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THE HEALTHY IMMIGRANT EFFECT IN CANADA: A SYSTEMATIC REVIEW

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KEY MESSAGES

Research indicates that foreign-born status confers a health advantage (a phenomenon known as the “healthy immigrant effect”). In this report, we systematically reviewed the literature on the healthy immigrant effect by grounding studies of migration and health in Canada within particular life-course stages. The key issues and findings identified from our review are:

- The healthy immigrant effect is not a universal phenomenon in Canada.
- Immigrants’ health advantage varies across the life-course, and within each stage of the life-course, by different health outcomes.
- The healthy immigrant effect appears to be strongest during adulthood but less so during childhood/adolescence and late life.
- A foreign-born health advantage is robust for mortality but less so for morbidity, with immigrants in Canada exhibiting a survival advantage over their Canadian-born counterparts.
- The healthy immigrant effect is quite variable for perinatal health. To the extent that there is a foreign-born health advantage for birth outcomes, it is only seen for preterm birth, and this advantage vanishes after the first decade of immigrants’ residence in Canada.
- Immigrant women have worse maternal health than Canadian-born women. Mental health among immigrant mothers is especially poor.
- Adult immigrants tend to fare better than their Canadian-born counterparts with regards to mental health, chronic conditions, disability/functional limitations, and risk behaviors. The results for self-rated health are more heterogeneous and vary depending on immigrants’ country/region of origin and duration in Canada.
- Immigrant seniors do not significantly differ from Canadian-born seniors in terms of their risks for chronic conditions or poor mental health. However, they tend to have worse self-rated health and more disability/functional limitations than Canadian-born seniors.
- Maternal and infant health is quite poor among refugees. But their risks of all-site cancer and mortality are significantly lower than the Canadian-born population.
- The healthy immigrant effect is stronger for recent (<10 years residence in Canada) immigrants and vanishes among more established immigrants. However, it is not possible to determine if these duration effects reflect true convergence or overshoot because the majority of the studies were based on cross-sectional analyses.
- Mortality studies suggest that the healthy immigrant effect is stronger for immigrants from poor or culturally distant countries; Future research should incorporate direct measures of sending country development (e.g., Human Development Index) and/or cultural (dis)similarity to evaluate the potential role of migrant selection processes on the healthy immigrant effect.
- Future research needs to incorporate both pre- and post-migration experiences in order to better understand the healthy immigrant effect and its vanishing over time with increased length of residence in the receiving country.
- One-size-fits-all policies may not be effective for addressing immigrants’ health. Policies must be targeted at specific life-course stages and, within each age group, at health outcomes for which immigrants are known to be at a disadvantage.

THE HEALTHY IMMIGRANT EFFECT IN CANADA: A SYSTEMATIC REVIEW

EXECUTIVE SUMMARY

Introduction

Many studies show that immigrants are typically healthier than the native-born population, at least initially upon arrival in their new country. Immigrants are also healthier than non-migrants in the countries of origin. This foreign-born health advantage (also known as the “healthy immigrant effect”) has been documented among immigrants in Europe (Bollini & Siem, 1995), the United States (Cunningham, Ruben, & Narayan, 2008) and Canada (Beiser, 2005). In Canada, much of what we know about the healthy immigrant effect is based on studies of adult migrants. Thus, it remains unclear whether immigrants’ health advantage extends to foreign-born children and older adults. Moreover, with the exception of a few publications (Beiser, 2005; Hyman & Jackson, 2010; Ng, 2010), there has not been an attempt to systematically document the extent of the healthy immigrant effect in Canada across multiple health indicators and life-course stages. The current report fills this lacuna.

Immigrants’ health advantage is believed to stem from the selective nature of international migration (Jasso et al., 2004). Selection can occur at two levels: individual and state. At the individual level, the migration process tends to favor the movement of individuals who are healthy and can endure the journey. Thus, individuals who migrate possess unobserved characteristics that may be directly and indirectly associated with better health. At the state level, receiving countries can impose a second layer of positive selection through their immigrant admissions policies (Chiswick, Lee, & Miller, 2008).

In Canada both immigrant self-selection and state imposed selection processes may result in the migration of healthy individuals. Canada’s point system selects immigrants on the basis of human capital and favors individuals with host language proficiency, higher education, work experience, and other skills that contribute to post-migration labor market success (Knowles, 2007). These same characteristics are also correlated with better health since healthier people tend to possess greater skill levels (Jasso et al., 2004). Additionally, Canada formally screens for healthy immigrants, via a medical exam, in order to minimize healthcare costs and public health risks (Gushulak & Williams, 2004). These state imposed selection mechanisms make it less likely that unhealthy immigrants will enter Canada.

In this report, we use a life-course perspective to understand immigrants’ post-migration health in Canada (Blane, 2006; Elder, Johnson, & Crosnoe, 2003). We systematically review the empirical evidence on the healthy immigrant effect in Canada by grounding studies of migration and health within particular life-course stages.

Methodology

We searched for research studies that were published between 1980 and 2014 and written in both French and English. We conducted broad searches of PubMed, Medline, Embase, Global Health, SOC Index, JSTOR, and Clinical Key between May and October 2014. Keywords used in the search included: healthy immigrant effect, migrant health, and immigration and health.

We selected quantitative studies that explicitly compared health outcomes between the foreign-born and Canadian-born populations. We further excluded review articles, editorials, and other publications that were not original research articles. We focused on studies that had the following health measures as their dependent variable: mortality, self-rated general health, mental health, chronic

conditions, functional limitations/disability, and risk behaviors. Studies that examined perinatal and child/adolescent health were also included. Our study inclusion criteria resulted in a total of 75 eligible studies for review.

Synthesis of Main Findings

We find that the healthy immigrant effect is not a universal phenomenon. Our systematic review indicates that immigrants' health advantage varies across the life-course and within each stage of the life-course, by different health outcomes.

Perinatal Period. The healthy immigrant effect is more variable for perinatal health, particularly birth outcomes. Immigrant women are more likely to deliver a small-for-gestational age (<10th percentile of sex-specific Canadian birthweight distribution) infant than Canadian-born women (Auger et al., 2008a, 2008b; Auger, Giraud, & Daniel, 2009; Urquia et al., 2010b). Immigrant women's risks of preterm birth (<37 weeks completed gestation) and low birthweight (< 2500 grams) are either similar to or worse than that of Canadian-born women (Auger et al., 2011, 2012, 2013; Auger, Giraud, & Daniel, 2009; Shah et al., 2011). Birth outcomes are influenced by immigrant women's sociodemographic characteristics and duration of residence in Canada. Moreover, these patterns vary across different provinces and types of birth outcomes.

In terms of maternal health, immigrant mothers have worse self-rated health than Canadian-born mothers. They also have more postpartum health problems such as pain, bleeding and high blood pressure (Gagnon et al., 2013). Mental health among immigrant mothers is especially poor (Ganann et al., 2012; Miszkurka, Goulet, & Zunzunegui, 2012a, 2012b; Stewart et al., 2008; Van Lieshout et al., 2011).

Childhood and Adolescence. Immigrant children do not consistently have better health than their Canadian-born counterparts. For example, sub-national level analyses reveal that first generation children in Ontario have more psychosocial distress than their second generation peers (Hamilton, Noh, & Adlaf, 2009). However, national-level estimates show significantly better mental health for first generation children relative to their Canadian-born counterparts (both second and third generation) (Beiser et al., 2002). Likewise, studies of weight gain as children age over time in Canada show mixed results, with a health advantage (i.e., lower body mass index) for first generation children in Montreal (Maximova, O'Loughlin, & Gray-Donald, 2011) but a weight disadvantage for first generation children nationwide (Quon, McGrath and Roy-Gagnon, 2012). These heterogeneous patterns suggest that the healthy immigrant effect does not seem to concern the early stages of the life-course.

Adulthood. The health of adult immigrants is either better than or similar to that of Canadian-born adults, particularly with regards to mental health, chronic conditions, disability/functional limitations, and risk behaviors. For example, adult immigrants are significantly less likely than Canadian-born adults to report symptoms of depression, anxiety, and other psychosocial distress (Aglipay, Coleman, & Chen, 2013; Ali, 2002; Menezes, Georgiades, & Boyle, 2011; Puyat, 2013; Schaffer et al., 2009; Setia et al., 2012; Stafford, Newbold, & Ross, 2011). Foreign-born status is also protective against chronic diseases (e.g., cancer, diabetes, heart disease) and conditions (e.g., obesity, asthma) (Betancourt & Roberts, 2010; McDonald & Kennedy, 2004; Newbold & Danforth, 2003; Newbold, 2006; Vissandjee et al., 2004). In contrast, the results for self-rated health are more heterogeneous and vary depending on immigrants' country/region of origin and duration in Canada.

Late Life. Immigrant seniors (aged 65 and older) have worse self-rated health and more disability/functional limitations than Canadian-born seniors. Whether or not immigrant seniors have a health advantage over their Canadian-born age counterparts depends on immigrants' sociodemographic characteristics and duration in Canada.

Mortality. The healthy immigrant effect is quite strong for mortality. Immigrants have lower age-standardized mortality rates than the Canadian-born population (Chen, Wilkins, & Ng, 1996; Desmeules et al., 2004, 2005; Ng, 2011; Omariba, Ng, & Vissandjee, 2014; Sharma, Michalowski, & Verma, 1990; Trovato, 1993; Trovato & Clogg, 1992; Trovato & Odynak, 2011). And this survival advantage is more pronounced for male migrants (Chen, Wilkins, & Ng, 1996; DesMeules et al., 2005; Ng, 2011; Omariba, Ng, & Vissandjee, 2014). Immigrants' survival advantage extend to most cause-specific deaths (e.g., cancer, cardiovascular disease, diabetes, etc.), with important sex differences for deaths due to AIDS, infectious and parasitic diseases, and suicide.

Refugees. Refugees have worse maternal and infant health than the Canadian-born population (Gagnon et al., 2013; Stewart et al., 2008). Cancer and mortality risks were lower for refugees than the Canadian-born population, however (DesMeules et al., 2005). Refugees' survival advantage is particularly strong for deaths from cardiovascular diseases, accidents/poisoning/violence, respiratory diseases, diabetes, and cancer (DesMeules et al., 2004).

Determinants of Immigrant Health. Current explanations for the healthy immigrant effect typically center on selection, acculturation, or exposures to harmful post-migration environments (Jasso et al., 2004). The latter is often measured indirectly using immigrants' duration of residence in the receiving country, with the assumption that established immigrants have had more exposure to harmful post-migration environments than recent immigrants (McDonald & Kennedy, 2004). There is not enough empirical evidence to either formally support or refute the migrant selection hypothesis. Likewise, the evidence for the purported deleterious effects of acculturation on immigrant health is suggestive at best. Studies confirm that the healthy immigrant effect is stronger for recent immigrants and vanishes among more established immigrants. The underlying causes of immigrants' health deterioration are not clear, however. Mortality studies also suggest that the healthy immigrant effect is stronger for immigrants from poor or culturally distant countries, but upstream empirical evidence such as measures of human development and cultural (dis)similarities from sending countries will be needed to support this hypothesis.

Conclusions

Canada's immigration admissions policy culls for individuals with high human capital (Knowles, 2007). Given the strong links between human capital and health (Jasso et al., 2004) and previous research which suggested the presence of a seemingly universal foreign-born health advantage among Canada's migrant population, we expected to see the healthy immigrant effect across the life-course and for multiple health outcomes. What we found instead was a pattern much more complex than previously envisioned. Our synthesis reveals a clear survival advantage for immigrants, likely due in part to positive self and state selection processes (at least for non-refugee migrants). However, there is greater variation in the healthy immigrant effect for morbidity. Moreover, viewed through the lens of different life-course stages, we uncover a strong foreign-born health advantage in adulthood but less so during the perinatal period, childhood/adolescence, and late life. Immigrant selection may be less relevant for the very young and very old, and of course we should thus not expect the presence of a healthy immigrant effect for these groups if that is the case. But even during adulthood when the

healthy immigrant effect appears to be most effective, some discrepancies still remain between different immigrant subgroups depending on the type of health measure used (e.g., greater variation for self-rated health but less variation for mental health, disability/functional limitations, risk behaviors, and chronic conditions).

Recommendations

We have three recommendations for future research and policy. First, the studies we reviewed did not take into account potentially important premigration experiences. Future studies should incorporate simple measurements tracing early life conditions in the sending country, such as the business cycle or the infant mortality rate during the year of birth, in existing surveys in order to test how premigration exposures and protections affect post-migration health. Second, longitudinal analyses which follow individuals over time must be employed in future research in order to illuminate patterns and processes of health deterioration or convergence. Third, one-size-fits-all policies may not be effective for addressing immigrants' health. Policies must be targeted at specific life-course stages and, within each age group, at health outcomes for which immigrants are known to be at a disadvantage. For instance, while the healthy immigrant effect is particularly evident in adulthood, immigrant women have worse maternal health than Canadian-born women, and mental health is especially poor among immigrant mothers.

INTRODUCTION

According to the 2011 National Household Survey one in five people living in Canada is foreign-born (Statistics Canada, 2013). With 6.7 million immigrants in Canada currently, and projected increases of an additional 334,000 foreign-born residents per annum by 2035/2036 (Statistics Canada, 2014a), the health of immigrants and their descendants will play a key role in shaping the future health profile of Canadians. In particular, the health status and health-related service requirements of immigrants in Canada will have an important impact on public health, public spending, future immigration policy, and immigrants' integration. As an illustration of the trends that will likely affect the future of health costs, it is estimated for instance that the proportion of foreign-born among the elderly population (65+) will be approximately 25%, 35% and 40% in 2025, 2035 and 2055, respectively (Carrière et al., 2014).

Many studies have shown that immigrants are typically healthier than the native-born population, at least initially upon arrival in their new country. Immigrants also tend to be healthier than non-migrants in the countries of origin. This foreign-born health advantage (also known as the "healthy immigrant effect") has been found among immigrants in Europe (Bollini & Siem, 1995), the United States (Cunningham, Ruben, & Narayan, 2008) and Canada (Beiser, 2005). In Canada, much of what we know about the healthy immigrant effect is based on studies of adult migrants. Thus, it remains unclear whether immigrants' health advantage extends to foreign-born children and older adults. Moreover, with the exception of a few publications (Beiser, 2005; Hyman & Jackson, 2010; Ng, 2010), there has not been an attempt to systematically document the extent of the healthy immigrant effect in Canada across multiple health indicators and life-course stages. The current report fills this lacuna.

Immigrants' health advantage is believed to stem from the selective nature of international migration (Jasso et al., 2004). Selection can occur at two levels: individual and state. At the individual level, the migration process tends to favor the movement of individuals who are healthy and can endure the journey. Thus, individuals who migrate possess unobserved characteristics that may be directly and indirectly associated with better health. At the state level, receiving countries can impose a second layer of positive selection through their immigrant admissions policies (Chiswick, Lee, & Miller, 2008). In some immigrant-receiving countries, processes of self- and state-selection may operate simultaneously.

Canada is one such receiving country where immigrant self-selection and state imposed selection processes may result in the migration of healthy individuals. Canada's point system selects immigrants on the basis of human capital and favors individuals with host language proficiency, higher education, work experience, and other skills that contribute to post-migration labor market success (Knowles, 2007). These same characteristics are also correlated with better health since healthier people tend to possess greater skill levels (Jasso et al., 2004). Additionally, Canada formally screens for healthy immigrants, via a medical exam, in order to minimize healthcare costs and public health risks (Gushulak & Williams, 2004). These state imposed selection mechanisms make it less likely that unhealthy immigrants will enter Canada.

In this report, we use a life-course perspective to understand immigrants' post-migration health in Canada (Blane, 2006; Elder, Johnson, & Crosnoe, 2003). Accordingly, immigrants' health is seen as the accumulation of advantages or disadvantages in both the sending and receiving countries. Both pre and post-migration experiences and exposures to environmental risks and protections are seen as key health inputs. Unfortunately, most research on migration and health tend to only emphasize post-migration

experiences because information about migrants' premigration lives are often lacking. Thus, migration is studied as a onetime life event with its immediate determinants or consequences.

Post-migration adaptation has received the lion's share of attention in studies of migration and health, not only because of the absence of premigration data, but because of mounting evidence that immigrants' health advantage vanishes over time in the receiving country (Beiser, 2005; Cunningham, Ruben & Narayan 2008; Hyman & Jackson, 2010). In some cases the loss of migrants' health advantage leads to a *convergence* of health status between immigrants and the native-born population. In other cases, immigrants' health becomes worse than that of the native-born population, a phenomenon known as *overshoot* (Beiser, 2005). A life-course perspective may also be useful for understanding immigrants' health deterioration, if any, because it takes into account social structure (Blane, 2006). Immigrant social disadvantage in one sphere (e.g., underemployment or poverty) is linked to exclusion in other spheres (e.g., lack of access to healthcare services). These social elements of immigrants' post-migration lives combine with biological elements to then impact on their health. For example, research shows that post-1970s immigrants in Canada are not doing as well economically as their predecessors (Reitz, 2007) and that integration to the labor market varies by country of origin and gender (Lacroix, 2014). And there is some evidence that limited socioeconomic integration contributes to immigrants' poor health (Dean & Wilson, 2009).

In this report we systematically review the empirical evidence on the healthy immigrant effect in Canada by grounding studies of migration and health within particular life-course stages. In doing so, we find that the healthy immigrant effect is not a universal phenomenon. Our systematic review shows that immigrants' health advantage varies across the life-course and within each stage of the life-course, by different health outcomes. The healthy immigrant effect appears to be strongest during adulthood but less so during childhood/adolescence and late life. A foreign-born health advantage is also more robust for mortality but less so for morbidity.

The report is structured into four sections. Section 1 describes the methodology we used to obtain eligible studies and summarizes key characteristics of the studies. In section 2 we summarize the prevalence of immigrants' health advantage across different health indicators during the perinatal period, childhood/adolescence, adulthood, and late life. Subgroup differences within the immigrant population are also highlighted where possible. In section 3 we review and discuss the empirical evidence for selection, duration, and acculturation, three common explanations for immigrants' health advantage and/or deterioration. Section 4 concludes with a discussion of directions for future research.

SECTION 1 – METHODOLOGY

We searched for research studies that were published between 1980 and 2014 and written in both French and English.¹ Journals in the social and behavioral sciences were included as were medical, public health and social work journals. We conducted broad searches of PubMed, Medline, Embase, Global Health, SOC Index, JSTOR, and Clinical Key between May and October 2014. Keywords used in the search included: healthy immigrant effect, migrant health, and immigration and health. The search

¹ Although we included both French and English publications in our search, all the eligible studies reviewed for this report were in English.

produced a total of 1,135 publications and reports.² Among these publications, 200 were either based in Canada or included Canada as part of a larger cross-national analysis. We further identified and retrieved additional relevant works cited in the Canadian-based publications.

For the review, we selected quantitative studies that explicitly compared health outcomes between the foreign-born (hereafter immigrant) and the native-born (hereafter Canadian-born) populations.³ Studies that examined health differentials within the immigrant population (e.g., by country/region of origin, ethnicity, or duration of residence in Canada) but did not compare immigrant subgroups with the Canadian-born population were not considered relevant for this review since we are interested in the healthy immigrant effect (and its dissipation over time spent in Canada), which by definition involves a comparison with the Canadian-born population. We further excluded review articles, editorials, and other publications that were not original research articles. We focused on studies that had the following health measures as their dependent variable: mortality, self-rated general health, mental health, chronic conditions, functional limitations/disability, and risk behaviors. Studies that examined perinatal and child/adolescent health were also included. Studies that focused on healthcare access or utilization were excluded because, although important in understanding immigrant health, they are not, in and of themselves, direct measures of health status.

Our study inclusion criteria resulted in a total of 75 eligible studies for review (see Appendix for complete list of studies).⁴ Table 1 summarizes the key characteristics of these studies. The majority of the studies were published recently (since 2000), with over half published between 2010 and 2014 alone. The analyses for 49% of the studies were based on population-based surveys. The Canadian Community Health Survey (CCHS) and the National Population Health Survey (NPHS) were the two most frequently used surveys. Other nationally representative surveys used were the National Longitudinal Study of Children and Youth (NLSCY), the Canadian Health Measures Survey (CHMS), the General Social Survey (GSS), and the Joint Canada/United States Survey of Health (JCUSH). Vital statistics data, the Canadian Census, and hospital discharge records and charts were the second major source of data used in the studies (32%). The remaining studies (19%) relied on primary data (or administrative data in combination with supplemental primary data) collected by the authors. Given the nature of the data sources, the majority of the studies (67%) provided national-level health estimates for immigrant and Canadian-born populations.

Nearly all the studies used nativity status to define the immigrant and Canadian-born populations. Authors commonly combined nativity status with information on the number of years that immigrants had lived in Canada (i.e., duration) to differentiate between recent and established immigrants. Some studies combined information on nativity status with information on immigrants' birthplace to further disaggregate them into distinct country and/or region of origin groups (e.g., European vs. non-European). Other definitions involved disaggregating the immigrant population by

² Our initial search was intentionally broad and included countries other than Canada because another goal of our project is to produce a meta-analysis of different health conditions (e.g., obesity, self-rated health) for immigrants versus the native-born population across a number of immigrant-receiving countries.

³ Many studies included nativity status as a statistical control in the analysis but did not report point or parameter estimates for this variable and thus were excluded from the review. Studies that only reported univariate or multivariate results stratified by nativity status were excluded as well if there was no way for us to statistically compare and test group differences between foreign-born and native-born populations.

⁴ Although our review is based on a total of 75 studies, the same databases were used multiple times across many of the studies. Consequently, our synthesis is based on a smaller number of effective studies. This means that we may be putting greater emphasis on some results than is warranted.

visible minority status (e.g., white vs. nonwhite) or generation status (e.g., first vs. second and/or third generation).

SECTION 2 –HEALTH DIFFERENTIALS ACROSS THE LIFE-COURSE

In this section, we summarize patterns of morbidity and mortality according to the life-course stage in which the conditions occurred. Studies of mortality, which are often based on age-standardized measures, typically span the entire life-course and as such are summarized separately. The majority of the comparisons shown in Tables 2-7 are based on adjusted point (means, proportions, rates) or parameter (regression coefficients, odds ratios, hazard ratios) estimates. We believe it is more informative to present results that have been adjusted for possible confounding factors (e.g., socioeconomic status (SES), age, gender, etc.) since group differences in these characteristics may contribute to health disparities between immigrants and Canadian-born residents.⁵ Comparisons from studies where only unadjusted estimates were reported by the authors are noted with a letter superscript (^U). The Canadian-born population is the reference group for all comparisons. The majority of the studies did not differentiate the Canadian-born population by additional characteristics such as visible minority status or ethnicity. Throughout this paper, we highlight the few instances wherein such further disaggregation of the reference group was made. Lastly, most studies did not differentiate the immigrant population by immigrant class (e.g., refugee, family class or economic migrants). Therefore, the results shown in Tables 2-7 are for all immigrants, regardless of immigrant class. A handful of studies did distinguish between refugees and non-refugee migrants, in which case we reported findings for non-refugee migrants relative to the Canadian-born only. Findings for refugees are summarized separately in Section 2.6.⁶

For each health indicator listed in Tables 2-7, there are four possible comparison outcomes: immigrants can have either worse, better, similar, or mixed health relative to the Canadian-born population. We use check marks (as opposed to percentages) to indicate the frequency with which the comparison outcomes occurred across the studies because the number of studies for each health indicator, within a life-course stage, are rather small. A finding of ‘similar’ health means that nativity status differences were not statistically significant at the $P < 0.05$ level. A ‘mixed’ finding indicates that immigrant subgroups (as differentiated by characteristics such as country/region of origin, duration of residence in Canada, gender, education, etc.) differed from the Canadian-born population in terms of their health. Different combinations of letter superscripts—‘w’, ‘b’, or ‘s’ indicating worse, better, or similar health, respectively—are provided after each check mark to show the actual combination of comparison outcomes that were found in each study. For example, $\checkmark^{(w/s)}$ means that a study we coded as having mixed results found worse health for some immigrant subgroups (e.g., females or non-European origin migrants) compared to the Canadian-born population, but there were no significant nativity status differences for other immigrant subgroups (e.g., males or European-origin migrants).

2.1 Perinatal Period

We divided the perinatal health studies into those that pertain to infants (N=11) and those that concerned mothers (N=10). Perinatal health, including birth outcomes, is dependent on a multitude of

⁵ Studies varied in terms of the types of statistical adjustments that were made. Some studies only adjusted for one or two confounding variables (e.g., age or gender) whereas others included more comprehensive sets of demographic, socioeconomic, lifestyle, and environmental controls.

⁶ We only highlight refugee health because the studies we reviewed did not differentiate among other classes of immigrants (e.g., family class or economic migrants).

risk and protective factors that span the course of a mother's life, up to and including her health and behavior during pregnancy (Gagnon et al., 2013).

Table 2 summarizes differences in infant health between immigrant and Canadian-born women. Adverse birth outcomes such as preterm birth (< 37 weeks completed gestation), low birthweight (LBW, <2500 grams), and small-for-gestational age (SGA, <10th percentile of the sex- and gestational age-specific Canadian birthweight distribution) comprised the majority of the infant health studies we reviewed. Only one study examined infant health conditions other than birth outcomes (Gagnon et al., 2013). Consistent with prior studies (Bollini et al., 2009; Gagnon et al., 2009; Urquia et al., 2010a), we found that the healthy immigrant effect is more variable for perinatal health.

Immigrant women were more likely to deliver an SGA infant than Canadian-born women (Auger et al., 2008a, 2008b; Auger, Giraud, & Daniel, 2009; Urquia et al., 2010b). However, considering that the determination of SGA births can vary depending on the birthweight distribution used (birthweight distributions specific to immigrants' world regions of origin tend to produce fewer SGA births than the Canadian distribution) (Urquia et al., 2015), it's unclear whether the delivery of smaller babies among immigrant women represents a true health deficit. Immigrant women's risk of PTB was either similar to or worse than that of Canadian-born women (Auger et al., 2011, 2012, 2013; Auger, Giraud, & Daniel, 2009; Shah et al., 2011). The studies that produced mixed results confirm that PTB risk among immigrant subgroups were either worse than or similar to that of Canadian-born women (Auger et al., 2008a; Urquia et al., 2010b; Urquia, O'Campo, & Heaman, 2012). Likewise, LBW was also stratified into the worse or similar categories (Auger et al., 2008b; Moore, Daniel, & Auger, 2009; Shah et al., 2011). Only two studies showed better birth outcomes for some immigrant subgroups (Auger et al., 2008b; Urquia, O'Campo, & Heaman, 2012).

Closer examination of the 'mixed' studies revealed that birth outcomes were influenced by immigrant women's sociodemographic characteristics and duration of residence in Canada. Moreover, these patterns varied across different provinces and types of birth outcomes. For example, Auger and colleagues (2008b) found that the healthy immigrant effect mostly applies to less educated women. Consistent with the epidemiological paradox wherein low socioeconomic status is unexpectedly associated with favourable health outcomes (Acevedo-Garcia, Berkman, & Soobader, 2005), foreign-born status was protective against LBW and SGA among women in Quebec with less than a high school education. In contrast, university educated immigrant women had significantly higher risks of SGA and PTB than similarly educated Canadian-born women. Also in Quebec, immigrants from South Asia and the Caribbean had higher adjusted risks of LBW than Canadian-born women (Moore, Daniel & Auger 2009). But in Toronto, it was immigrants from Latin America/Caribbean, Middle East/North Africa, and South Asia who were more susceptible to LBW than Canadian-born women (Shah et al., 2011). In terms of duration, there were minimal differences in PTB risk between recent (<10 years) immigrants and Canadian-born women who delivered in Ontario. However, established (≥ 10 years) immigrants were more likely to deliver a premature baby than Canadian-born women. In contrast, immigrants, regardless of duration in Canada, had significantly higher adjusted odds of SGA than Canadian-born women (Urquia et al., 2010b). These results suggest that to the extent that there is a foreign-born health advantage for birth outcomes, it is only seen for PTB, and this advantage vanishes after the first decade of immigrants' residence in Canada. For the most part, birth outcomes are worse for the foreign-born (but similar to Canadian-born outcomes for some immigrant subgroups).

Maternal health differences between immigrant and Canadian-born mothers are summarized in Table 3. Immigrant mothers had worse self-rated health than Canadian-born mothers (Ganann et al.,

2012). They also had more postpartum health problems (e.g., pain, bleeding, high blood pressure, infection, and poor general health) than their Canadian-born counterparts (Gagnon et al., 2013). Differences in gestational weight gain (Larouche et al., 2010) and illness during pregnancy (Urquia, O'Campo, & Heaman, 2012) between immigrant and Canadian-born women varied depending on immigrants' duration of residence in Canada. But the risk of hospitalization during pregnancy was the same for immigrant and Canadian-born women, regardless of duration (Urquia, O'Campo, & Heaman, 2012).

Mental health among immigrant mothers was especially poor. Five out of the eight studies that examined mental health found that immigrant women had significantly higher unadjusted (Ganann et al., 2012; Miszkurka, Goulet, & Zunzunegui, 2012a, 2012b) and adjusted (Stewart et al., 2008; Van Lieshout et al., 2011) rates of antenatal and postpartum depression than Canadian-born women. In fact, one study found that immigrant women, regardless of whether or not they experienced abuse, were significantly more susceptible to antenatal depression than their non-abused Canadian-born counterparts (Miszkurka, Goulet, & Zunzunegui, 2012b). There were minimal mental health differences between immigrant and Canadian-born mothers in two studies, however (Ballantyne, Benzies, & Trute, 2013; Miszkurka, Goulet, & Zunzunegui, 2010). Postpartum depression also varied by immigrants' duration of residence in Canada, with higher risks of depression for recent (<10 years) immigrants and immigrants who uprooted as children than Canadian-born women of European descent. However, there were no statistically significant differences between established (≥10 years) immigrants and Canadian-born women of European descent (Urquia, O'Campo, & Heaman, 2012).

2.2 Childhood and Adolescence

Table 4 shows the results of seven studies that examined health during childhood and adolescence. The majority (5 out of 7) of these studies assessed generational status differences in health; that is, first generation children were compared with second and/or third generation children.⁷ The reference group was not consistent across all the studies we reviewed. Therefore, we use different superscript roman numerals (*i*, *ii*, or *iii*) after each check mark to indicate the comparison that was made. In general, immigrant children's health varied across the different measures with no clear pattern of a health advantage or disadvantage relative to Canadian-born children.

In terms of mental health, sub-national level analyses revealed that first generation children in Ontario had more psychosocial distress than their second generation peers (Hamilton, Noh, & Adlaf, 2009). In Toronto, first generation children from middle income (but not upper or lower income) countries were less likely to exhibit internalizing symptoms than third generation children. Generational status differences for externalizing symptoms were not statistically significant, however (Montazer & Wheaton, 2011). However, national-level estimates showed significantly better mental health for first generation children relative to their Canadian-born counterparts (both second and third generation) (Beiser et al., 2002).

Analysis of risky behaviors uncovered lower adjusted risks of drinking and delinquency (but not illicit drug use) for first than second generation youth, suggesting a protective effect of foreign-born status (Hamilton, Noh, & Adlaf, 2009). Studies of weight gain as children aged over time in Canada were mixed. At baseline, body mass index (BMI) was similar between first generation children and their

⁷ Second generation is defined as a child who is born in Canada but has at least one foreign-born parent. Third generation refers to Canadian-born children whose parents are both born in Canada.

second and third generation peers in Montreal. By adolescence, however, there was a clear advantage for immigrant children, with a slower rate of unhealthy weight gain for first generation than either second or third generation youth (Maximova, O'Loughlin, & Gray-Donald, 2011). Nationwide analysis showed contradictory results, however. Quon, McGrath and Roy-Gagnon's (2012) analysis of the NLSCY revealed that first generation adolescents had *higher* BMI than their third generation peers. Again, these generational differences were less pronounced during childhood. Other studies that examined nutrition (as measured by vitamin D concentration) and asthma also showed the absence of a universal foreign-born advantage for children (Vatanparast, Nisbet, & Gushulak, 2013; Wang et al., 2008).

One interpretation of these heterogeneous patterns is that the healthy immigrant effect does not seem to concern the early stages of the life-course. As such, immigrant children are not necessarily in better health than their Canadian-born counterparts. It is also possible that measures of health are perhaps much less sensitive when applied to young (and thus generally quite healthy) people. Thus, group differences that may be too subtle to be detected in young ages could turn significant over the long run. Finally, the absence of a clear health advantage for immigrant children hints at the possibility that the selection hypothesis is mostly applicable to adults, who are after all the main applicants for immigration.

2.3 Adulthood

Table 5 shows the results of 34 studies that examined adult health. Although there was some variation across the studies, in general immigrants either had better or similar health compared to Canadian-born adults, particularly with regards to mental health, chronic conditions, disability/functional limitations, and risk behaviors. In contrast, the results for self-rated health were more heterogeneous and varied depending on immigrants' country/region of origin and duration in Canada. Due to space limitations, we only summarize the findings for mental health, self-rated health and chronic conditions.

The ten studies we reviewed on mental health revealed a clear advantage for immigrants. They were significantly less likely than Canadian-born adults to report symptoms of depression, anxiety, and other psychosocial distress (Aglipay, Coleman, & Chen, 2013; Ali, 2002; Menezes, Georgiades, & Boyle, 2011; Puyat, 2013; Schaffer et al., 2009; Setia et al., 2012; Stafford, Newbold, & Ross, 2011). Only one study reported worse mental health for immigrants than Canadian-born adults, but this was specific to a sample of homeless patients in Ottawa (Dealberto, Middlebro, & Farrell, 2011). Another study found minimal nativity status differences in psychological distress (Pahwa et al., 2012). The mental health advantage was especially strong for nonwhite immigrants (Setia et al., 2012; Stafford, Newbold, & Ross, 2011) and immigrants from Asia, Africa, and Central/South America (Ali, 2002).

The effect of duration of residence in Canada on mental health varied across the studies. For example, Wu and Schimmele (2005a) found a health advantage for recent (<10 years) but not established (≥10 years) immigrants. However, in Ali's (2002) analysis immigrants continued to experience better mental health than Canadian-born adults nearly two decades post-migration. Migrants' mental health advantage only vanished after 20 years of residence in Canada. In contrast, Aglipay and colleagues (2013) observed a foreign-born health advantage for anxiety disorders, regardless of immigrants' duration in Canada. Thus, while immigrant adults tend to have fewer mental health issues than their Canadian-born counterparts, the jury is still out as to whether and when immigrants' mental health advantage dissipates with increased duration in Canada.

Foreign-born status was also protective against chronic diseases (e.g., cancer, diabetes, heart disease) and conditions (e.g., obesity, asthma). Among the studies that examined the presence of *any* chronic condition, five reported a health advantage for immigrants (Betancourt & Roberts, 2010; McDonald & Kennedy, 2004; Newbold & Danforth, 2003; Newbold, 2006; Vissandjee et al., 2004), two observed no nativity status differences (Dunn & Dyck, 2000; Laroche, 2000), and two found mixed results, depending on immigrants' region of origin and duration in Canada (Chen, Ng, & Wilkins, 1996) and the health measure used (So & Quan, 2012). The protective effect of foreign-born status on any chronic condition was especially strong for non-European immigrants (Chen, Ng, & Wilkins, 1996). For specific chronic conditions, immigrants were less likely than Canadian-born adults to suffer from asthma (Newbold & Danforth, 2003; Siddiqi et al., 2013), cancer (Betancourt & Roberts, 2010; Luo et al., 2004; McDermott et al., 2011), and to a lesser extent, cardiovascular-related problems (Betancourt & Roberts, 2010; Newbold & Danforth, 2003; Siddiqi et al., 2013). The results for arthritis, diabetes, and overweight/obesity were more varied, with no clear immigrant health advantage.

The extent to which duration of residence in Canada affected immigrants' likelihood of reporting a chronic condition varied across the studies. For instance, Vissandjee and colleagues (2004) found that both immigrant men and women were less likely to report a chronic condition than their Canadian counterparts, regardless of duration. In contrast, Chen and colleagues (1996) observed an advantage for recent (≤ 10 years) non-European immigrants but a convergence towards the Canadian-born rate for established (>10 years) non-European immigrants. But European immigrants, regardless of duration in Canada, had similar age-adjusted rates of any chronic condition as Canadian-born adults.

Finally, immigrants' self-rated health tends to be either worse than or similar to that of Canadian-born adults. Six studies observed trivial differences in self-rated health between immigrant and Canadian-born adults (Newbold, 2005; Laroche, 2000; Noymer & Lee, 2013; So & Quan, 2012; Siddiqi et al., 2013; Wu & Schimmele, 2005b). Immigrants had worse self-rated health than Canadian-born adults in three studies (Dunn & Dyck, 2000; Muggah, Dahrouge, & Hogg, 2012; Newbold & Danforth, 2003) but better self-rated health in one study (Omariba & Ng, 2011). Among the six studies that produced 'mixed' findings, immigrants' self-rated health relative to the Canadian-born population varied by gender and duration of residence. In terms of gender, female immigrants reported better self-rated health than Canadian-born women in some studies (e.g., McDonald & Kennedy, 2004) but worse health in other studies (e.g., Setia et al., 2012). Nativity status differences for men were not significant. In terms of duration, Gee, Kobayashi and Prus (2004) observed a health advantage for middle-aged (45-64 year olds) recent (<10 years) immigrants, but convergence for established (≥ 10 years) immigrants, relative to their Canadian-born age counterparts. Vissandjee and colleagues (2004) analyzed the effects of both gender and duration on self-rated health. They found that both very recent (0-2 years) and short-term (3-9 years) male immigrants were less likely to report poor health compared to Canadian-born men. But there was a convergence in self-rated health for established (≥ 10 years) male immigrants. Among women, very recent immigrants had better self-rated health than Canadian-born women. In contrast, there was a convergence (similar) for short-term but an overshoot (worse) for established female immigrants compared to Canadian-born women. The results suggest that immigrant women are more susceptible to health deterioration earlier on in the settlement process than their male migrant counterparts.

Ethnic differences in self-rated health for immigrants versus Canadian-born adults were examined in two studies. Kobayashi, Prus and Lin (2008) disaggregated immigrants by ethnicity and compared them to their Canadian-born coethnic counterparts. Among visible minorities, the authors found that black and Chinese immigrants had a health advantage over Canadian-born black and Chinese

adults. Among whites, French and English immigrants were more likely to report positive health than Canadian-born French and English adults. In contrast, white immigrants from other ethnic backgrounds were less likely to report positive health than their Canadian-born coethnic counterparts. Likewise, Vissandjee and colleagues (2004) found that black immigrant men had better self-rated health than Canadian-born men (regardless of race/ethnicity). In comparison, Western European immigrant men had worse self-rated health than Canadian-born men. Among women, only South Asian immigrants had significantly worse self-rated health than Canadian-born women. These studies suggest that the healthy immigrant effect is less applicable for adult self-rated health, and it may also not apply to certain ethnic groups.

2.4 Late Life

The results of six studies that examined health in late life are shown in Table 6. These studies had varying definitions of the senior population. For the purposes of this review, we only report results for individuals aged 65 and older.⁸ Overall, immigrant seniors did not significantly differ from Canadian-born seniors in terms of their risks for chronic conditions (Newbold & Filice, 2006; Prus, Tfaily, & Lin, 2010) or poor mental health (Aglipay, Colman, & Chen, 2013). However, they tend to have worse self-rated health and more disability/functional limitations than Canadian-born seniors. Below, we summarize the results for self-rated health and disability/functional limitations, two indicators for which there were relatively more studies available.

Four studies examined disability/functional limitations. One study found similar rates of disability, as measured by cognitive impairment, between immigrant and Canadian-born seniors (Prus, Tfaily, & Lin, 2010). In contrast, immigrant seniors had lower functional ability (Filice & Newbold, 2006), as measured by the Health Utility Index, and required greater assistance (Turcotte & Schellenberg, 2006) than their Canadian-born age counterparts. However, Gee and colleagues (2004) found that immigrants' duration of residence moderated the effect of nativity status on both disability and functional limitations. Recent (<10 years) immigrant seniors were no different from Canadian-born seniors in terms of activity restrictions or functional limitations. But established (≥ 10 years) immigrant seniors had significantly higher odds of activity restrictions and lower mean functional health than their Canadian-born age counterparts.

Five studies compared self-rated health between immigrant and Canadian-born seniors. Self-rated health among immigrant seniors was either worse than (Turcotte & Schellenberg, 2006) or similar to (Newbold & Filice, 2006) that of Canadian-born seniors. Three studies corroborated this general pattern of worse or similar health, depending on immigrants' sociodemographic characteristics and duration in Canada. For example, self-rated health was worse for established (≥ 10 years) (Gee, Kobayashi, & Prus, 2004) and non-white (Prus, Tfaily, & Lin, 2010) immigrants. These duration and race related health disadvantages operate differently for male and female migrants, however. Recent (<10 years) nonwhite male migrants were more likely to report poor/fair health than Canadian-born senior men. But the self-rated health of established (≥ 10 years) male migrants, regardless of race, was no different from that of Canadian-born senior men. In contrast, white female migrants, regardless of duration in Canada, were more likely to report poor/fair health than Canadian-born senior women.

⁸ Exceptions to this age range include Newbold and Filice (2006) and Turcotte and Schellenberg (2006) who examined persons aged 55 and older, and Aglipay, Colman and Chen (2013) who examined persons aged 60 and older.

Among nonwhite females, established (but not recent) immigrants were more likely to report poor/fair health than their Canadian-born age and sex counterparts (Kobayashi & Prus, 2012).

2.5 Mortality

Table 7 summarizes the results of 12 studies that examined mortality. The healthy immigrant effect is quite strong for mortality, unlike the more heterogeneous patterns observed for morbidity. The overwhelming conclusion from the literature is that immigrants in Canada have a survival advantage over their Canadian-born counterparts. Among the nine studies that examined all-cause mortality, all found lower age-standardized mortality rates for immigrants than Canadian-born residents (Chen, Wilkins, & Ng, 1996; Desmeules et al., 2004, 2005; Ng, 2011; Omariba, Ng, & Vissandjee, 2014; Sharma, Michalowski, & Verma, 1990; Trovato, 1993; Trovato & Clogg, 1992; Trovato & Odynak, 2011). However, the health advantage was more pronounced for male migrants (Chen, Wilkins, & Ng, 1996; DesMeules et al., 2005; Ng, 2011; Omariba, Ng, & Vissandjee, 2014).

Estimates of life expectancy showed widening longevity gaps between immigrants and the Canadian-born population over time. In 1981, life expectancy at birth was around 71.9 and 79.1 years for Canadian-born men and women, respectively. The corresponding estimates for immigrant men and women were 75.1 and 80.5 years, representing an additional 3.2 and 1.4 years of life (Sharma, Michalowski, & Verma, 1990). Two decades later, the longevity gap between immigrants and the Canadian-born population increased: immigrant men and women had 4.4 and 3.1 additional years of life over their Canadian-born counterparts, respectively (Trovato & Odynak, 2011).

Immigrants' survival advantage extended to most of the cause-specific deaths listed in Table 7. However, there were important sex differences for deaths due to AIDS, infectious and parasitic diseases, and suicide. Female migrants were more likely to die from AIDS than Canadian-born women whereas nativity status differences in AIDS-related deaths for males were not statistically significant (DesMeules et al., 2005). Deaths from infectious and parasitic diseases were similar between immigrant and Canadian-born women. But, male immigrants had significantly lower mortality due to infectious and parasitic diseases than Canadian-born men. There were significant gender and nativity status differences in 1969-1973 suicide rates, with immigrant men (but not women) having lower risks of death compared to their Canadian-born counterparts (Kliewer & Ward, 1988; Kliewer, 1991). More recent data indicated that 1980-1998 suicide rates were significantly lower for both male and female immigrants compared to Canadian-born men and women, however (DesMeules et al., 2005). Finally, immigrants from the US and other parts of the world had higher suicide rates than the Canadian-born population. But the suicide rates for Scottish, English, and Italian immigrants were lower than the Canadian-born rate (Trovato, 1992).

Table 8 summarizes these birthplace differences in all-cause mortality from four studies (DesMueles et al., 2004, 2005; Ng, 2011; Omariba, Ng, & Vissandjee, 2014). Immigrants, irrespective of country or region of birth, had lower mortality than the Canadian-born population. Exceptionally, female immigrants from the US had similar age-standardized mortality rates as Canadian-born women (Ng, 2011). Likewise, the mortality gap between immigrants from the UK and the Canadian-born population was much smaller (8% lower risk of mortality) (Omariba, Ng, & Vissandjee, 2014), but still statistically significant. Similarly, there were region of origin differences in life expectancy. European-origin male and female migrants could expect to live an additional 2.7 and 1.4 years relative to their Canadian-born counterparts in 1991 whereas non-European origin male and female migrants lived about 6.7 and 5.3 years longer than Canadian-born men and women on average (Chen, Wilkins, & Ng, 1996).

2.6 Refugee Health

Refugees tend to report poorer health overall and lose their health advantage – if they have any – quicker than economic migrants (Beiser, 2005; Newbold, 2009). The harsh contexts of exit within which refugees fled their countries of origin and the difficulties of post-migration adjustment influence their health status. For instance, refugees are often housed in camps prior to their resettlement in Canada and the camp environment may expose them to infectious diseases such as tuberculosis and malaria (Evans, 1987). Also unlike economic and family class migrants, refugees who filed successful claims of asylum from within Canada can remain in the country even if they have poor medical conditions that would otherwise render them inadmissible (Gushulak & Williams, 2004).

There were only a handful of studies (N=5) that distinguished the immigrant population by refugee status. Refugees tend to have worse maternal and infant health than the Canadian-born population. For example, refugee mothers who delivered an infant in Montreal, Toronto, and Vancouver had a five-fold risk of postpartum depression compared to Canadian-born mothers (Stewart et al., 2008). Gagnon and colleagues (2013) also found higher postpartum problems (e.g., pain, bleeding, breast care, high blood pressure, infection, and poor psychosocial and general health), four months post-delivery, among refugee mothers compared to their Canadian-born counterparts. Likewise, infant health problems (e.g., poor safety, inadequate clothing, vitamin D deficiency) were more prevalent among babies born to refugee versus Canadian-born women.

Refugees fared better than the Canadian-born population with respect to cancer and mortality, however. All-site cancer was significantly lower for refugees than for the Canadian-born population. But the incidences of liver and nasopharynx cancers were higher among refugee than Canadian-born men. Cervical cancer was elevated among middle aged (45-64) refugee than Canadian-born women (McDermott et al., 2011). Yet, in terms of mortality, refugees had lower death rates than the Canadian-born population (DesMeules et al., 2005), particularly for deaths from cardiovascular diseases, accidents/poisoning/violence, respiratory diseases, diabetes, and cancer (DesMeules et al., 2004). The survival advantage of refugees may come as a surprise to some readers, especially in light of the documented health problems for this population. However, research from Denmark also shows lower death rates for refugees relative to native-born Danes (Norredam et al., 2012), suggesting that refugees' survival advantage is not unique to Canada. Since refugees are not admitted on the basis of human capital, their survival advantage implies that factors other than migrant selection may be operating for this group.

SECTION 3 – DETERMINANTS OF IMMIGRANT HEALTH

Current explanations for the healthy immigrant effect tend to center on selection, acculturation, or exposures to harmful post-migration environments (Jasso et al., 2004). The latter is often measured indirectly using immigrants' duration of residence in the receiving country, with the assumption that established immigrants have had more exposure to harmful post-migration environments than recent immigrants (McDonald & Kennedy, 2004). Other determinants of immigrant health (e.g., social support, socioeconomic status, and neighborhood characteristics) were also examined in some of the studies we reviewed but are not highlighted here due to space limitations.

3.1 Immigrant Health Selectivity

Support for the selection thesis has been documented for adult immigrants in the US with regards to disability (Mehta & Elo, 2012) and self-rated health (Akresh & Frank, 2008) as well as infant

mortality (Landale, Oropesa, & Gorman, 2000). In Canada, we found only one study that explicitly tested for positive selection with respect to the country of origin. Wang and colleagues (2008) compared asthma rates among Chinese immigrant youth and Canadian-born Chinese and non-Chinese youth in Vancouver with non-migrant Chinese adolescents residing in three regions in China (Wang et al., 2008). They found that Chinese immigrant girls, but not boys, in Vancouver had significantly *higher* rates of asthma compared to non-migrant Chinese youth in Guangzhou, China. These results contradict the idea that immigrants to Canada are positively selected. However, given that the study involved the comparison of only one ethnic group in a specific life-course stage and locale, the generalizability of these findings is quite limited. Thus, it remains to be seen whether and to what extent selection (both self and state imposed) plays a role in immigrants' post-migration health in Canada.

Notably, selection may operate differently for immigrant seniors given that their motivations for migration are less tied to the labor market (Jasso et al. 2004). There are two distinct subpopulations of immigrant seniors: (i) those who emigrated when young but aged in the receiving country and (ii) those who uprooted when already in late life. The former is more likely to be positively selected on health owing to their work-related migration. In contrast, the latter may be negatively selected on health because migration at more advanced ages is likely tied to family reunification purposes (Gee, Kobayashi, & Prus, 2004). The finding that immigrant seniors tend to either have worse or similar health relative to Canadian-born seniors may reflect this bi-modal distribution of both positively and negatively selected older adult immigrants.

Finally, the country/region of origin difference observed in the mortality studies may reflect migrant selection processes as well. Immigrants from less developed and culturally dissimilar countries may be even more positively selected on health than immigrants originating from countries that are developmentally and culturally similar to Canada. This is premised on the idea that individual decisions to migrate are the result of cost-benefit analyses that take into account potential financial gains and losses as well as non-monetary risks or benefits associated with migration, including the difficulties of adapting to a new cultural milieu (Jasso et al., 2004). Skill and health selectivity of migrants is expected to be greatest when there are greater costs involved in moving, as is the case when sending and receiving countries differ in levels of development and culture. Omariba, Ng and Vissandjee (2014) attributed the country/regional differences in mortality in their study to differential durations in Canada: immigrants from the UK had a smaller survival advantage relative to the Canadian-born population than immigrants from China, the Philippines, and the Caribbean and UK immigrants had also been in Canada longer than any of the other immigrant subgroups. But it's just as possible that the non-European immigrants were more positively selected on human capital and health owing to the greater migration costs involved. Likewise, the two studies by DesMeules and colleagues (2004, 2005) also showed a smaller survival advantage for European migrants relative to the Canadian-born population whereas the survival advantage was much larger for immigrants from Asia and the Pacific Region, Middle East and Africa, and the Americas and Caribbean. The same overall regional difference was also seen for mortality in Ng's report (2011). Future research should incorporate direct measures of sending country development (e.g., Human Development Index) and/or cultural (dis)similarity to evaluate the potential role of migrant selection processes on the healthy immigrant effect.

3.2 Duration Effects

Duration effects were tested in 25 (34%) of the studies we reviewed. In the majority of the studies, immigrants were differentiated into recent and established subgroups and then compared to the Canadian-born population. The definitions of recent and established immigrants varied across the

studies, but on average centered around 10 years as the cut-off point. Two studies used established (>10 years) European/USA immigrants as the reference group as opposed to the Canadian-born population (Omariba & Ng, 2011, 2014). Four studies used a continuous specification of duration (Beiser et al., 2002; McDonald & Kennedy, 2004; So & Quon, 2012; Wu & Schimmele, 2005a), in which case there was no reference group.

In general these studies confirmed that the healthy immigrant effect is stronger for recent immigrants and vanishes among more established immigrants. However, it is not possible to determine if these duration effects reflect true convergence or overshoot because the majority of the studies were based on cross-sectional analyses. Claims about health deterioration with cross-sectional data can be misleading because issues of attrition may bias the results. Immigrants who still remain in Canada after 10 years can be a selected subsample of the original group of immigrants that arrived earlier; less healthy migrants may have returned to their country of origin. Such selective emigration of immigrants, described as the salmon effect (Pablos-Mendez, 1994), would produce conservative estimates of health deterioration since the less healthy immigrants would have left before being reported as less healthy in older ages. In other words, we could observe even worse health deterioration among established immigrants if unhealthy migrants always remained in the country. However, this salmon bias is most likely minute in the Canadian case (Omariba, Ng, & Vissandjee, 2014).

There were a few longitudinal studies that examined the effect of duration in Canada on immigrants' health.⁹ So and Quan (2012) found that immigrants had a tendency to transition into both worse and better health over time. Their unusual finding may reflect measurement error as opposed to a real bimodal distribution of healthy and unhealthy immigrants, however. Notably, Ng and colleagues' (2005) analysis of the NPHS showed significant deterioration in self-rated health over time for both recent (<10 years) and established (≥ 10 years) non-European immigrants relative to the Canadian-born population. Recent non-European immigrants were also more likely than the Canadian-born population to experience an increase in BMI over time. But there were no significant differences between the Canadian-born population and other immigrant subgroups in terms of health deterioration or weight gain. Moreover, aside from self-rated health and BMI, there was little evidence that immigrants were more likely than the Canadian-born population to pick up unhealthy habits, such as sedentary lifestyles and daily cigarette smoking, over time. The one exception was recent European immigrants, who had a higher likelihood of adopting sedentary habits than their Canadian-born counterparts. These results indicate that convergence and overshoot are not universal patterns among all immigrants in Canada.

A key issue with analyses of duration effects on health is that duration of residence in the receiving country confounds immigration cohort and post-migration exposures. Because duration is defined by year of immigration, it may be picking up effects owing to differences in immigration cohort, differential post-migration exposures, or both (Jasso et al. 2004). Yet, most studies we reviewed interpreted duration effects as reflecting only post-migration exposures. However, there is reason to believe that immigration cohort effects may influence post-migration health. In recent decades, there has been changes to Canadian immigration policy (e.g., Bill C31 regarding asylum seekers) (Zahn, 2012) and such changes may have both indirect and direct bearing on the health of immigrants who enter Canada in particular years. Cohort effects stemming from conditions in the sending countries that may

⁹ Setia and colleagues (2012) conducted a longitudinal analysis of self-rated health and mental health for immigrants compared to the Canadian-born population. The authors reported that they controlled for "time since immigration" in immigrant-only models but they did not report the regression coefficient for this variable. Thus, it was not possible to assess what the duration effect was in their study.

have affected the health of particular waves of immigrants may also be consequential. Notably, the pre-1973 cohorts are still alive and cohort effects may be partly responsible for some of the variation in health we observed among immigrant and Canadian-born older adults. Exceptionally, McDonald & Kennedy (2004) addressed the issue of confounding cohort and duration effects by using a synthetic cohort design to disentangle effects owing to membership in different migration cohorts versus differential exposure in Canada. They found significant cohort effects for both chronic conditions and self-rated health, with more favorable health observed among pre-1980s immigrants.

Finally, lack of access to healthcare has been proposed as a possible explanation for immigrants' health deterioration (Beiser, 2005; Newbold & Danforth, 2003). Immigrants may not receive the care they need despite universal health insurance because of linguistic and cultural barriers (Edge & Newbold, 2013; Newbold, 2009). Additionally, structural changes in the Canadian healthcare system during the 1990s may have rendered healthcare less accessible for some subgroups (e.g., poor, less educated) (Newbold, 2005). Cross-sectional qualitative studies confirm that immigrants have difficulties accessing healthcare (Asanin & Wilson, 2008; Lai & Chau, 2007). However, a recent longitudinal study indicates that immigrants were not more likely to have unmet healthcare needs than the Canadian-born population (Setia et al., 2011a). In fact, the longer immigrants resided in Canada, the more likely they were to have access to a regular doctor. We did not include studies of healthcare access in our review. However, future research may benefit from directly investigating the links between healthcare access and immigrant health deterioration.

3.3 Acculturation Effects

Part of the interest in examining duration effects is that length of residence may be picking up processes of acculturation taking place among immigrants. It is believed that immigrants' health advantage may be due to cultural buffering (Landale et al., 1999). Immigrant cultures may favor norms and values that minimize risky behaviors such as smoking and drinking alcohol—behaviors that have been linked to obesity (Abraido-Lanza, Chao, & Florez, 2005) and premature mortality (Ho & Elo, 2013). Diets may also be culturally-linked and differences in nutritional intake between immigrants and non-immigrants may partly explain nativity status differentials in health (Osypuk et al., 2009). Acculturation of Western norms, adoption of risky behaviors, and consumption of high-fat, processed foods are often blamed for migrants' health deterioration (Hochhausen, Perry, & Le, 2010).

There were only a handful of studies that explicitly examined the association between acculturation and immigrant health.¹⁰ Wu and Schimmele (2005a) found that acculturation (ability to speak English/French) had little bearing on adult mental health. Neighborhood-level language assimilation also had no statistically significant effect on SGA (Auger et al., 2008a). However, an individual-level measure of linguistic assimilation (ability to converse in English) did significantly decrease the odds of experiencing health deterioration (functional ability and self-rated health only) but was not associated with improvements in health (So & Quan, 2012). Likewise, Newbold (2005) found that a *lack* of linguistic assimilation (speaking a language other than English or French), was protective against declines in self-rated health. The inconsistent associations between language assimilation and

¹⁰ A total of 15 studies include at least one of the commonly used variables of acculturation (e.g., host language proficiency, generation status, duration). Seven studies reported the effect of these acculturation variables on immigrants' health while in the remaining eight studies, the authors either did not consider the variables as measures of acculturation or they considered them simply as control variables and therefore did not show results for the variables.

health are likely due to the different definitions of linguistic assimilation used across the studies. Moreover, it is not clear whether there is a one-to-one correlation between language assimilation and adoption of western cultural norms, values and behaviors.

Assimilation of supposed ‘western’ risky behaviors was measured with cigarette smoking in one study on mental health (Pahwa et al., 2012) and cigarette smoking, alcohol consumption, and physical inactivity in another study on self-rated health, functional limitations, and chronic conditions (Newbold & Filice, 2006). In both studies, risky behaviors were associated with poorer mental and physical health. These results were interpreted as evidence that acculturation had negative consequences on immigrants’ health. However, considering that behaviors such as cigarette smoking and alcohol consumption are not exclusively western habits, these are arguably poor measures of acculturation. Only one study of postpartum depression among mothers with preterm infants in neonatal intensive care units measured cultural assimilation with an acculturation index (Vancouver Index of Acculturation) which gauged mainstream and heritage cultural identities (Ballantyne, Benzies, & Trute, 2013). Bivariate correlations showed that a *less* mainstream cultural identity was associated with more depression; in other words, a lack of acculturation was harmful to health. However, since nativity status and acculturation were highly correlated, this may not be a pure effect of acculturation per se.

Other studies assessed acculturation effects on immigrant health indirectly by using generation status (Quon, McGrath, & Roy-Gagnon, 2012), duration (Urquia et al., 2010b), age-at-migration (Wu & Schimmele, 2005a), or a combination of age-at-migration, duration, and ethnicity (Urquia, O’Campo, & Heaman, 2012). These studies were more likely to report statistically significant acculturation effects. But, given that these indirect measures of acculturation may be picking up other things besides cultural assimilation, the evidence for the purported deleterious effects of acculturation on immigrant health is suggestive at best.

SECTION 4 – DISCUSSION & CONCLUSION

In Canada, as is elsewhere in other immigrant-receiving countries such as the US (Cunningham, Ruben, & Narayan, 2008), there is a diversity of health status among immigrants. Though we found much evidence in many studies for both the presence and the vanishing (with increased duration of residence) of the healthy immigrant effect, our review uncovered substantial heterogeneity in immigrant’s health relative to the Canadian-born population. For instance, during the perinatal period, there was a tendency for immigrant mothers to have worse mental health and more SGA babies than Canadian-born mothers. Furthermore, there was also no clear pattern of a health advantage for immigrants during childhood/adolescence and late life. As argued above, it is possible that selection may be less relevant for the very young and very old, and of course we should thus not expect the presence of a healthy immigrant effect for these groups if that is the case. In contrast, there was a clearer health advantage for adult health, especially with regards to mental health, disability/functional limitations, risk behaviors, and chronic conditions. Immigrants also exhibited a strong and systematic survival advantage over the Canadian-born population.

4.1 Future Research

Our review raised many questions that ought to be addressed in future research if we are to better understand the healthy immigrant effect in Canada. First, the studies we reviewed did not take into account potentially important premigration experiences. Yet, migration itself represents an on-going “natural experiment” in which individuals are transplanted from a specific environment with its

own set of risk and protective factors to a sometimes quite different context with alternative risks and conditions. Whether and how immigrants are able to adapt to their new environment has implications for their physiology as well as mental health. Additionally, premigration conditions, such as exposure to famines or diseases in early childhood in the sending country may have enduring effects on migrants' health even after they have uprooted and settled in a new country (see Gagnon and Mazan (2009) and Gagnon (2012) for review of early-in-life origins of adult mortality and the role of mid-life migration as a potential modifier of this relationship). The main challenge to integrating premigration factors in studies of immigrant health will undoubtedly be data availability. To our knowledge, none of the nationally representative surveys or administrative databases commonly used to assess immigrant health in Canada contains information on immigrants' premigration experiences and environmental exposures. Yet, simple measurements tracing early life conditions such as the business cycle or the infant mortality rate during the year of birth in the country of origin could be easily derived and tested in existing longitudinal surveys.

Second, the studies we reviewed did not assess the association between interpersonal and/or institutional discrimination and immigrants' post-migration health. In Canada, 60% of the visible minority population is foreign-born (Statistics Canada, 2013) and one in five visible minorities experience discrimination or unfair treatment because of their ethnocultural background (Statistics Canada, 2003). These statistics underscore the potential importance of discrimination in processes of migrant's health status and deterioration over time. Indeed, qualitative research suggests that discrimination is negatively associated with poor health among immigrants in Canada (Edge & Newbold, 2013; Noh, Kaspar, & Wickrama, 2007). The inclusion of discrimination as a covariate in population-based quantitative research may illuminate some of the country/region of origin differences in morbidity and mortality that we observed in the various studies reviewed. Recent data developments (e.g., the 2013 Canadian Community Health Survey, rapid release module on discrimination) will undoubtedly open up new opportunities to explore the link between discrimination and immigrant health (Statistics Canada, 2014b).

Finally, if we are to seriously apply a life-course approach to the study of immigrant health then longitudinal analyses which follow individuals over time must be employed. Some studies (e.g., Newbold, 2009; Setia et al., 2011b), not included in our systematic review, use the Longitudinal Study of Immigrants to Canada (LSIC) to assess immigrants' health during the first six years of settlement. But since the LSIC has a follow-up of only six years and does not include a Canadian-born comparison sample, it is difficult to ascertain whether and how immigrants' health trajectories differ from those of native-born Canadians over the long run. Unfortunately, now that the NPHS is no longer in operation, we know of no future data developments, government-sponsored or otherwise, that would produce nationally representative longitudinal health data that can be used to assess immigrant's post-migration health trajectories.

4.2 Conclusion

Canada's immigration admissions policy culls for individuals with high human capital (Knowles, 2007). Given the strong links between human capital and health (Jasso et al., 2004) and previous research which suggested the presence of a seemingly universal foreign-born health advantage among Canada's migrant population, we expected to see the healthy immigrant effect across the life-course and for multiple health outcomes. What we found instead was a pattern much more complex than previously envisioned. Our review uncovered a clear survival advantage for immigrants, owing in part to positive self and state selection processes (at least for non-refugee migrants). However, there is greater

variation in the healthy immigrant effect for morbidity. Moreover, viewed through the lens of different life-course stages, we uncovered a strong foreign-born health advantage in adulthood but less so during the perinatal period, childhood/adolescence, and late life. But even during adulthood when the healthy immigrant effect appears to be most effective, some discrepancies still remain between different immigrant subgroups depending on the type of health measure used (e.g., greater variation for self-rated health but less variation for mental health, disability/functional limitations, risk behaviors, and chronic conditions).

Nonetheless, since Canada's immigrant population is comprised mostly of core working age adults, with a median age of 47.4 in 2011 (Statistics Canada, 2013), it remains the case that the healthy immigrant effect characterizes the majority of contemporary immigrants. However, as the age composition of immigrants in Canada changes over time—due to aging and possible changes in migration patterns that increase the proportion of family-sponsored migrants—younger and older immigrants may come to comprise a greater share of the foreign-born population. This means that in future, researchers, practitioners and policymakers will need to pay greater attention to the heterogeneity of the healthy immigrant effect across different stages of the life-course and different health outcomes in order to more effectively target public health interventions and facilitate immigrants' successful integration in Canadian society.

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Table 1. Characteristics of eligible studies (N=75)

Study Characteristics	N	%
Publication period		
1980-1989	1	1.3
1990-1999	8	10.7
2000-2009	26	34.7
2010-2014	40	53.3
Data sources		
Population-based data registers	24	32.0
Population-based surveys	37	49.3
Other ¹	14	18.7
Geographic coverage of study		
National	50	66.7
Provincial	9	12.0
Sub-provincial	16	21.3
Definition of immigrant used ²		
Nativity status	72	---
Country/region of birth	24	---
Duration (years) of residence in Canada ³	25	---
Other ⁴	13	---
Health outcome per life-course stage ⁵		
Perinatal health	21	---
Childhood & adolescent health	7	---
Adult health	34	---
Older adult health	6	---
Mortality	12	---

¹Other data sources included primary data (or administrative data in combination with supplemental primary data) collected by the authors.

²Counts do not add up to total because some studies combined multiple definitions and therefore were counted more than once.

³Duration is defined by the number of years that an immigrant has lived in Canada.

⁴Other definitions included race/ethnicity and generation status.

⁵Counts do not add up to total because some studies included multiple health indicators or multiple sub-populations (e.g., both infants and mothers or both older and younger adults) and therefore were counted more than once.

Table 2. Infant health indicators examined (N=11)

Health Indicator	No. studies ¹	COMPARISON OF INFANTS OF FOREIGN-BORN VS NATIVE-BORN MOTHERS			
		Worse	Better	Similar	Mixed
Preterm birth (PTB) ²	8	✓ ^u		✓ ^u ✓ ^u ✓ ^u ✓	✓ ^(w/s) ✓ ^(b/s) ✓ ^(w/s)
Low birthweight (LBW) ³	3	✓			✓ ^(w/b/s) ✓ ^(w/s)
Small-for-gestational age (SGA) ⁴	4	✓✓ ^u ✓ ^u			✓ ^(w/b/s)
Other ⁵	1	✓			

Notes. Unless otherwise indicated, comparisons are based on adjusted estimates.

^uComparison based on unadjusted estimates.

^wImmigrant subgroup has worse health than the Canadian-born population.

^bImmigrant subgroup has better health than the Canadian-born population.

^sImmigrant subgroup has similar health as the Canadian-born population.

¹Number of studies do not add up to total because some studies examined more than one health outcome and therefore were counted more than once.

²Infant born less than 37 weeks completed gestation.

³Infant weighed less than 2500 grams at birth.

⁴Infant birthweight less than the 10th percentile of the sex- and gestational age-specific Canadian birthweight distribution.

⁵Other infant health conditions include safety, feeding, general health, vitamin D, immunization, inadequate clothing, among other things.

Table 3. Maternal health indicators examined (N=10)

Health Indicator	No. studies ¹	COMPARISON OF FOREIGN-BORN VS NATIVE-BORN MOTHERS			
		Worse	Better	Similar	Mixed
Self-reported health	1	✓ ^u			
Mental health ²	8	✓ ^u ✓ ^u ✓ ^u ✓ ^u		✓✓	✓ ^(w/s)
Other ³	4	✓		✓	✓ ^(b/s) ✓ ^(b/s)

Notes. Unless otherwise indicated, comparisons are based on adjusted estimates.

^uComparison based on unadjusted estimates.

^wImmigrant subgroup has worse health than the Canadian-born population.

^bImmigrant subgroup has better health than the Canadian-born population.

^sImmigrant subgroup has similar health as the Canadian-born population.

¹Number of studies do not add up to total because some studies examined more than one health outcome and therefore were counted more than once.

²Antepartum and postpartum depression.

³Includes postpartum problems (e.g., pain, bleeding, breast care, high blood pressure, infection, and poor psychosocial and general health), gestational weight gain, illness during pregnancy, hospitalisation during pregnancy, smoking cigarettes daily before pregnancy, weekly alcohol consumption before pregnancy, and BMI.

Table 4. Child and adolescent health indicators examined (N=7)

Health Indicator	No. studies ¹	COMPARISON OF FOREIGN-BORN VS NATIVE-BORN CHILDREN/ADOLESCENTS			
		Worse	Better	Similar	Mixed
Asthma	1				✓ ^u (b/s)¥
Mental health ²	3	✓ ⁽ⁱ⁾	✓ ^u (i, ii)		✓ ^(b/s) ¶
Overweight and obesity	2		✓ ^(i, ii)		✓ ^(w/s) †
Other ³	4	✓ ⁽ⁱⁱⁱ⁾	✓ ⁽ⁱ⁾ ✓ ⁽ⁱ⁾	✓ ⁽ⁱ⁾	

Notes. Unless otherwise indicated, comparisons are based on adjusted estimates.

^uComparison based on unadjusted estimates.

^wImmigrant subgroup has worse health than the Canadian-born population.

^bImmigrant subgroup has better health than the Canadian-born population.

^sImmigrant subgroup has similar health as the Canadian-born population.

ⁱFirst generation vs. second generation.

ⁱⁱFirst generation vs. third generation.

ⁱⁱⁱForeign-born vs. Canadian-born; the Canadian-born population was not differentiated by generation status.

¹Number of studies do not add up to total because some studies examined more than one health outcome and therefore were counted more than once.

²Includes psychological distress, emotional/behavioral problems, and internalizing/externalizing symptoms.

³Includes risk behaviors (alcohol consumption, illicit drug use, delinquency) and nutrition.

¥Lower prevalence of asthma for first generation Chinese than Canadian-born non-Chinese. Similar asthma rates between first generation and Canadian-born Chinese.

Table 4, continued. Child and adolescent health indicators examined (N=7)

[¶]First generation children from middle-income countries had lower internalizing symptoms than third generation children. All other first generation immigrant subgroups were no different from third generation children in terms of internalizing symptoms. Generation status differences were not statistically significant for externalizing symptoms.

[†]First generation youth had higher BMI than third generation youth during adolescence (12-17 years old), but no statistically significant generational status differences in BMI during childhood (6-11 years old).

Table 5. Adult health indicators examined (N=34)

Health Outcome	No. studies ²	COMPARISON OF FOREIGN-BORN VS NATIVE-BORN ADULTS (18-64) ¹			
		Worse	Better	Similar	Mixed
Chronic conditions (at least one) ³	9		✓✓✓✓✓ ^u	✓✓ ^u	✓(b/s) ✓(b/s)
<i>Arthritis</i>	2	✓ ^u		✓	
<i>Asthma</i>	3		✓✓✓ ^u		
<i>Cancer</i>	3		✓✓✓		
<i>Cardiovascular/hypertension</i>	3		✓✓ ^u	✓	
<i>Diabetes</i>	3	✓✓ ^u		✓	
<i>Overweight/obesity</i>	4		✓	✓	✓(b/w) ✓(w/s)
Disability ⁴ /Functional limitations ⁵	10	✓ ^u	✓✓	✓✓✓ ^u	✓(b/s) ✓(b/s) ✓(b/s) ✓(w/b)
Mental health ⁶	10	✓	✓✓✓✓✓ ^u ✓ ^u	✓	✓(b/s) ✓(b/s) ✓(b/s)
Risk behaviors ⁷	4		✓		✓(b/s) ✓(b/s) ✓(b/s)
Self-rated health ³	16	✓✓ ^u ✓ ^u	✓	✓✓✓	✓(b/s) ✓(w/b/s) ✓(w/s) ✓(w/s) ✓(w/b) ✓(w/b)

Notes. Unless otherwise indicated, comparisons are based on adjusted estimates.

Table 5, continued. Adult health indicators examined (N=34)

^uComparison based on unadjusted estimates.

^wImmigrant subgroup has worse health than the Canadian-born population.

^bImmigrant subgroup has better health than the Canadian-born population.

^sImmigrant subgroup has similar health as the Canadian-born population.

¹The study population for some studies extended beyond the age range of 18-64. For example, a study may have included all individuals aged 12 and older in its analysis without distinguishing between individuals under 18 and those 18 and older. We include these studies with broad age ranges in the adulthood stage because the majority of the sample is within the ages of 18-64.

²Number of studies do not add up to total because some studies examined more than one health outcome and therefore were counted more than once.

³Includes general chronic conditions such cancer, cardiovascular disease, asthma, diabetes, overweight/obesity, etc.

⁴Includes cognitive impairment.

⁵Measured with the Health Utility Index (HUI), with higher scores reflecting better health.

⁶Includes depression, anxiety and other psychosocial distress.

⁷Includes alcohol consumption and cigarette smoking.

Table 6. Older adult health indicators examined (N=6)

Health Outcome	No. studies ¹	COMPARISON OF FOREIGN-BORN VS NATIVE-BORN OLDER ADULTS (65+)			
		Worse	Better	Similar	Mixed
Self-rated health	5	✓		✓	✓ ^(w/s) ✓ ^(w/s) ✓ ^(w/s)
Disability ² /Functional ability ³	4	✓✓		✓	✓ ^(w/s)
Chronic conditions ⁴	3			✓✓	✓ ^(w/s)
Mental health	1			✓	

Notes. Unless otherwise indicated, comparisons are based on adjusted estimates.

^wImmigrant subgroup has worse health than the Canadian-born population.

^bImmigrant subgroup has better health than the Canadian-born population.

^sImmigrant subgroup has similar health as the Canadian-born population.

¹Number of studies do not add up to total because some studies examined more than one health outcome and therefore were counted more than once.

²Includes activity restrictions (i.e., need for assistance) and cognitive impairment.

³Measured with the Health Utility Index (HUI).

⁴Includes cardiovascular disease, high blood pressure, glaucoma, and stroke.

Table 7. Mortality by nativity status (N=12)

Health Outcome	No. studies	COMPARISON OF FOREIGN-BORN VS NATIVE-BORN PERSONS			
		Worse	Better	Similar	Mixed
Mortality, all-cause	9		✓✓✓✓✓ ✓✓✓✓		
Cause-specific mortality:					
Accidents, poisoning, violence	3		✓✓✓		
AIDS	1				✓ ^(w/s)
Cancer	2		✓✓		
Cardiovascular diseases	2		✓✓		
Diabetes	2		✓✓		
Infectious and parasitic diseases	1				✓ ^(w/s)
Respiratory diseases	2		✓✓		
Suicide	4		✓		✓ ^(w/b) ✓ ^(w/b)
Other ¹	1		✓		✓ ^(w/s)

Notes. Unless otherwise indicated, results shown are based on adjusted estimates for both men and women.

^wImmigrant subgroup has higher mortality than the Canadian-born population.

^bImmigrant subgroup has lower health than the Canadian-born population.

^sImmigrant subgroup has similar mortality as the Canadian-born population.

¹Includes deaths from mental disorders, nervous system or sensory disorders, circulatory disease, chronic obstructive pulmonary disease and asthma, digestive disease, genitourinary disease, motor vehicle traffic accidents, and ill-defined causes.

Table 8. Comparison of mortality by nativity status and immigrants' country/region of birth

	SMR ¹	HR ²	ASMR ³
<i>Americas & Caribbean</i>			
United States	<		< ^a , = ^b
Caribbean	<	<	
Caribbean/Central & South America			<
<i>Europe</i>			
Western Europe			<
United Kingdom		<	
Eastern Europe	<		<
<i>Middle East⁴</i>			
	<		<
<i>Africa</i>			
	<		< ^a , = ^b
<i>Asia & Pacific Region</i>			
	<		
East Asia	<		<
China		<	
South Asia	<		<
India		<	
Southeast Asia	<		
Philippines		<	<
Oceania & Pacific Islands	<		

Notes. Unless otherwise indicated, results shown are based on adjusted estimates for both men and women.

< immigrants have lower mortality than the Canadian-born population.

= mortality is similar between immigrants and the Canadian-born population.

^aDifference between immigrant and Canadian-born men.

^bDifference between immigrant and Canadian-born women.

¹Standardized mortality ratios (SMR) from DesMueles et al. (2004, 2005).

²Hazard ratios (HR) from Omariba, Ng & Vissandjee (2014).

³Age-standardized mortality rates (ASMR) from Ng (2011).

Appendix. Eligible studies included in review, by life-course stage (N=75)

Life-course stage	Eligible studies	Total eligible studies ¹
Perinatal	<p><i>Infant</i> Auger, Giraud & Daniel (2009); Auger et al. (2008a); Auger et al. (2008b); Auger et al. (2011); Auger et al. (2012); Auger et al. (2013); Gagnon et al. (2013); Moore, Daniel & Auger (2009); Shah et al. (2011); Urquia et al. (2010b); Urquia, O'Campo & Heaman (2012)</p> <p><i>Maternal health</i> Ballantyne, Benzies & Trute (2013); Gagnon et al. (2013); Ganann et al. (2012); Larouche et al. (2010); Miskurka, Goulet & Zunzunegui (2010); Miskurka, Goulet & Zunzunegui (2012a); Miskurka, Goulet & Zunzunegui (2012b); Stewart et al. (2008); Urquia, O'Campo & Heaman (2012); Van Lieshout et al. (2011)</p>	21
Childhood & adolescence	Beiser et al. (2002); Hamilton, Noh & Adlaf (2009); Maximova, O'Loughlin & Gray-Donald (2011); Montazer & Wheaton (2011); Quon, McGrath & Roy-Gagnon (2012); Vatanparast, Nisbet & Gushulak (2013); Wang et al. (2008).	7
Adulthood	Aglipay, Colman & Chen (2013); Ali (2002); Betancourt & Roberts (2010); Cairney & Ostbye (1999); Chen, Ng & Wilkins (1996); Chen, Wilkins & Ng (1996); Dealberto, Middlebro & Farrell (2011); Dunn & Dyck (2000); Gee, Kobayashi & Prus (2004); Kobayashi, Prus & Lin (2008); Laroche (2000); Luo et al. (2004); McDermott et al. (2011); McDonald & Kennedy (2004); Menezes, Georgiades & Boyle (2011); Muggah et al. (2012); Newbold (2005); Newbold (2006); Newbold & Danforth (2003); Newbold & Neligan (2012); Ng et al. (2005); Noymer & Lee (2013); Omariba & Ng (2011); Omariba & Ng (2014); Pahwa, et al. (2012); Puyat (2013); Schaffer et al. (2009); Setia et al. (2012); Siddiqi t al. (2013); So & Quan (2012); Stafford, Newbold & Ross (2011); Vissandjee et al. (2004); Wu & Schimmele (2005a); Wu & Schimmele (2005b)	34

Late life	Aglipay, Colman & Chen (2013); Gee, Kobayashi & Prus (2004); Kobayashi & Prus (2012); Newbold & Filice (2006); Prus, Tfamily & Lin (2010); Turcotte & Schellenberg (2006)	6
Mortality	Chen, Wilkins & Ng (1996); DesMeules et al. (2004); DesMeules et al. (2005); Kliewer (1991); Kliewer & Ward (1988); Ng (2011); Omariba, Ng & Vissandjee (2014); Sharma, Michalowski & Verma (1990); Trovato (1992); Trovato (1993); Trovato & Clogg (1992); Trovato & Odynak (2011)	12

¹Counts do not add up to total because some studies included multiple health indicators or multiple sub-populations (e.g., both infants and mothers or both older and younger adults) and therefore were counted more than once.