overlap in prevalence (BFS/FFS & other data sources combined)	
	Manitoban (Non-immigrant) 172,342 (83.62)	International Immigrant 33,754 (16.38)	Manitoban (Non-immigrant) 172,342 (83.62)	International Immigrant 33,754 (16.38)	Manitoban (Non-immigrant) 172,342 (83.62)	International Immigrant 33,754 (16.38)
Late initiation of prenatal care >13 weeks						
Yes	3,544 (2.06)	301 (0.89)	NA	NA	NA	NA
No	158,397 (91.91)	31,960 (94.69)	NA	NA	NA	NA
Missing	10,401 (6.04)	1493 (4.42)	NA	NA	NA	NA
			Discharge Abstract Database (DAD) & Medical Services (MS)			
Inadequate prenatal care (R-GINDEX)						
Yes			13,652 (7.92)	2,416 (7.16)	NA	NA
No			157,089 (91.15)	31,189 (92.40)	NA	NA
Missing			1601 (0.93)	149 (0.44)	NA	NA

Frequencies expressed as n (%)

** = Suppressed for cell frequencies <6*

*** Total include missing values for outcomes*

NA= Not applicable (variable not available in other datasets or for computing overlap in prevalence)

Appendix IV: Comparing missing proportions between immigrants and non-immigrants

Perinatal health risk indicators	Missing	Non-immigrants	Immigrants	Std diff*
Psychosocial indicators				
Depression, mood & anxiety	24,907 (12.09)	20,409 (11.84)	4,498 (13.33)	0.04
Social isolation	44,430 (21.56)	40,104 (23.27)	4,326 (12.82)	0.27
Relationship distress	23,658 (11.48)	19,875 (11.53)	3,783 (11.21)	0.01
Partner violence	66,862 (32.44)	57,794 (33.53)	9,068 (26.86)	0.15
Behavioral indicators				
Alcohol use during pregnancy	41,373 (20.07)	37,602 (21.82)	3,771 (11.17)	0.29
Smoking during pregnancy	9473 (4.60)	8,266 (4.80)	1,207 (3.58)	0.06
Substance use during pregnancy	42,198 (20.47)	38,311 (22.23)	3,887 (11.52)	0.29
Late initiation of prenatal care	11,894 (5.77)	10,401 (6.04)	1,493 (4.42)	0.07

Frequencies expressed as n (%)

**Std diff= standardized difference of missing proportion*

Bold values= Significant difference (value >0.1 or 10%)

Appendix V: Missing outcome rates across predictor variables by immigrant status

	Social isolation		Partner violence		Alcohol use in pregnancy		Substance use in pregnancy	
	Non-immigrant	Immigrant	Non-immigrant	Immigrant	Non-immigrant	Immigrant	Non-immigrant	Immigrant
Mother's age at birth of index child								
below 20years	3522 (8.78)	80 (1.85)	4756 (8.23)	143 (1.58)	3227 (8.58)	72 (1.91)	3314 (8.65)	75 (1.93)
20-24 years	8982 (22.40)	615 (14.22)	12150 (21.02)	1085 (11.97)	8303 (22.08)	566 (15.01)	8508 (22.21)	598 (15.38)
25-29 years	12111 (30.20)	1302 (30.10)	17276 (29.89)	2676 (29.51)	11422 (30.38)	1158 (30.71)	11663 (30.44)	1182 (30.41)
30-34 years	10383 (25.89)	1356 (31.35)	15708 (27.18)	3046 (33.59)	9804 (26.07)	1150 (30.50)	9944 (25.96)	1192 (30.67)
35-39 years	4330 (10.80)	785 (18.15)	6690 (11.58)	1716 (18.92)	4120 (10.96)	671 (17.79)	4152 (10.84)	681 (17.52)
40-55 years	776 (1.93)	188 (4.35)	1214 (2.10)	402 (4.43)	726 (1.93)	154 (4.08)	730 (1.91)	159 (4.09)
Lone mother								
Yes	5073 (12.65)	182 (4.21)	7848 (13.58)	419 (4.62)	4530 (12.05)	149 (3.95)	4666 (12.18)	162 (4.17)
No	28906 (72.08)	3632 (83.96)	43379 (75.06)	8094 (89.26)	28064 (74.63)	3178 (84.27)	28553 (74.53)	3267 (84.05)
Unknown	6125 (15.27)	512 (11.84)	6567 (11.36)	555 (6.12)	5008 (13.32)	444 (11.77)	5092 (13.29)	458 (11.78)
Rural/Urban residence								
Rural	14972 (37.33)	550 (12.71)	17994 (31.13)	706 (7.79)	14314 (38.07)	538 (14.27)	14648 (38.23)	554 (14.25)
Urban	25132 (62.67)	3776 (87.29)	39800 (68.87)	8362 (92.21)	23288 (61.93)	3233 (85.73)	23663 (61.77)	3333 (85.75)
Neighborhood Income Quintile								
Q1 -Lowest	10712 (26.71)	1403 (32.43)	14599 (25.26)	2752 (30.35)	9530 (25.34)	1220 (32.35)	9751 (25.45)	1265 (32.54)
Q2	8397 (20.94)	994 (22.98)	11980 (20.73)	1874 (20.67)	7851 (20.88)	859 (22.78)	8046 (21.00)	876 (22.54)
Q3	7359 (18.35)	748 (17.29)	10698 (18.51)	1670 (18.42)	7093 (18.86)	655 (17.37)	7222 (18.85)	691 (17.78)
Q4	7314 (18.24)	706 (16.32)	10893 (18.85)	1559 (17.19)	7043 (18.73)	630 (16.71)	7129 (18.61)	637 (16.39)
Q5-Highest	6322 (15.76)	475 (10.98)	9624 (16.65)	1213 (13.38)	6085 (16.18)	407 (10.79)	6163 (16.09)	418 (10.75)
Low education								
Yes	7314 (18.24)	395 (9.13)	10059 (17.40)	707 (7.80)	6767 (18.00)	365 (9.68)	6961 (18.17)	386 (9.93)
No	16642 (41.50)	1965 (45.42)	28856 (49.93)	5572 (61.45)	16260 (43.24)	1657 (43.94)	16600 (43.33)	1717 (44.17)
Unknown	16148 (40.27)	1966 (45.45)	18879 (32.67)	2789 (30.76)	14575 (38.76)	1749 (46.38)	14750 (38.50)	1784 (45.90)
Received EIA								
Yes	8315 (20.73)	270 (6.24)	11439 (19.79)	511 (5.64)	7436 (19.78)	231 (6.13)	7587 (19.80)	241 (6.20)
No	31789 (79.27)	4056 (93.76)	46355 (80.21)	8557 (94.36)	30166 (80.22)	3540 (93.87)	30724 (80.20)	3646 (93.80)
Family size (1 or more vs. none)								
None	16909 (42.16)	1673 (38.67)	24697 (42.73)	3554 (39.19)	15995 (42.54)	1495 (39.64)	16350 (42.68)	1570 (40.39)
At least one	23195 (57.84)	2653 (61.33)	33097 (57.27)	5514 (60.81)	21607 (57.46)	2276 (60.36)	21961 (57.32)	2317 (59.61)

Frequencies expressed as n (%)

Bold values = covariate predictors of higher missing rates

Appendix VI: Prevalence of outcomes and missing proportions among immigrant childbearing women in Manitoba, Canada, by duration of residence, secondary vs. primary immigrants, and refugee vs. non-refugees

	Immigrants		Refugees		Duration of residence		
	Secondary	Primary	Refugee	Non-refugee	<5years	5-9years	10 years+
Psychosocial indicators							
Social isolation							
Yes	832 (13.04)	2773 (10.13)	565 (13.68)	3040 (10.26)	2964 (16.02)	488 (5.55)	153 (2.37)
No	5013 (78.60)	20810 (76.02)	2912 (70.53)	22911 (77.34)	13272 (71.72)	7136 (81.23)	5415 (83.78)
Missing	533 (8.36)	3793 (13.86)	652 (15.79)	3674 (12.40)	2270 (12.27)	1161 (13.22)	895 (13.85)
Relationship distress							
Yes	92 (1.44)	550 (2.01)	206 (4.99)	436 (1.47)	280 (1.51)	183 (2.08)	179 (2.77)
No	5802 (90.97)	23527 (85.94)	3322 (80.46)	26007 (87.79)	16186 (87.46)	7644 (87.01)	5499 (85.08)
Missing	484 (7.59)	3299 (12.05)	601 (14.56)	3182 (10.74)	2040 (11.02)	958 (10.90)	785 (12.15)
Partner violence							
Yes	24 (0.38)	102 (0.37)	39 (0.94)	87 (0.29)	62 (0.34)	39 (0.44)	25 (0.39)
No	5243 (82.20)	19317 (70.56)	2763 (66.92)	21797 (73.58)	13541 (73.17)	6420 (73.08)	4599 (71.16)
Missing	1111 (17.42)	7957 (29.07)	1327 (32.14)	7741 (26.13)	4903 (26.49)	2326 (26.48)	1839 (28.45)
Depression, mood & anxiety disorder							
Yes	259 (4.06)	1263 (4.61)	281 (6.81)	1241 (4.19)	597 (3.23)	414 (4.71)	511 (7.91)
No	5372 (84.23)	22362 (81.68)	3255 (78.83)	24479 (82.63)	15374 (83.08)	7213 (82.11)	5147 (79.64)
Missing	747 (11.71)	3751 (13.70)	593 (14.36)	3905 (13.18)	2535 (13.70)	1158 (13.18)	805 (12.46)
Behavioral indicators							
Alcohol use during pregnancy							
Yes	140 (2.20)	728 (2.66)	118 (2.86)	750 (2.53)	349 (1.89)	193 (2.20)	326 (5.04)
No	5791 (90.80)	23324 (85.20)	3425 (82.95)	25690 (86.72)	16212 (87.60)	7554 (85.99)	5349 (82.76)
Missing	447 (7.01)	3324 (12.14)	586 (14.19)	3185 (10.75)	1945 (10.51)	1038 (11.82)	788 (12.19)
Smoking during pregnancy							
Yes	83 (1.30)	501 (1.83)	123 (2.98)	461 (1.56)	220 (1.19)	136 (1.55)	228 (3.53)
No	6109 (95.78)	25854 (94.44)	3802 (92.08)	28161 (95.06)	17637 (95.30)	8320 (94.71)	6006 (92.93)
Missing	186 (2.92)	1021 (3.73)	204 (4.94)	1003 (3.39)	649 (3.51)	329 (3.75)	229 (3.54)
Substance use during pregnancy							
Yes	9 (0.14)	57 (0.21)	17 (0.41)	49 (0.17)	9 (0.05)	20 (0.23)	37 (0.57)
No	5905 (92.58)	23896 (87.29)	3504 (84.86)	26297 (88.77)	16488 (89.10)	7714 (87.81)	5599 (86.63)
Missing	464 (7.28)	3423 (12.50)	608 (14.73)	3279 (11.07)	2009 (10.86)	1051 (11.96)	827 (12.80)

	Immigrants		Refugees		Duration of residence		
	Secondary	Primary	Refugee	Non-refugee	<5years	5-9years	10 years+
Late initiation of prenatal care >13 weeks							
Yes	83 (1.30)	218 (0.80)	74 (1.79)	227 (0.77)	188 (1.02)	61 (0.69)	52 (0.80)
No	6050 (94.86)	25910 (94.64)	3782 (91.60)	28178 (95.12)	17488 (94.50)	8365 (95.22)	6107 (94.49)
Missing	245 (3.84)	1248 (4.56)	273 (6.61)	1220 (4.12)	830 (4.49)	359 (4.09)	304 (4.70)

Frequencies expressed as n (%)

Appendix VII: Prevalence of outcomes and missing proportions by birth region among immigrant childbearing women in Manitoba, Canada

	Maternal birth region									
	SEA**	S & RA**	EE**	WE**	RE**	EA**	WA**	RA**	NA&O**	LA&C**
Psychosocial indicators										
Social isolation										
Yes	700 (7.27)	1389 (13.48)	335 (11.52)	54 (3.98)	70 (5.41)	282 (14.40)	141 (12.85)	262 (18.42)	35 (2.90)	337 (13.02)
No	7489 (77.83)	7772 (75.43)	2219 (76.33)	1214 (89.53)	982 (75.95)	1451 (74.11)	874 (79.67)	977 (68.71)	967 (80.12)	1878 (72.54)
Missing	1433 (14.89)	1142 (11.08)	353 (12.14)	88 (6.49)	241 (18.64)	225 (11.49)	82 (7.47)	183 (12.87)	205 (16.98)	374 (14.45)
Relationship distress										
Yes	169 (1.76)	116 (1.13)	28 (0.96)	20 (1.47)	20 (1.55)	69 (3.52)	49 (4.47)	66 (4.64)	13 (1.08)	92 (3.55)
No	8214 (85.37)	8927 (86.64)	2639 (90.78)	1278 (94.25)	1155 (89.33)	1653 (84.42)	913 (83.23)	1172 (82.42)	1090 (90.31)	2288 (88.37)
Missing	1239 (12.88)	1260 (12.23)	240 (8.26)	58 (4.28)	118 (9.13)	236 (12.05)	135 (12.31)	184 (12.94)	104 (8.62)	209 (8.07)
Partner violence										
Yes	32 (0.33)	26 (0.25)	10 (0.34)	6 (0.44)	6 (0.46)	15 (0.77)	12 (1.09)	11 (0.77)	6 (0.50)	9 (0.35)
No	6658 (69.20)	7477 (72.57)	2258 (77.67)	1228 (90.56)	900 (69.61)	1452 (74.16)	773 (70.46)	1000 (70.32)	891 (73.82)	1916 (74.01)
Missing	2932 (30.47)	2800 (27.18)	639 (21.98)	122 (9.00)	387 (29.93)	491 (25.08)	312 (28.44)	411 (28.90)	310 (25.68)	664 (25.65)
Depression, mood & anxiety disorder										
Yes	290 (3.01)	332 (3.22)	125 (4.30)	58 (4.28)	126 (9.74)	64 (3.27)	36 (3.28)	78 (5.49)	157 (13.01)	256 (9.89)
No	8005 (83.19)	8496 (82.46)	2444 (84.07)	1132 (83.48)	1031 (79.74)	1613 (82.38)	897 (81.77)	1147 (80.66)	916 (75.89)	2053 (79.30)
Missing	1327 (13.79)	1475 (14.32)	338 (11.63)	166 (12.24)	136 (10.52)	281 (14.35)	164 (14.95)	197 (13.85)	134 (11.10)	280 (10.81)
Behavioral indicators										
Alcohol use during pregnancy										
Yes	246 (2.56)	100 (0.97)	123 (4.23)	43 (3.17)	82 (6.34)	37 (1.89)	19 (1.73)	29 (2.04)	66 (5.47)	123 (4.75)
No	8169 (84.90)	9246 (89.74)	2465 (84.80)	1232 (90.86)	985 (76.18)	1740 (88.87)	1013 (92.34)	1230 (86.50)	944 (78.21)	2091 (80.76)
Missing	1207 (12.54)	957 (9.29)	319 (10.97)	81 (5.97)	226 (17.48)	181 (9.24)	65 (5.93)	163 (11.46)	197 (16.32)	375 (14.48)
Smoking during pregnancy										
Yes	122 (1.27)	69 (0.67)	70 (2.41)	32 (2.36)	104 (8.04)	28 (1.43)	7 (0.64)	18 (1.27)	42 (3.48)	92 (3.55)
No	9146 (95.05)	9866 (95.76)	2736 (94.12)	1275 (94.03)	1145 (88.55)	1833 (93.62)	1059 (96.54)	1355 (95.29)	1128 (93.45)	2420 (93.47)
Missing	354 (3.68)	368 (3.57)	101 (3.47)	49 (3.61)	44 (3.40)	97 (4.95)	31 (2.83)	49 (3.45)	37 (3.07)	77 (2.97)
Substance use during pregnancy										
Yes	13 (0.14)	8 (0.08)	10 (0.34)	*	8 (0.62)	*	*	*	*	11 (0.42)
No	8363 (86.92)	9314 (90.40)	2570 (88.41)	1273 (93.88)	1052 (81.36)	1762 (89.99)	1023 (93.25)	1251 (87.97)	1002 (83.02)	2191 (84.63)

	Maternal birth region									
	SEA**	S & RA**	EE**	WE**	RE**	EA**	WA**	RA**	NA&O**	LA&C**
Missing	1246 (12.95)	981 (9.52)	327 (11.25)	82 (6.05)	233 (18.02)	192 (9.81)	70 (6.38)	167 (11.74)	202 (16.74)	387 (14.95)
Late initiation of prenatal care >13 weeks										
Yes	86 (0.89)	65 (0.63)	34 (1.17)	9 (0.66)	11 (0.85)	23 (1.17)	12 (1.09)	23 (1.62)	8 (0.66)	30 (1.16)
No	9088 (94.45)	9785 (94.97)	2770 (95.29)	1307 (96.39)	1231 (95.20)	1798 (91.83)	1035 (94.35)	1318 (92.69)	1151 (95.36)	2477 (95.67)
Missing	448 (4.66)	453 (4.40)	103 (3.54)	40 (2.95)	51 (3.94)	137 (7.00)	50 (4.56)	81 (5.70)	48 (3.98)	82 (3.17)

Frequencies expressed as n (%)

** = Suppressed for cell frequencies <6*

*** = (SEA= Southeast Asia; S & RA= South & Rest of Asia; EE= Eastern Europe; WE= Western Europe; RE= Rest of Europe; EA= East Africa; WA= West Africa; RA= Rest of Africa; NA&O= North America & Oceania; LA&C= Latin America & Caribbean)*

Appendix VIII: Standardized difference comparing missing proportions among immigrant subgroups

	International Immigrant	Refugee status	Maternal birth region								
			SEA vs. WE**	S &RA vs. WE**	EE vs. WE**	RE vs. WE**	EA vs. WE**	WA vs. WE**	RA vs. WE**	NA&O vs. WE**	LA&C vs. WE**
Psychosocial indicators	Secondary vs. Primary immigrant	Refugee vs. non-refugee									
Social isolation	0.18	0.10	0.27	0.16	0.20	0.37	0.18	0.04	0.22	0.33	0.26
Relationship distress	0.15	0.11	0.31	0.29	0.16	0.19	0.29	0.29	0.31	0.18	0.16
Partner violence	0.28	0.13	0.56	0.49	0.36	0.55	0.44	0.51	0.53	0.45	0.45
Depression, mood & anxiety disorder	0.06	0.03	0.05	0.06	0.02	0.05	0.06	0.08	0.05	0.04	0.04
Behavioral indicators											
Alcohol use during pregnancy	0.18	0.10	0.23	0.13	0.18	0.36	0.12	0.00	0.20	0.33	0.28
Smoking during pregnancy	0.05	0.08	0.00	0.00	0.01	0.01	0.07	0.04	0.01	0.03	0.04
Substance use during pregnancy	0.18	0.11	0.24	0.13	0.19	0.37	0.14	0.01	0.20	0.34	0.29
Late initiation of prenatal care >13 weeks	0.04	0.11	0.09	0.08	0.03	0.05	0.19	0.08	0.14	0.06	0.01

Bold values= Significant difference (value >0.1 or 10%)

Maternal birth region (comparison group)=WE

*** = (SEA= Southeast Asia; S &RA= South & Rest of Asia; EE= Eastern Europe; WE= Western Europe; RE= Rest of Europe; EA= East Africa; WA= West Africa; RA= Rest of Africa; NA&O= North America & Oceania; LA&C= Latin America & Caribbean)*

Appendix IX: Prevalence, unadjusted and adjusted GEE odds ratio estimate for inadequate prenatal care among immigrants compared to non-immigrants (Selection bias)

Inadequate or no prenatal care (R-GINDEX) - Discharge Abstract/Medical records (Maternities with screening record- met criteria inclusion criteria)				
N = 206,096	R-GINDEX N= (204,346) [†]	Prevalence, n (%)	OR* (95% CI)	aOR** (95% CI)
Non-immigrants n= 172,342	170,741 (83.55)	13,652 (8.00)	1.0 (Reference)	1.0 (Reference)
Immigrants n= 33,754	33,605 (16.45)	2,416 (7.19)	0.89 (0.85, 0.93)	1.38 (1.30, 1.45)
Inadequate or no prenatal care (R-GINDEX) - Discharge Abstract/Medical records (Maternities without screening record & did not meet inclusion criteria cohort)				
N = 59,010	R-GINDEX N= (57,481) [†]	Prevalence, n (%)	OR* (95% CI)	aOR** (95% CI)
Non-immigrants n= 54,005	52,587 (91.49)	14,600 (27.03)	1.0 (Reference)	1.0 (Reference)
Immigrants n= 5,005	4,894 (8.51)	580 (11.59)	0.35 (0.32, 0.39)	0.56 (0.51, 0.62)
Inadequate or no prenatal care (R-GINDEX) - Discharge Abstract/Medical records (All maternities)				
N = 265,106	R-GINDEX N= (261,827) [†]	Prevalence, n (%)	OR* (95% CI)	aOR** (95% CI)
Non-immigrants n= 226,347	223,328 (85.30)	28,252 (12.65)	1.0 (Reference)	1.0 (Reference)
Immigrants n=38,759	38,499 (14.70)	2,996 (7.78)	0.58 (0.56, 0.61)	1.09 (1.04, 1.15)

Frequencies expressed as n (%)

*OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models

**aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models, adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, and employment & income assistance

Bold values = Significant association ($p < 0.05$)

[†]Total excludes missing values for outcome where N= ()

Frequencies missing for Inadequate or no prenatal care (R-GINDEX): Included cohort (N=1,750), Excluded cohort (n=1,529), All maternities, accounting for the excluded cohort (N=3,279).

Appendix X: Unadjusted and adjusted GEE odds ratio estimates of perinatal health indicators between immigrant and non-immigrant childbearing women in Manitoba, Canada (missing included in analysis)

Psychosocial indicators		International immigrants N=33,754	Non-immigrants N=172,342	International immigrants versus Non-immigrants	
		n (%)	n (%)	OR (95% CI)*	aOR (95% CI)**
Social isolation	Yes	3605 (10.68))	4013 (2.33)	4.46 (4.24, 4.69)	6.95 (6.57, 7.36)
	Unknown	4,326 (12.82)	40,104 (23.27)	0.54 (0.52, 0.56)	0.53 (0.51, 0.56)
Relationship distress	Yes	642 (1.90))	9155 (5.31)	0.34 (0.31, 0.37)	0.72 (0.66, 0.78)
	Unknown	3,783 (11.21)	19,875 (11.53)	0.93 (0.89, 0.97)	1.12 (1.07, 1.17)[†]
Partner violence	Yes	126 (0.37)	2716 (1.58)	0.21 (0.18, 0.25)	0.51 (0.42, 0.62)
	Unknown	9,068 (26.86)	57,794 (33.53)	0.71 (0.69, 0.73)	0.67 (0.65, 0.69)
Depression, Mood & Anxiety Disorder	Yes	1522 (4.51)	28022 (16.26)	0.24 (0.23, 0.26)	0.26 (0.25, 0.29)
	Unknown	4,498 (13.33)	20,409 (11.84)	0.98 (0.95, 1.02)	1.17 (1.13, 1.22)[†]
Behavioral indicators					
Alcohol use during pregnancy	Yes	868 (2.57)	19069 (11.06))	0.18 (0.17, 0.19)	0.23 (0.21, 0.25)
	Unknown	3771 (11.17)	37602 (21.82)	0.40 (0.38, 0.41)	0.40 (0.38, 0.42)
Smoking during pregnancy	Yes	584 (1.73)	32123(18.64))	0.08 (0.07, 0.08)	0.11 (0.10, 0.12)
	Unknown	1207 (3.58)	8266 (4.80)	0.60 (0.57, 0.64)	0.88 (0.81, 0.95)
Substance use during pregnancy	Yes	66 (0.20)	6377 (3.70))	0.04 (0.03, 0.06)	0.09 (0.07, 0.11)
	Unknown	3887 (11.52)	38311 (22.23)	0.43 (0.42, 0.45)	0.42 (0.41, 0.44)
Late initiation of prenatal care >13 weeks	Yes	301 (0.89)	3544 (2.06)	0.42 (0.37, 0.48)	0.84 (0.74, 0.95)
	Unknown	1493 (4.42)	10401 (6.04)	0.71 (0.67, 0.75)	1.17 (1.09, 1.26)[†]

Frequencies expressed as n (%)

*OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models (multinomial probability distribution)

**aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models (multinomial probability distribution), adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, and employment & income assistance
Bold values = Significant association (p<0.05)

Shaded rows= missing prevalences and odds ratios with 95% CI (Confidence Intervals) of outcomes in the missing categories

[†]Associations further away from the null in the unknown/missing outcomes compared to main findings

Appendix XI: Unadjusted and adjusted GEE odds ratio estimates of depression between immigrant and non-immigrant childbearing women in Manitoba, Canada (sensitivity analysis using Discharge Abstract Database & Medical Services data)

Psychosocial indicator	International Immigrants		Non-immigrants		International immigrants versus Non-immigrants	
	N	n (%)	N	n (%)	OR (95% CI)*	aOR (95% CI)**
Depression, mood & anxiety disorder N=206,096	33,754	4897 (4.51)	172,342	29,899 (17.35)	0.81 (0.78, 0.84)	0.81 (0.78, 0.84)

Frequencies expressed as n (%)

*OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models

**aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, and employment & income assistance

Bold values = Significant association ($p < 0.05$)

Appendix XII: Unadjusted and adjusted GEE odds ratio estimates for psychosocial perinatal health indicators among immigrant childbearing women in Manitoba, Canada (missing included in analysis)

International immigrants n =33754	Ref = No	Social isolation		Relationship distress		Partner violence		Depression, mood & anxiety disorder	
		OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**
Immigrants									
Primary		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Secondary	Yes	1.25 (1.13, 1.37)	0.76 (0.68, 0.85)	0.68 (0.54, 0.86)	0.73 (0.55, 0.97)	0.87 (0.55, 1.36)	0.84 (0.50, 1.43)	0.85 (0.73, 1.00)	0.98 (0.82, 1.18)
	Unk	0.58 (0.53, 0.65)	0.64 (0.57, 0.73)	0.59 (0.54, 0.66)	0.84 (0.74, 0.95)	0.51 (0.48, 0.55)	0.72 (0.66, 0.78)	0.83 (0.76, 0.90)	0.93 (0.85, 1.03)
Refugees									
Non-refugee		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Refugee	Yes	1.46 (1.32,1.62)	1.17 (0.99, 1.38)	3.70 (3.09, 4.42)	1.39 (1.02, 1.90)	3.54 (2.37, 5.28)	1.02 (0.52, 1.98)	1.70 (1.46, 1.98)	1.37 (1.11, 1.70)
	Unk	1.40 (1.27, 1.54)	0.90 (0.78, 1.04)	1.48 (1.34, 1.63)	1.09 (0.95, 1.25)	1.35 (1.26, 1.46)	0.94 (0.85, 1.04)	1.14 (1.04, 1.25)	0.99 (0.87, 1.12)
Maternal birth region									
Western Europe		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Southeast Asia	Yes	2.10 (1.50, 2.95)	1.76 (1.21, 2.56)	1.31 (0.79, 2.19)	1.21 (0.68, 2.16)	1.48 (0.52, 4.20)	1.04 (0.35, 3.03)	0.71 (0.51, 0.98)	0.71 (0.49, 1.04)
	Unk	2.64 (2.09, 3.33)	2.11 (1.57, 2.84)	3.23 (2.49, 4.43)	1.46 (1.06, 2.03)	4.44 (3.61, 5.46)	2.05 (1.61, 2.60)	1.13 (0.97, 1.32)	0.82 (0.68, 0.99)
South & Rest of Asia	Yes	4.02 (2.88, 5.61)	3.03 (2.10, 4.36)	0.83 (0.49, 1.40)	1.28 (0.73, 2.26)	1.07 (0.37, 3.08)	1.12 (0.38, 3.30)	0.76 (0.55, 1.06)	0.93 (0.65, 1.34)
	Unk	2.03 (1.60, 2.56)	1.54 (1.14, 2.07)	3.11 (2.33, 4.14)	1.49 (1.08, 2.07)	3.78 (3.07, 4.65)	1.86 (1.46, 2.36)	1.18 (1.01, 1.38)	0.90 (0.75, 1.08)
Eastern Europe	Yes	3.39 (2.38, 4.84)	2.95 (2.01, 4.33)	0.68 (0.36, 1.28)	0.99 (0.50, 1.95)	1.36 (0.41, 4.49)	1.54 (0.44, 5.34)	0.99 (0.69, 1.45)	1.08 (0.72, 1.61)
	Unk	2.19 (1.70, 2.84)	2.48 (1.82, 3.38)	2.00 (1.47, 2.74)	1.27 (0.90, 1.80)	2.85 (2.28, 3.57)	2.13 (1.66, 2.74)	0.94 (0.79, 1.13)	0.79 (0.65, 0.97)
Rest of Europe	Yes	1.60 (1.06, 2.42)	2.01 (1.30, 3.10)	1.11 (0.57, 2.13)	1.06 (0.53, 2.10)	1.02 (0.23, 4.57)	0.85 (0.18, 4.07)	2.39 (1.65, 3.44)	2.06 (1.39, 3.07)
	Unk	3.39 (2.58, 4.44)	3.35 (2.42, 4.65)	2.25 (1.60, 3.16)	1.07 (0.74, 1.56)	4.32 (3.41, 5.48)	2.43 (1.87, 3.17)	0.90 (0.71, 1.13)	0.69 (0.54, 0.89)
East Africa	Yes	4.37 (3.07, 6.23)	2.45 (1.62, 3.69)	2.67 (1.54, 4.61)	1.12 (0.57, 2.21)	3.18 (1.05, 9.58)	0.86 (0.22, 3.34)	0.77 (0.51, 1.17)	0.62 (0.38, 1.00)
	Unk	2.14 (1.64, 2.80)	1.13 (0.79, 1.61)	3.15 (2.30, 4.30)	1.03 (0.71, 1.48)	3.40 (2.72, 4.28)	1.26 (0.96, 1.66)	1.19 (0.98, 1.44)	0.75 (0.59, 0.95)
West Africa	Yes	3.63 (2.50, 5.27)	2.59 (1.71, 3.92)	3.43 (1.93, 6.08)	2.03 (1.02, 4.02)	4.77(1.50,15.16)	1.92 (0.54, 6.90)	0.78 (0.48, 1.27)	0.76 (0.45, 1.30)
	Unk	1.29 (0.93, 1.80)	1.13 (0.76, 1.69)	3.26 (2.33, 4.56)	1.53 (1.05, 2.24)	4.07 (3.19, 5.19)	2.14 (1.62, 2.84)	1.25 (1.00, 1.55)	0.96 (0.75, 1.24)
Rest of Africa	Yes	6.03 (4.21, 8.63)	3.59 (2.40, 5.38)	3.60 (2.08, 6.23)	1.51 (0.77, 2.96)	3.38(1.05,10.91)	0.75 (0.20, 2.91)	1.33 (0.90, 1.95)	1.10 (0.70, 1.73)
	Unk	2.58 (1.96, 3.41)	1.91 (1.33, 2.74)	3.46 (2.51, 4.77)	1.44 (0.99, 2.09)	4.14 (3.28, 5.23)	1.94 (1.47, 2.56)	1.17 (0.95, 1.44)	0.85 (0.67, 1.08)
North America & Oceania	Yes	0.81 (0.50, 1.34)	0.65 (0.38, 1.09)	0.76 (0.37, 1.58)	0.82 (0.38, 1.77)	1.38 (0.34, 5.52)	1.25 (0.32, 4.85)	3.35 (2.32, 4.82)	3.46 (2.33, 5.14)
	Unk	2.92 (2.21, 3.86)	3.35 (2.40, 4.70)	2.10 (1.47, 3.00)	1.32 (0.90, 1.95)	3.50 (2.73, 4.49)	2.90 (2.20, 3.82)	0.99 (0.79, 1.26)	0.75 (0.58, 0.97)
Latin America & Caribbean	Yes	4.03 (2.84, 5.74)	3.21 (2.20, 4.69)	2.57 (1.51, 4.39)	1.48 (0.83, 2.64)	1.44 (0.44, 4.70)	0.63 (0.19, 2.14)	2.43 (1.73, 3.42)	2.14 (1.47, 3.11)
	Unk	2.75 (2.13, 3.54)	2.08 (1.53, 2.84)	2.01 (1.47, 2.76)	0.92 (0.64, 1.30)	3.49 (2.80, 4.37)	1.75 (1.35, 2.25)	0.93 (0.77, 1.13)	0.71 (0.58, 0.88)
Duration of residence									
<5years	Yes	7.90 (6.61, 9.45)	9.04 (7.48, 10.94)	0.53 (0.44, 0.65)	0.68 (0.53, 0.87)	0.84 (0.52, 1.36)	1.22 (0.71, 2.10)	0.39 (0.34, 0.45)	0.46 (0.39, 0.53)
	Unk	1.03 (0.95, 1.13)	1.21 (1.08, 1.35)	0.88 (0.81, 0.97)	0.87 (0.78, 0.97)	0.91 (0.85, 0.97)	0.93 (0.86, 1.00)	1.05 (0.97, 1.15)	1.03 (0.94, 1.13)
5-9 years	Yes	2.42 (1.99, 2.95)	2.64 (2.15, 3.24)	0.74 (0.59, 0.91)	0.84 (0.66, 1.08)	1.12 (0.67, 1.86)	1.32 (0.75, 2.32)	0.58 (0.50, 0.67)	0.65 (0.56, 0.75)
	Unk	0.98 (0.89, 1.08)	1.16 (1.03, 1.30)	0.88 (0.79, 0.97)	0.87 (0.77, 0.97)	0.91 (0.84, 0.98)	0.95 (0.88, 1.04)	1.03 (0.93, 1.13)	1.01 (0.91, 1.13)
10 years and more		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)

**OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models(multinomial probability distribution)*

***aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models (multinomial probability distribution), adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, employment & income assistance, and knowledge of official Canadian languages*

Bold values = Significant association (p<0.05)

Unk= Unknown/missing category

Shaded column= odds ratios with 95% CI (Confidence Intervals) of outcomes in the missing categories

Appendix XIII: Unadjusted and adjusted GEE odds ratio estimates for behavioral perinatal health indicators among immigrant childbearing women in Manitoba, Canada (missing included in analysis)

	Ref = No	Maternal alcohol use during pregnancy		Maternal smoking during pregnancy		Maternal substance use during pregnancy		Late initiation of Prenatal care	
		OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**
International immigrants n =33754									
Immigrants									
Primary		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Secondary	Yes	0.77 (0.64, 0.94)	0.94 (0.75, 1.17)	0.70 (0.53, 0.93)	0.71 (0.52, 0.97)	0.64 (0.31, 1.30)	0.81 (0.37, 1.78)	1.63 (1.25, 2.13)	1.32 (0.97, 1.78)
	Unk	0.54 (0.49, 0.60)	0.61 (0.53, 0.70)	0.77 (0.66, 0.91)	0.81 (0.66, 0.99)	0.55 (0.14, 0.15)	0.62 (0.54, 0.70)	0.84 (0.73, 0.97)	1.14 (0.95, 1.37)
Refugees									
Non-refugee		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)
Refugee	Yes	1.18 (0.96, 1.46)	0.94 (0.72, 1.25)	1.98 (1.54, 2.53)	1.20 (0.85, 1.71)	2.60 (1.43, 4.76)	0.94 (0.40, 2.19)	2.43 (1.86, 3.17)	1.59 (1.07, 2.36)
	Unk	1.38 (1.25, 1.52)	0.95 (0.82, 1.10)	1.51 (1.29, 1.76)	1.09 (0.86, 1.39)	1.39 (1.27, 1.53)	0.95 (0.83, 1.10)	1.67 (1.45, 1.91)	0.87 (0.69, 1.09)
Maternal birth region									
Western Europe		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	(-)	(-)	1.0 (Reference)	1.0 (Reference)
Southeast Asia	Yes	0.86 (0.60, 1.23)	1.02 (0.66, 1.60)	0.53 (0.34, 0.82)	0.63 (0.36, 1.11)	(-)	(-)	1.37 (0.65, 2.92)	1.88 (0.82, 4.30)
	Unk	2.25 (1.77, 2.86)	2.10 (1.54, 2.85)	1.01 (0.74, 1.37)	0.79 (0.53, 1.18)	(-)	(-)	1.61 (1.16, 2.24)	0.81 (0.55, 1.21)
South & Rest of Asia	Yes	0.31 (0.21, 0.45)	0.45 (0.28, 0.71)	0.28 (0.17, 0.45)	0.40 (0.23, 0.72)	(-)	(-)	0.96 (0.45, 2.08)	1.23 (0.54, 2.82)
	Unk	1.57 (1.24, 2.01)	1.38 (1.02, 1.87)	0.97 (0.72, 1.32)	0.79 (0.53, 1.17)	(-)	(-)	1.51 (1.09, 2.11)	0.79 (0.54, 1.17)
Eastern Europe	Yes	1.43 (0.98, 2.09)	1.96 (1.27, 3.04)	1.02 (0.64, 1.62)	1.53 (0.89, 2.62)	(-)	(-)	1.78 (0.79, 4.00)	1.77 (0.75, 4.17)
	Unk	1.97 (1.51, 2.56)	2.51 (1.82, 3.46)	0.96 (0.67, 1.37)	0.93 (0.61, 1.42)	(-)	(-)	1.21 (0.83, 1.77)	0.74 (0.48, 1.14)
Rest of Europe	Yes	2.39 (1.58, 3.60)	2.10 (1.31, 3.39)	3.62 (2.28, 5.74)	3.57 (2.10, 6.07)	(-)	(-)	1.30 (0.51, 3.30)	1.54 (0.58, 4.07)
	Unk	3.49 (2.64, 4.62)	3.71 (2.64, 5.21)	1.00 (0.65, 1.55)	0.86 (0.52, 1.43)	(-)	(-)	1.35 (0.88, 2.08)	0.78 (0.47, 1.29)
East Africa	Yes	0.61 (0.38, 0.97)	0.83 (0.46, 1.49)	0.61 (0.35, 1.05)	0.41 (0.20, 0.86)	(-)	(-)	1.86 (0.81, 4.26)	1.06 (0.40, 2.76)
	Unk	1.58 (1.20, 2.09)	0.97 (0.67, 1.40)	1.38 (0.97, 1.96)	0.68 (0.42, 1.09)	(-)	(-)	2.49 (1.74, 3.57)	0.90 (0.57, 1.43)
West Africa	Yes	0.54 (0.29, 1.01)	0.63 (0.31, 1.27)	0.26 (0.11, 0.61)	0.25 (0.09, 0.65)	(-)	(-)	1.68 (0.67, 4.22)	1.48 (0.53, 4.15)
	Unk	0.98 (0.69, 1.38)	1.05 (0.69, 1.59)	0.76 (0.48, 1.20)	0.59 (0.34, 1.05)	(-)	(-)	1.58 (1.02, 2.45)	0.92 (0.54, 1.57)
Rest of Africa	Yes	0.68 (0.41, 1.12)	0.84 (0.46, 1.51)	0.53 (0.27, 1.04)	0.35 (0.14, 0.87)	(-)	(-)	2.53 (1.10, 5.81)	1.40 (0.55, 3.60)
	Unk	2.02 (1.52, 2.68)	1.76 (1.21, 2.55)	0.94 (0.62, 1.42)	0.57 (0.34, 0.95)	(-)	(-)	2.01 (1.36, 2.96)	0.94 (0.59, 1.51)
North America & Oceania	Yes	2.00 (1.31, 3.05)	2.47 (1.52, 4.02)	1.48 (0.83, 2.65)	1.64 (0.85, 3.20)	(-)	(-)	1.01 (0.37, 2.74)	1.04 (0.37, 2.93)
	Unk	3.17 (2.39, 4.22)	4.12 (2.92, 5.82)	0.85 (0.55, 1.34)	0.55 (0.33, 0.93)	(-)	(-)	1.36 (0.88, 2.11)	0.73 (0.44, 1.22)
Latin America & Caribbean	Yes	1.69 (1.15, 2.47)	1.74 (1.10, 2.74)	1.51 (0.95, 2.41)	1.14 (0.66, 1.99)	(-)	(-)	1.76 (0.78, 3.96)	1.31 (0.56, 3.05)
	Unk	2.73 (2.11, 3.53)	2.42 (1.73, 3.25)	0.83 (0.57, 1.20)	0.66 (0.43, 1.03)	(-)	(-)	1.08 (0.74, 1.59)	0.53 (0.34, 0.82)
Duration of residence									
<5years	Yes	0.35 (0.30, 0.41)	0.43 (0.35, 0.52)	0.33 (0.27, 0.40)	0.46 (0.36, 0.60)	0.08 (0.04, 0.17)	0.07 (0.03, 0.16)	1.26 (0.93, 1.72)	1.50 (1.07, 2.12)
	Unk	0.81 (0.74, 0.89)	0.94 (0.84, 1.05)	0.97 (0.83, 1.13)	1.06 (0.87, 1.30)	0.82 (0.75, 0.90)	0.93 (0.83, 1.04)	0.95 (0.83, 1.09)	0.97 (0.81, 1.16)
5-9 years	Yes	0.42 (0.35, 0.51)	0.52 (0.42, 0.64)	0.43 (0.34, 0.54)	0.58 (0.45, 0.75)	0.39 (0.23, 0.68)	0.44 (0.25, 0.78)	0.86 (0.59, 1.25)	0.94 (0.64, 1.40)
	Unk	0.93 (0.84, 1.03)	1.13 (1.00, 1.28)	1.04 (0.87, 1.23)	1.18 (0.96, 1.44)	0.92 (0.83, 1.02)	1.10 (0.98, 1.24)	0.86 (0.74, 1.01)	0.86 (0.70, 1.04)
10 years and more		1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)	1.0 (Reference)

**OR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models(multinomial probability distribution)*

***aOR: Odds Ratios with 95% CI (Confidence Intervals) are derived from Generalized Estimating Equation models (multinomial probability distribution), adjusted for Maternal age, lone mother, low education, neighborhood income quintile, urban residence, family size, employment & income assistance, and knowledge of official Canadian languages*

Bold values = Significant association (p<0.05)

(-) = unreportable (n < 6 for internal comparison group)

Unk= Unknown/missing category

Shaded column= odds ratios with 95% CI (Confidence Intervals) of outcomes in the missing categories

SUPERVISORY COMMITTEE MEMBERS

Advisor

Dr. Marcelo L. Urquia MSc., PhD
Research Scientist, Manitoba Center for Health Policy (MCHP),
Associate Professor,
Department of Community Health Science,
Rady Faculty of Health Sciences, University of Manitoba

CHS Committee voting members

Dr. Mariette J. Charter PhD
Senior Research Scientist (MCHP),
Assistant Professor,
Department of Community Health Science,
Rady Faculty of Health Sciences, University of Manitoba

Dr. Nathan Nickel MPH, PhD
Research Scientist (MCHP),
Associate Professor,
Department of Community Health Science,
Rady Faculty of Health Sciences, University of Manitoba

Authorship declaration

The work of this thesis was conceived and executed by the student (Roheema Ewesesan). A peer reviewed publication from this thesis was prepared by the student supervised by the thesis advisor Dr. Marcelo L. Urquia, in collaboration with other supervisory committee members: Drs. Mariette J. Chartier, Nathan Nickel, and Elizabeth Wall-Wieler until when Dr. Elizabeth Wall-Wieler ceased to be a faculty member at the University of Manitoba. Roheema Ewesesan formulated the research questions, study design, data cleaning, statistical analysis, interpretation of results, and prepared the manuscript. Dr. Marcelo L. Urquia contributed to the funding, research design, interpretation of results, manuscript preparation, supervision, and overall research integrity. Dr. Mariette J. Chartier provided content expertise on Baby First and Family First Screening data. All authors contributed to the methodology and interpretation of the findings, revised the manuscript drafts, and approved the final version.