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Mood and Anxiety Disorders, Measurement, and Migrant Groups in Ontario

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A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Epidemiology and Biostatistics

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Abstract

Our objectives were to: (1) evaluate the current literature on the epidemiology of mood or anxiety disorders among migrant groups; (2) assess how current tools for measuring mood or anxiety disorders at the population level influence our understanding of the epidemiology by a) analyzing the concordance between two commonly used population measures, and b) using a Bayesian analysis to create a combined estimate using both measures; (3) estimate the prevalence and effects of potential risk factors on the prevalence of mood or anxiety disorders among first-generation migrant groups compared to the general population in Ontario. We conducted a systematic review and multiple secondary data analyses using data available from ICES to complete our objectives. Data sources included the 2012 Canadian Community Health Survey–Mental Health, in addition to health administrative data sources in Ontario. Canadian evidence suggests the prevalence of mood or anxiety disorders was consistently lower among migrant groups compared to estimates from the general population. Our findings suggest there was low concordance between survey and administrative data derived estimates of mood or anxiety disorders among migrant and non-migrant groups. Our Bayesian analysis suggests that the true prevalence of mood or anxiety disorders may lie between estimates derived from administrative and survey data. Our findings also indicate that the relationship between migration and mood or anxiety disorders is variable depending on migrant specific risk factors including migrant class and region of birth. Our work highlights the importance of contextualizing population-level data sources to accurately inform policy.

Keywords: Migration, Mood and Anxiety Disorders, Measurement, Population Surveillance, Canada.

Summary for lay audience

One in five Canadians are foreign born. Experiences prior to, during, and following migration can affect mental health. Two of the most common mental disorders are depression and anxiety disorders, which contribute to approximately three quarters of all mental health care visits in Canada. Measuring the occurrence of depression and anxiety disorders at the population level is challenging, and typically is done using data from either surveys or regularly collected health administrative data, which include information on visits to physicians, emergency departments, and to the hospital. Prior Canadian evidence suggests that migrant groups have lower amounts of depression and anxiety disorders compared to the general population, however, these findings rely on survey data. We identified a need to study this relationship using health administrative data, and to see whether people identified as having depression or anxiety in surveys were also identified in health administrative data. Our findings suggest there are large differences between survey and health administrative data. Specifically, surveys may be providing an overestimate of depression and anxiety in the population, while health administrative data may be providing an underestimate. The findings from our study of depression and anxiety among migrants, using health administrative data alone, revealed that while migrant groups had lower depression and anxiety disorders compared to the general population, this relationship was dependent on migrant specific factors including region of birth and migrant class. We found that refugee groups had the highest estimates of depression and anxiety disorders compared to other migrant groups. Our findings highlight the complexity between migration and depression and anxiety. Migrant status alone provides an incomplete picture of these relationships. We must continue to make use of the strengths of

available population level data to help unravel the complexities of these relationships. Providing detailed estimates of depression and anxiety disorders are key to help inform policy to design programs to support high risk migrant groups. Ensuring new Canadians mental health care needs are addressed is an essential component of ensuring their success in Canada and the success of the nation as a whole.

Co-Authorship Statement

All chapters of this doctoral dissertation were written by Jordan Edwards as part of the fulfilment of requirements for his Doctor of Philosophy from the Department of Epidemiology and Biostatistics. Chapters 4,5, and 6 were based on secondary data made available from ICES, which included data from the Canadian Community Health Survey – Mental Health (CCHS-MH), as well from Ontario Health Insurance Program (OHIP) billing data.

Mr. Edwards was responsible for conducting the literature review, introduction, methods, results, and discussion sections of all papers and his thesis. Mr. Edwards was responsible for conducting statistical analyses in all chapters and received support for analyses in Chapter 5 by Demetri Pananos, and Chapter 6 by ICES analyst Britney Le. Mr. Edwards's supervisory committee (Dr. Saverio Stranges, Dr. Maria Chiu) provided direction and feedback in the creation of research questions and interpretation of results. Mr. Edwards was responsible for drafting all manuscripts included in this thesis (percentage contribution was more than 85% for all four published papers), supervisory committee members and colleagues (Dr. Kelly K. Anderson, Dr. Amardeep Thind, Dr. Saverio Stranges, Dr. Maria Chiu, Demetri Pananos, Rebecca Rodrigues) were listed as co-authors in cases where they assisted in conceptualization, interpretation, data analysis, and revising manuscripts.

Dedications

This doctoral research is dedicated to:

- 1) New Canadians
- 2) Service providers, policy makers, researchers, who work to understand and improve mental health outcomes for Canada's diverse population.

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List of Abbreviations

CAD	Canadian Dollars
CCHS	Canadian Community Health Survey
CCHS-MH	Canadian Community Health Survey – Mental Health
CFI	Cultural Formulation Index
CI	Confidence Interval
DAD	Discharge Abstract Database
DALYs	Disability-adjusted life years
DSM	Diagnostic and statistical manual of mental Disorders.
HMC	Hamiltonian Monte Carlo
G7	Group of Seven
ICD	International Classification of Disease
IFHP	Interim Federal Health Program.
K6/K10	Kessler Psychological Distress Scale
MOHLTC	Ontario Ministry of Health and Long-Term Care
MOOSE	Meta-analysis of Observational Studies in Epidemiology
NACRS	National Ambulatory Care Reporting System
OHIP	Ontario Health Insurance Program
OMHRS	Ontario Mental Health Reporting System
OR	Odds Ratio
PR	Prevalence Ratio
PROSPERO	International Prospective Register of Systematic Reviews
RECORD	Reporting of studies Conducted using Observational Routinely-Collected Health Data)
RPDB	Registered Persons Database
SCID	Structured Clinical Interview
SD	Standard Deviation
TKS	Taijin Kyofusho
UK	United Kingdom
US	United States
WHO	World Health Organization
WHO-CIDI	World Mental Health -Composite International Diagnostic Interview
YLDs	Years Lived with disability.

Chapter 1: Background

1.1 Introduction

One in five Canadians are foreign born, and despite Canada's reputation as a welcoming and receptive country, migrant groups face enormous challenges, including social, environmental, and cultural stressors.⁽¹⁾ Immigrants and refugees have unique experiences that can affect their mental health, which require culturally adapted mental health services and support.^(2,3) Some of the main contributors to mental illness in migrant populations are their migration trajectories, which include experiences prior to, during, and after the migratory experience.⁽⁴⁻⁶⁾ Experiences of settlement in Canada suggest some migrant groups experience an initial period of hope and optimism, which have a positive effect on a person's well-being.⁽²⁾ However, these early periods of optimism may be followed by discouraging times, driven by unmet expectations and ongoing challenges associated with living in Canada, such as the various structural barriers and inequalities present in Canadian society.⁽⁷⁻⁹⁾

Two of the most common classes of mental disorders are mood and anxiety disorders, which are comprised of a broad spectrum of conditions with a wide range of severity, from states of anxiety and poor adjustment to more severe debilitating disorders. Compared to native-born groups, the frequency of mood and anxiety disorders is highly variable among migrant groups, and are influenced by the socio-political context, which varies across location and time.⁽⁵⁾

Multiple studies in Canada have provided estimates of mood or anxiety disorders among migrant groups.⁽¹⁰⁾ Although these estimates indicate a lower prevalence of mood or anxiety disorders among migrant groups compared to Canadian born comparison groups, they provide an incomplete view of this relationship due to an over-reliance on self-reported data.⁽¹⁰⁾ There remain many important gaps in our understanding of the relationship between migration and mood or anxiety disorders in Canada, including a lack of information on the effects of various migrant specific factors such as migrant class.

The complexity and variety of the experiences of recent migrants highlights the need to obtain accurate, context-specific, and population-based estimates of these disorders to inform service planning. Ontario is an ideal setting to conduct this research, as it is the most populous and diverse province in Canada with approximately 30% of its population being foreign born.⁽¹¹⁾ Furthermore, the province has extensive health administrative data linkages, which enable us to fill current knowledge gaps in our understanding of mood and anxiety disorders among migrant groups in Ontario.

1.2 The Epidemiology of Mood and Anxiety Disorders

1.2.1 Defining Mood and Anxiety Disorders

Mood and anxiety disorders are comprised of a broad spectrum of conditions with a wide range of severity, ranging from states of anxiety and poor adjustment to more severe debilitating disorders such as obsessive-compulsive disorder, phobic disorder, major depressive disorder, and bipolar disorder. Mood disorders are characterized by the lowering or elevation of one's mood. An example are depressive disorders, which are defined by depressed mood and diminished interest in activities. Bipolar disorders on the

other hand, are highlighted by elevated mood and increased energy that may or may not occur with depressive symptoms.⁽¹²⁾ The mental disorders under the umbrella of mood disorders include: (1) major depressive disorder; (2) dysthymic disorder; (3) bipolar disorder; (4) substance-induced mood disorder; (5) mood disorder due to a general medical condition; (6) adjustment disorder with depressed mood; and (7) other psychiatric conditions in which depression can be a primary symptom including posttraumatic stress disorder.⁽¹²⁾ Anxiety disorders are characterized by overwhelming and persistent feelings of apprehension, worry, nervousness, or fear.⁽¹³⁾ The symptoms of anxiety have been described in literature for over 400 years, and pathological anxiety, for example specific phobias, have been described for millennia.⁽¹⁴⁾ The mental disorders under the anxiety disorder class include: (1) generalized anxiety disorder; (2) obsessive compulsive disorder; (3) panic disorder with or without agoraphobia; (3) posttraumatic stress disorder; and (4) social anxiety disorder including specific phobias.⁽¹⁵⁾ The most common of these disorders include panic disorder, generalized anxiety disorder, social anxiety disorder, as well as separation anxiety, and specific phobic disorders.⁽¹⁴⁾ We have used the DSM-IV to guide our definitions of mood and anxiety disorders as it most closely aligns with the majority of available data on mental disorders in Canada.

Evidence suggests there is roughly double the presentations for mood or anxiety disorders among women compared to men, however, these differences have been falsely inflated by gender differences in help-seeking and diagnostic practices.⁽¹⁶⁾ The highest prevalence estimates are in people between the ages of 30 and 54 years, which may be due life stressors at these ages, including work-related stress.⁽¹³⁾ The prevalence estimates remain high for older adults aged 55 and older, which may result from the relationship between common mental disorders and cognitive impairments, in addition to chronic health

conditions, bereavement, and loneliness.⁽¹³⁾ Both classes of disorders can have major impacts on a person's everyday life, and can range from short episodes to a more chronic course of illness.^(13,17) Mood and anxiety disorders influence family and peer relationships, cognitive abilities, and performance at work and school.^(18,19) The impact of these disorders can result in problems at school and with family and friends, which can lead to a deterioration of social supports, and an increased risk of substance abuse.^(16,20) Mood disorders are associated with an increased risk of all-cause mortality.⁽¹⁶⁾ Risk of death is increased from an elevated risk of suicide, in addition to an elevated risk of dying from other physical conditions, including heart disease.⁽²¹⁾ Evidence from a community sample of older adults suggests that there is a 1.75-fold increase in the risk of death among people with a mood disorder compared to those without.⁽²²⁾ Mood and anxiety disorders have shown to have bi-directional relationships with many other chronic diseases, and as such, presentations for these disorders are intertwined with other conditions throughout the life course. Notable associations are the relationship between mood and anxiety disorders and the onset of asthma, heart disease, chronic back pain, and migraines.⁽¹³⁾ Furthermore, evidence from Canada suggests that living with a chronic condition leads to double the risk of developing major depression.⁽²³⁾ Both mood and anxiety disorders respond well to treatment, particularly treatment initiated early after the onset of symptoms.⁽²⁴⁾ The combination of self-management strategies and professional care can lead to recovery and the overall improvement of a person's well-being.⁽¹⁸⁾

Mood and anxiety disorders are often studied together for numerous reasons, including a high comorbidity between these classes of disorders. Over half (50 to 60%) of people with a lifetime history of a major depressive disorder reported one or more anxiety disorders.⁽²⁵⁾

In Canada, estimates from the Canadian Community Health Survey (CCHS) suggest that

50% of people self-reporting a generalized anxiety disorder additionally self-reported a major depressive episode.^(26,27) Both classes of disorders have synergistic effects – for example, having an anxiety disorder is associated with a more persistent course of depression, and depression negatively impacts outcomes from anxiety disorders.⁽²⁸⁾ Another reason these disorders are evaluated together is the diagnostic fluidity that exists between people with either a mood or anxiety disorder. From a research perspective, it can be difficult to distinguish between the two classes using health administrative data due to the variation that exists in coding practices.⁽²⁹⁾ For example, there are distinct three-digit diagnostic codes for depression and anxiety, however, reactive depression uses the same code as anxiety. Furthermore, three-digit codes limit our ability to differentiate between type 1 and 2 bipolar disorder, which require the fourth and fifth digit in the diagnostic code. The vast majority of bipolar disorders identified in administrative data will be bipolar 1, which is characterized by the presence of at least one manic episode. A diagnosis of bipolar 2 is provided when there is evidence of an elevated mood that is not a manic episode. Although this level of detail is provided in hospital discharge data, most cases of mood or anxiety disorders will not lead to admission into hospital settings.⁽²⁹⁾ Some research has attempted to classify these disorders by making use of pharmaceutical data, however, prescription patterns are typically not specific to single conditions, and there is much overlap between the pharmaceuticals prescribed for both mood and anxiety disorders.⁽³⁰⁾ More recently, researchers have argued that mood and anxiety disorders should be combined together in an overarching class of emotional disorders.⁽³¹⁾

1.2.2 Service use for mood and anxiety disorders

Common mental disorders, mood and anxiety disorders, are illnesses largely identified, diagnosed, and managed in primary care settings.^(14,16) Evidence suggests that

approximately 90% of people with mental health problems are managed exclusively in primary care.⁽¹⁶⁾ Presentations often are a mix of symptoms of depression and anxiety concurrently. Roughly half of people presenting with depression will have repeated episodes, and both mood and anxiety disorders are characterized as long-term mental illnesses requiring repeated contact with the health care system.⁽¹⁶⁾ More severe mood and anxiety disorders, for example bipolar disorders, are often referred to psychiatric specialist care, and depending on severity, these people may be admitted to a psychiatric hospital.⁽¹⁶⁾ Common mental disorders do present to emergency departments, and over the past two decades evidence from developed countries suggests up to a 40% increase in the use of acute care for mental health services.⁽³²⁾ Evidence from Australia suggests that a third of mental health presentations to the emergency department were for mood or anxiety disorders, which resulted in 0.76% of all presentations during the one-year period.⁽³³⁾

1.2.3 Diagnostic Challenges

Diagnosing mood or anxiety disorders can be a challenge for many clinicians, as people rarely present with symptoms that can easily be placed into diagnostic categories.⁽¹⁶⁾ Furthermore, there are many people who will present with only somatic symptoms, which are physical symptoms as an expression of psychological distress.⁽¹⁶⁾ Clinicians are often tasked with differentiating between the presence of somatic symptoms and co-morbid physical conditions. Evidence suggests that a third of somatic symptoms are medically unexplained.⁽³⁴⁾ When clinicians identify somatic symptoms, they are further required to assign these symptoms to a given class of mental disorder, which can further blur the lines between diagnoses assigned to mood disorders and diagnoses assigned to anxiety disorders. Furthermore, cultural differences can lead to variation in presentations of mood

and anxiety disorders.⁽³⁵⁾ Specifically, variation in somatic symptoms among various cultural groups can be challenging for clinicians to interpret and link to mood or anxiety disorders.⁽³⁵⁾

There are a number of patient and clinician factors that are associated with a person receiving a diagnosis of a mood or anxiety disorder in a primary care setting. People presenting with milder symptoms or somatic symptoms are less likely to receive a diagnosis, whereas people who have a history of psychiatric illness with many contacts with primary care settings are more likely to receive a diagnosis.⁽¹⁶⁾ Furthermore, clinician attitudes towards mental health play a role in diagnostic practices. Stigma in health care settings has a bi-directional impact on the likelihood of receiving a mental health diagnosis, as anticipated stigma from healthcare providers can limit help-seeking behaviours, and lead to less effective treatment from providers.⁽³⁶⁾

1.3 Mood and Anxiety Disorders in Canada

Between 1996 and 2010, an estimated 10% of the Canadian population used health services for mood or anxiety disorders each year, contributing to approximately three-quarters of all mental health service use in Canada.⁽¹³⁾ Estimates over this time period were stable, with the highest prevalence of service use among people aged 30 to 54 years, followed by people over the age of 55 years. The largest increase in prevalence throughout this period was among children and adolescents aged 5 to 14 years. In all age groups, except for the ages of 5 to 9 years, females had a higher prevalence of mood and anxiety disorders than males.⁽¹³⁾

Despite the notion that mood and anxiety disorders are commonly mild disorders, there is evidence that they contribute significantly to morbidity and mortality.⁽²⁾ In 2016, depressive disorders and anxiety disorders were the 6th and 7th leading contributors to years lived with disability (YLDs) in Canada.⁽³⁷⁾ Furthermore, depressive disorders alone were among the top ten contributors to death and disability in Canada, as assessed using disability-adjusted life years (DALYs). These disorders have a major economic impact – among the 3 million Canadians who have a mood and or anxiety disorder, 35% reported ever having stopped work due to their illness.⁽²⁹⁾ In 2008, the estimated cost of hospital care, physician visits, and pharmaceutical costs associated with mood and anxiety disorders was \$4.5 billion Canadian dollars (CAD).⁽³⁸⁾

1.4 Migration & Mental Health

The United Nations defines migrants as people residing in a foreign country, irrespective of the motivation and the means used to migrate.⁽³⁹⁾ The process of migration – that is, moving between cultural settings permanently or for an extended period of time – is driven by both push and pull factors, including economic, political, educational, and family influences.⁽⁴⁰⁾

As discussed in our editorial “Migrant mental health, Hickam’s dictum, and the dangers of oversimplification” published in the *International Journal of Public Health* (Appendix 1), there has been an increase in the recognition of the public health relevance of mental disorders among migrant groups. One example is the current crisis in Europe, where migrants fleeing conflict ridden countries are presenting with acute mental health care needs to new host countries.⁽⁴¹⁾ Although barriers to access mental health services have decreased, there remain many challenges in addressing migrant mental health care

needs.⁽⁴²⁾ Some of the challenges related to mental health help-seeking and health care utilization among migrants stem from cultural differences, language, discriminatory practices, medical care coverage, and health care costs.^(43–45) These challenges are present in high-income countries and are compounded in low- and middle-income countries where mental health professionals are less available, and there is less investment and availability of mental health services overall.⁽⁴⁶⁾ Evidence suggests that while mental health promotion initiatives have increased, there remains a division between policy and practice for migrant mental health.⁽⁴⁷⁾ To improve mental health outcomes for migrant groups there is a need to increase the communication between policy-makers, researchers, and clinicians.⁽⁴⁷⁾

1.4.1 Migration in Canada

Migration is one of the most distinguishing features of Canada's history. Migration has changed Canada over the past century and has affected Canadian society. Currently, there are approximately a quarter of a million new arriving migrants in Canada annually, and recent trends indicate that international migration to Canada will continue to be a defining demographic feature of Canada's population and society.⁽⁴⁸⁾ In the future, Canada's population will become more diverse, encompassing a wider range of migrant categories, which will build transnational migrant communities.⁽⁴⁸⁾

Migrants in Canada are grouped into three overarching categories: economic migrants, family class migrants, and refugees. A description of these groups can be found in Table 1.1. Divided into seven sub-categories, economic migrant groups are the most populous migrant group, comprising 58% of all migrants arriving in Canada in 2018.⁽¹⁾ Economic

migrant groups are subject to a human capital model of immigration, whereby points are awarded to applicants based on a variety of skills and attributes.^(49,50) Canada's system traditionally favours people who are young, educated, and proficient in English or French.⁽⁴⁹⁾ Family class migrants, who are sponsored by family members living in Canada, are the second most populous migrant class, comprising 26.5% of all migrants coming to Canada. Finally, refugee groups – typically people unable to return to their host country due to the threat of persecution or personal harm – made up 15.4% of all migrants in 2018.⁽¹⁾ All migrants arriving to Canada are subject to a pre-arrival medical exam, although only a fraction of people (~0.001%) are denied entry into Canada on the basis of their health status.⁽⁵¹⁾

Recent Canadian migration trends suggest that the proportion of economic migrants has decreased, and both family class and refugee migrant groups have increased. In part, this may be due to the increased use of specific migration programs, created in response to global migratory crises, such as the Syrian refugee crisis.⁽⁵²⁾ As an example, the blended sponsorship refugee program increased from 810 migrants in 2015 to 4,440 migrants in 2016.⁽¹⁾ The top five countries of origin for refugees to Canada between the years of 2006 and 2015 were Mexico, China, Columbia, Hungary, and Haiti, followed by the US.⁽¹⁾ The gender distribution of migrants in Canada is relatively equal for men and women, and most migrants are between the ages of 25 and 39 years.

Another recent change in Canada is an increased use of detention facilities for asylum seekers. Since December 2012, higher numbers of asylum seekers have been kept in detention facilities for a variety of reasons, including a lack of identification documents.⁽⁵³⁾

An average of 7,250 claimants are kept in detention annually, for an average duration of 19.5 days.⁽⁵⁴⁾

Ontario receives the highest proportion of migrants of any province in Canada, with 37.5% in 2016. Migration trends in Ontario mirror those in other parts of Canada. In 2016, there was an influx of refugees (28.6%), up from 12.4% in 2015.⁽¹⁾ Between the years of 2000 and 2015, the top five countries contributing migrants landing in Ontario were India (16.4%), China (13%), Philippines (7.7%), Pakistan (7.3%) and Iran (3.6%).

1.4.2 Characteristics of recently arrived migrants in Canada

An analysis of 2011 census data provides some information about the socio-demographic characteristics of migrant groups in Canada.⁽⁴⁸⁾ Recently arrived (<5years) migrants have an average age of arrival of 28 years, and approximately three quarters of recently arrived migrants are married or cohabiting. The vast majority of recent migrants reside in rental housing, with approximately one-third owning their house, compared to roughly two-thirds of non-migrant groups – these differences in home ownership even out following two decades of residence in Canada. Income of recently arrived migrant families is much lower than non-migrants, with more families below the Statistic's Canada low-income cut-off, compared to non-migrant groups. Many recent migrants settled in large cities, with a specific density of new migrant groups living in Canada's most populous cities – Toronto, Montreal, and Vancouver – which together receive approximately 40% of all new migrants. Approximately 90% of recently arrived migrants reported knowledge of English, French, or both. Compared to non-migrant groups, where nearly all (~99%) speak either English or French at home, 32% of recently arrived migrants spoke neither of these

languages at home. Approximately 13% of recent migrants reported speaking other European languages including Spanish, Italian, Portuguese, and Polish, while 6% reported speaking Arabic, 17% reported speaking South Asian languages including Punjabi, 25% reported speaking East Asian languages including Mandarin, and 7% reported that they speak some other language at home.

1.5 Migration and Mood and Anxiety Disorders

The relationship between migrant status and mood and anxiety disorders is complex and dependent on pre-migration, migration, and post-migration related factors. Interestingly, while migration is a global phenomenon, there are geographical trends in the prevalence of mood and anxiety disorders among migrant groups, compared to the native-born populations. Generally, evidence outside of North America suggests that first-generation migrant status is associated with an elevated risk of both anxiety and depressive disorders.^(42,55,56) International evidence also suggests that factors surrounding migration can negatively impact mental well-being, which is defined as a person's ability to develop their potential, work productively and creatively, build strong and positive relationships with others, and contribute to their community.^(57,58) Research from North America (both Canada and the United States) suggests the opposite trend, where migrant groups have lower estimates of mood and anxiety disorders compared to the native population.^(4,13)

1.5.1 Migration and Mood and Anxiety Disorders in Canada

Important to the contextualization of mood and anxiety disorders in Canada is understanding factors associated with mood and anxiety disorders among migrant groups. Research from Canada suggest there are currently a number of gaps that exist in our evaluation of factors relevant to migrant mental health. Table 1.2 describes factors related

to mood and anxiety disorders among migrant groups in Canada that have previously been assessed and those that have not yet been studied. These are grouped into pre-migration, migration, and post-migration related factors. In Canadian settings we are limited in the pre-migration factors we are able to evaluate, due to limitations in availability of data.

Evidence suggests that women and people arriving at an earlier age are at an elevated risk of a mood or anxiety disorder.⁽⁵⁹⁻⁶²⁾ Gaps in pre-migratory factors include evaluation of the relationship between country of origin, education, voluntary/forced migration, family history, and previous trauma of mood and anxiety disorders. We are also limited in our ability to assess the impact of migratory experiences including solo/group migration, exposure to violence, and child separation. A number of these factors can be evaluated using available Canadian data.

The vast majority of Canadian research has concentrated on the relationship between post-migration factors and mood and anxiety disorders, though gaps persist. Evidence suggests that employment, income, education, language skills, marital status, and migrant concentration are associated with lower prevalence of mood or anxiety disorders, whereas time spent in Canada and neighborhood disadvantage is associated with increased prevalence of mood or anxiety disorder.^(59-61,63-68) Research investigating mood and anxiety disorders among first- and second-generation South Asian populations suggests that first-generation migrants had a similar prevalence of depression and a higher prevalence of anxiety disorders.⁽⁶⁹⁾ There were differences in the factors related to higher prevalence of mood or anxiety disorders between groups. Generational status may be an important factor in mood or anxiety disorders among migrant groups, though other Canadian evidence on this topic is limited. Furthermore, Canadian researchers have not assessed factors related to housing, access to healthcare, racism/discrimination, and migrant class on the prevalence

of mood and anxiety disorders. Many of these factors have been assessed in other settings and have shown to have significant relationships with mood and anxiety disorders. As an example, compared to Dutch nationals, migrants in the Netherlands had an elevated risk of depression which varied by country of origin and generational status.⁽⁷⁰⁾ Also, evidence from France suggests that in certain settings there may be an increased risk of depression that persists through to the third generation migrant groups, compared to non-migrant groups.⁽⁷¹⁾ Migratory and social trajectories is another concept where there exists limited research in Canadian settings. Specifically, the influence of downward social mobility in the transfer from country of origin to host country.⁽⁴²⁾ As an example, it may be important to explore differences in prior education with current income, and neighborhood income.

Important concepts to consider when researching migrant health are selective migration and the healthy immigrant effect. Positive migrant selection, a form of selective migration, occurs when migrants are selected based on skills and education.⁽⁷²⁾ Canadian immigration policies result in an influx of healthier migrants compared to the general population.⁽⁷³⁾ This concept applies primarily to economic class migrants.⁽⁷⁴⁾ The healthy immigrant effect is a phenomenon where migrant groups are shown to be healthier during the early years post-migration, and then their health status worsens to more closely resemble that of the host country.⁽⁴⁾ This effect may be lessened by the existence of large immigrant communities in host countries having a protective effect against mental distress by facilitating social integration and minimizing social adversity.⁽⁷⁵⁾ Evidence suggests that the healthy immigrant effect may not hold true for refugee groups, who likely have elevated pre-migratory stressors which contribute to elevated mental distress and higher reported mental illness soon after arrival.⁽⁴³⁾ Another theory for the differentiation in migrant health is the presence of “salmon bias”, which posits that migrants return to their home country through

illness, while the healthier migrants remain in the host nation.⁽⁷⁶⁾ Although this bias may be less likely to impact Canada, compared to European nations, due to geographical isolation, it may still be playing a role in the healthy migrant effect in Canadian settings.

Further compounding the impacts of mental illness on migrants is the presence of somatic comorbidities with mood and anxiety disorders. For example, evidence from Denmark suggests that migrants who have been diagnosed with posttraumatic stress disorders and depression also have a higher likelihood of somatic comorbidity, including infectious, neurological, and pulmonary diseases.⁽⁷⁷⁾ Many migrant groups face challenges prior to and during their migratory process related to violence and trauma, and as such, the course and severity of mood and anxiety disorders may differ from the host population, due to the higher likelihood of comorbid diagnoses, especially the presence of posttraumatic stress and somatoform disorders.⁽⁷⁸⁾ This is particularly important in the context of refugee groups, who are at a higher risk of pre-migration trauma. Furthermore, evidence suggests that the post-migration context may play an equally important role in mental health trajectories, as post-migration factors may moderate the ability of refugee groups to recover from prior trauma.^(42,79)

1.5.2 Cultural Considerations

A key concept to consider when evaluating mental disorders among migrant groups is culture, which is an essential component of all comprehensive assessments of mental illness. Differences in cultural practices, symptomatology, stigma, and diagnostic practices of mood and anxiety disorders around the world may influence whether people self-report or seek mental health care for a mood or anxiety disorder.^(80,81) Furthermore, the

understanding, recognition, and language surrounding mental illnesses, as well as the strategies used to manage their symptoms, can be rooted in cultural beliefs.^(82,83) For example, people's self-esteem, an important component of vulnerability or resistance to depression, is often moulded by cultural norms.⁽⁸³⁾ Furthermore, in many cultures, psychological symptoms are rationalized in spiritual or sociomoral terms, rather than being considered a health problem.⁽⁸⁴⁾

Current evidence suggests that migrant groups are less likely to seek out or be referred to mental health services, which would result in an underestimation of the frequency of these disorders.^(43,85,86) Furthermore, there are known challenges with assigning clinical diagnoses for some ethnic minority groups.⁽⁸⁷⁾ For years, cultural psychiatrists have criticized the ethnocentrism and Westernization of the Diagnostic and Statistical Manual of Mental Disorders (DSM) and its focus on the individual, which ignores contributions of the social and cultural determinants of health.⁽⁸⁷⁻⁸⁹⁾ For many disorders, cross-cultural similarity cannot be assumed.⁽⁸⁷⁾ Consequently, it has been suggested that the minimal set of cultural variables that should be explored during initial clinical evaluations are language, religion, gender, sexual orientation, traditions and beliefs, migration history, and level of acculturation.⁽⁸⁸⁾ In Canada, research suggests that conducting transcultural, trauma-informed, and reflexive practices are a pathway to improve the health care experience of migrants.⁽⁹⁰⁾ It is important to note that included in the DSM-5 there is a Cultural Formulation Interview (CFI), which is designed to help address cross-cultural issues of diagnoses.^(91,92) Unfortunately, evidence suggests that this tool is used inconsistently across encounters.^(91,92)

1.5.3 Mental Health Care in Ontario for Migrants

Among migrants with permanent residency status, access to publicly funded healthcare varies by migrant class.⁽⁹³⁾ Economic and family class migrants have a 3-month waiting period prior to having the ability to access public funded health care through the Ontario Health Insurance Plan (OHIP). OHIP covers the vast majority of the population of Ontario (>96%), and provides care for all health care services from physicians, however does not include prescription drugs outside of the hospital, dental services, or private mental health care, including visits to psychologists.⁽⁹⁴⁾ Government assisted and privately sponsored refugees receive health care coverage immediately upon arrival until they qualify for OHIP coverage through the Interim Federal Health Program (IFHP).⁽⁹⁵⁾ The IFHP was developed to provide a basic level of health care coverage as well as supplemental and prescription drug coverage, which continues throughout the period of time refugee groups receive income assistance from the government.⁽⁹⁶⁾ Refugees who have landed in Canada are eligible to receive IFHP coverage for three months from the date an asylum claim has been accepted or until they qualify for OHIP.⁽⁹³⁾ Evidence suggests that refugees in Canada typically are delayed between six months to a year until they receive the approval of their OHIP coverage.⁽⁹⁶⁾ Furthermore, evidence from Ontario suggests that migrant youth are more likely to receive treatment for initial mental health crises from the emergency department, compared to the general population.⁽⁹⁷⁾ Taken together, this suggests that migrants may face barriers to outpatient psychiatric care in Ontario, leading to delays in treatment and potentially worse long-term outcomes.⁽⁹⁷⁾

1.6 Need for Research

When exploring mental health among migrant groups, there is a need for contextualization to inform policy-decision makers of the heterogeneity that exists within migrant groups.⁽⁴⁷⁾

As discussed in our editorial, migrant mental health is a multi-dimensional topic with many

internal and external influences (Appendix 1). As such, it is inherently a study of multiple causes. We expect that mental health outcomes will diverge for disparate migrant groups with vastly different migratory experiences. For example, evidence suggests there are many different risks and mental health trajectories for various migrant classes (economic, family, refugee), though they are largely grouped together in prior research.⁽²⁾ This variation can influence our conclusions regarding the role of migrant status as a risk or protective factor for numerous mental illnesses.⁽²⁾ Understanding the relationship between migration and mental health is dependent upon proper contextualization. These relationships demand detail that is currently limited in much of the available mental health research in various Canadian settings. This includes a gap in our understanding of the epidemiology of mood and anxiety disorders among migrant groups in Ontario. Taking a more focused approach to researching these topics will allow policy-makers to create more informed mental health care policies to better meet the needs of diverse migrant groups.

1.7 Thesis Objectives

The overarching goal of this dissertation was to provide a comprehensive examination of the epidemiology of mood and anxiety disorders among migrant groups in Ontario. This was accomplished by generating population-based prevalence estimates that further our understanding of both frequencies of mood and anxiety disorders and associated risk factors among migrant groups. Specifically, the objectives of this dissertation were to:

- 1 Evaluate the current literature on the epidemiology of mood and anxiety disorders among migrant groups in Canada.
- 2 Assess how current tools for measuring mood or anxiety disorders at the population level influence our understanding of the epidemiology by:
 - a) Estimating the concordance between two commonly used population measures of mood and anxiety disorders.
 - b) Using a Bayesian analysis to create a combined estimate of the prevalence of mood or anxiety disorders using the results of our concordance estimates and prior information on the psychometric properties of each measure.
- 3 Estimate the prevalence and effects of potential risk factors on the prevalence of mood or anxiety disorders among migrant groups compared to the general population in Ontario.

1.8 Thesis Organization

Chapter 2: This chapter is used to address objective 1: evaluating the current state of the Canadian literature on the epidemiology of mood and anxiety disorders among migrant groups in Canada. A version of this chapter is published in the *Canadian Journal of Psychiatry* (Manuscript 1).

Chapter 3: This chapter addresses objective 2a: estimating the concordance between survey and health administrative data derived mood or anxiety disorders. A version of this chapter is published in *Acta Psychiatrica Scandinavica* (Manuscript 2).

Chapter 4: This chapter addresses objective 2b: using a Bayesian analysis to estimate a combined estimate of the prevalence of mood or anxiety disorders using two common population measures and prior information on their psychometric properties. A version of this chapter has been submitted to *Epidemiology and Psychiatric Sciences* (Manuscript 3).

Chapter 5: This chapter addresses objective 3: estimating the prevalence of mood or anxiety disorders among migrant groups compared to the general population in Ontario. A version of this chapter will be submitted to the *Journal of Affective Disorders* (Manuscript 4).

Chapter 6: This chapter provides an amalgamated discussion, conclusion, and future direction section.

Appendices: This section includes supplemental materials, and data sharing agreements.

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Table 1.1: Description of migrant classes in Canada.

<i>Migrant Class</i>	<i>Descriptions⁽¹⁾</i>	<i>Proportion of Migrants⁽¹⁾</i>
<i>Economic</i>	Economic migrant groups are subdivided into seven sub-categories, which include Quebec skilled worker class, federal skilled trades, and the federal skilled worker program, the provincial nominee class, and the Canadian experience class. Applying for economic migrant status in Canada is done online by submitting a profile, under one of three federal Canada immigration programs or a provincial immigration program. People with the highest rankings are invited for application for permanent residency. People with a high net worth can also apply for residency for specific residency programs, for example, the immigrant investor venture capital pilot program.	58% of all migrants coming to Canada in 2018.
<i>Family Reunification</i>	These migrants are sponsored by family members in Canada. All Canadian citizens and permanent residents are able to sponsor family members to immigrant to Canada.	26.5% of all migrants coming to Canada in 2018
<i>Refugees</i>	Refugee status in Canada is determined by the Immigration and Refugee Board of Canada (IRB). Successful people are grouped into two separate categories, convention refugees: 1. convention refugees, which consist of persons unable to return to their host country due to the threat of persecution, and 2. People in need of protection, which are groups of migrants who cannot return to their host countries due to the threat of physical harm.	15.4% of all migrants coming to Canada in 2018.
<i>Other</i>	All other migrant groups, which includes migrants who were granted permanent resident status under specific programs that do not fall in one of the other migrant classes.	<1% in 2018.

Table 1.2: Potential risk and protective factors for mood and anxiety disorders among migrant groups in Canada.

Pre-Migration		Migration		Post-Migration	
Gender (Female) ^(60,61,63)	↑	Migration Process	?	Employment (Employed) ^(61,63,64)	↓
Age (Younger) ^(60,61,63)	↑	Solo/group migration	?	Income (Higher) ^(61,63,64)	↓
Country of Origin	?	Exposure to Violence	?	Education (More) ^(61,63,64)	↓
Ethnicity ⁽⁶¹⁾	~	Children Separation	?	Language Skills (More) ^(61,63,64)	↓
Education	?	Culture Shock	?	Marital status (Married) ^(61,63,64)	↓
Voluntary/Forced Migration		Cultural Bereavement	?	Years in host country (More) ^(63,65,67)	↑
Family History	?	Period of Migration	?	Migrant Concentration ^(63,65,67)	↓
Previous Trauma	?			Neighborhood Disadvantage (Greater) ^(63,65,67)	↑
-	-	-	-	Housing	?
-	-	-	-	Access to healthcare	?
-	-	-	-	Racism/ Discrimination	?
-	-	-	-	Migrant Status	?
-	-	-	-	Generation Status	?

Note: Upward arrow ↑ indicates that this factor is associated with an increase in the risk of mood or anxiety disorders among migrant groups in Canadian settings. Downward arrow ↓ indicates the opposite. A ~ indicates that this factor is associated with variable risk of mood or anxiety disorders among migrant groups. Question mark indicates a potential risk/protective factor that has not been assessed in a Canadian setting.

Chapter 2: Gaps in Understanding of the Epidemiology of Mood and Anxiety Disorders among Migrant Groups in Canada: A Systematic Review¹

2.1 Introduction

One in five Canadians are foreign born, which is the highest proportion among the seven nations with the largest economies in the world (G7).⁽¹⁾ The relationship between mental health and immigrant and refugee status is complex, and its reporting requires thorough contextualization.^(2,3) Two of the most common classes of psychiatric disorders are mood and anxiety disorders, which have a profound impact on the overall burden of mental illness in Canada.⁽⁴⁾ Mood and anxiety disorders are comprised of a broad spectrum of conditions with a wide range of severity, from states of anxiety and poor adjustment to more severe debilitating disorders such as obsessive-compulsive disorders, phobic disorders, depressive disorders, and bipolar disorder. Both classes of disorders can have major impacts on a person's everyday life and range from short episodes to a more chronic course of illness.⁽⁵⁾

Compared to native-born residents, the prevalence and incidence of mood and anxiety disorders are highly variable among migrant groups and are influenced by the socio-political context.⁽⁶⁾ Experiences prior to, during, and following migration have been shown to influence the risk of mood and anxiety disorders.^(7,8) Research from Canada and the United States (US) suggests that generation status (i.e. first- versus second-generation), age

¹ Edwards J, Hu M, Thind A, Stranges S, Chiu M, Anderson KK. Gaps in Understanding of the Epidemiology of Mood and Anxiety Disorders among Migrant Groups in Canada: A Systematic Review. *The Canadian Journal of Psychiatry*. 2019 Sep;64(9):595-606.

at migration, length of time in the new country of residence, and country of origin all influence the relationship between migrant status and mental disorders.^(6,9,10,11,12)

The prevalence and incidence of mood and anxiety disorders can impact health service planning and public health initiatives.⁽¹³⁾ Variation in observed estimates may be due to factors such as cultural differences in access to mental health care and help seeking attempts in ethnic minority populations.⁽¹⁴⁾ Furthermore, the availability and use of culturally sensitive measures of mood and anxiety disorders may also contribute to observed differences. For example, the Cultural Formulation Interview (CFI), which was designed to address cross-cultural issues with diagnoses made using the DSM-5, is readily available, however prior research suggests it is used inconsistently across encounters.^(15, 16)

Although the epidemiology of mood and anxiety disorders among migrant groups has been studied previously in Canadian settings,⁽¹⁷⁻⁴³⁾ a comprehensive synthesis of the literature does not exist. Synthesizing available estimates and assessing the state and quality of currently available Canadian evidence will strengthen our understanding of the etiology of mood and anxiety disorders among Canadian migrant groups, and will help inform health service planning to meet the mental health needs of newcomers. It is also important for highlighting gaps in the current evidence base and priorities for future research directions.

2.1.1 Objective

Our objective was to conduct a systematic review of the literature on mood and anxiety disorders among migrant groups in Canada. We specifically sought to synthesize prevalence ratios and incidence rate ratios of mood and anxiety disorders among

immigrants, refugees, and Canadian-born or long-term resident comparison groups. We further sought to explore whether these estimates varied by age, gender, length of time in Canada, age at migration, or country of origin.

Our systematic review followed the guiding principles of the Cochrane Collaboration,⁽⁴⁴⁾ and adheres to the Meta-analysis of Observational Studies in Epidemiology (MOOSE) reporting guidelines⁽⁴⁵⁾ (Appendix 2.1). The review methodology was pre-registered with the PROSPERO international prospective register of systematic reviews (CRD42018087869).

2.2 Methods

2.2.1 Search Strategy

Following consultation with a librarian, we searched the electronic databases Medline, EMBASE, Sociological Abstracts, and PsycINFO in March 2018 using controlled vocabulary and keyword variations of the following concepts: Mood, Anxiety, Immigrant, Refugee, and Canada (search strategy Appendix 2.2). We searched for studies on any mood or anxiety disorder, which included but were not limited to depression, generalized anxiety disorder, and bipolar disorders. We also conducted forward and backward citation searches of included studies.⁽¹⁸⁻⁴³⁾

We searched the grey literature in April 2018 using the electronic databases *Dissertations and Theses* and *Canadian Health Research Collection* using identical controlled vocabulary as our previous electronic search. We further searched the grey literature guided by the Grey Matters' checklist⁽⁴⁶⁾ by searching all websites listed in the checklist

under the headings of “health statistics” and “Canada” (Appendix 2.2) using the terms “mood” or “anxiety”. We did not restrict searches by date or language. When abstracts or unpublished papers were retrieved in our search, we contacted the corresponding authors to establish whether the work had been subsequently published.

2.2.2 Selection Criteria

We included studies that used population-based samples and reported the incidence or prevalence (or numerator and denominator data that enables computation) of diagnosed or self-reported mood or anxiety disorders for at least one migrant group aged 16 and over from any country (first-generation immigrant or refugee) compared to a reference group from Canada. We did not impose limits on language or date. We included relevant review articles if they presented primary data on prevalence or incidence estimates that had not been reported elsewhere. Definitions for our inclusion criteria were as follows:

- **Population:** Our population of interest were all people over the age of 16, as this age range has been previously used to describe adult psychiatric populations.⁽¹³⁾ Studies focusing on child and adolescent populations were excluded given that psychiatric presentations may differ in these age groups.⁽¹²⁾ If a study was unclear regarding included ages, we considered it to have an adequately ‘adult’ population if there was a mean age of at least 30 years.
- **Exposure:** We included any person coming to Canada from any country as any class of immigrant or refugee (i.e. economic, family class, or refugee).⁽⁴⁸⁾ We restricted our search to first-generation migrant groups, as we were interested in exploring influences of the migration process on mood and anxiety disorders.
- **Comparison:** We included studies using Canadian-born or long-term resident

comparison groups, defined by Chen et al., in 2009, which may or may not include second-generation migrant groups.⁽²³⁾ We excluded studies that specifically used a second-generation migrant reference group, as directly comparing first and second-generation migrant groups was outside of the scope of this review.

- **Outcome:** We included studies assessing any mood or anxiety disorders that used symptom-rating scales, self-reported diagnoses, or diagnoses obtained from medical records or health administrative data.
- **Study Design:** We included studies that provided estimates from any Canadian setting, whether national, provincial, or specific geographic regions. We included studies using any well-defined population. The populations must have been defined by geographic boundaries (e.g. Ontario) or by other criteria such as a membership (e.g. Blue Cross Health Insurance Plan) or occupation (e.g. research using occupational cohorts). Included studies were also required to provide denominator data for their estimates of prevalence or incidence.⁽⁵⁾

2.2.3 Study Selection and Data Extraction

The first author (JE) screened titles and abstracts from the electronic database search for studies meeting our inclusion criteria. The first author also screened the titles from the grey literature searches and conducted backward and forward citation searches. Full text articles were obtained for potentially relevant studies or where relevance was unclear. Two authors (JE & MH) independently assessed the full text articles to determine eligibility and to complete data extraction. In the case of disagreement, resolution was achieved by discussion with a third reviewer. A bibliographic list of excluded studies from full text assessment can be found in Appendix 2.3. We used a data extraction form developed a

priori (see Appendix 2.4), to record information about the methods and results of each included study. This information was partitioned into three categories:

- **Study characteristics:** author, publication year, setting, study design, study duration, data source, study population, population ethnicity, country of birth, study exclusion criteria, sampling methodology, age range, diagnostic outcomes.
- **Incidence and prevalence estimates:** sample size of migrant groups & reference groups, prevalence estimates or incidence rates, prevalence type, adjustment (if any) for confounding factors.
- **Risk factors:** other data derived from the included studies to allow for further analyses of potential variation in prevalence and incidence estimates. We extracted data on all risk factors assessed.

2.2.4 Critical Appraisal

Two independent reviewers (JE & MH) assessed the risk of bias. In the case of disagreement, resolution was achieved by including a third reviewer. We used a risk of bias tool that was developed by Kirkbride and colleagues in 2012,⁽⁴⁹⁾ which assesses study characteristics, and outcome variables based on best practice in epidemiological studies. Study quality is rated on a 7-point scale from 0 to 6. There are seven indicators of study quality that are assessed: defined catchment area, accurate denominator data, population-based case finding, standardized research diagnosis, blinding to demographic variables, inclusion criteria clearly listed, and leakage study conducted. We modified this tool by removing the last item on leakage studies, which are used to identify potential missed cases from screening procedures, as this was largely not applicable to the included

studies given that all but one used survey design, and therefore this item did not differentiate study quality.⁽⁴⁹⁾

2.2.5 Data Analysis

We summarized information on the characteristics of included studies, including study location, data sources, sample, type of migrant group, mood or anxiety disorders measured, measurement type, and risk factors assessed. We used this information to perform a narrative synthesis of the results to summarize broad themes across the available literature. We also presented unadjusted prevalence, incidence, and prevalence/incidence ratios for each of the included studies. Our forest plot was created using the *metan* package for STATA (version 13).⁽⁵⁰⁾ We made a *post-hoc* decision to not conduct a meta-analysis due to the high degree of homogeneity of the estimates and the substantial overlap in secondary data sources used to compute these estimates – as such, pooled estimates would neither increase the precision nor resolve inconsistencies in the estimates of mood and anxiety disorders among migrant groups in Canada. Finally, publication bias was explored by creating funnel plots using the *confunnel* procedure and performing Egger's test.

2.3 Results

Our search strategy identified 2725 citations – we screened 101 full text articles and 19 primary studies met the inclusion criteria (Figure 2.1).⁽¹⁸⁻⁴³⁾

2.3.1 Study Characteristics

The 19 included studies were conducted between 2002 and 2017 (Table 2.1). Nearly all studies (n=15) used data from different waves of the Canadian Community Health Survey (CCHS), which provided national estimates. Of the remaining studies, one used data from Ontario, three concentrated on British Columbia, and one was conducted in Quebec. Two studies^(23,42) used a longitudinal design, whereas the rest used a cross-sectional design. Seventeen studies collected data from any migrant group, whereas two studies focused on migrant groups with Chinese/South Asian descent.^(24,39) Most studies considered migrants as a single group, with little consideration of ethnicity, country of origin, or migrant class. Four of the included studies provided age estimates for both migrant and Canadian-born/long-term resident groups.^(26,39,42,43) Four of the included studies provided estimates for recent (less than 10 years in Canada) and long-term (more than 10 years in Canada) migrant groups.^(18,34,37,3)

Mood and anxiety disorders were measured in three ways: (i) using symptom rating scales, specifically the Composite International Diagnostic Interview (CIDI n=6; CIDI-Short Form n=7); (ii) using self-reported diagnosis (e.g. "Do you have a diagnosed anxiety disorder such as a phobia, obsessive-compulsive disorder, or panic disorder?"; n=5); and (iii) using clinical diagnoses based on ICD-9 codes from health administrative data (n=1).

The majority of included studies had low risk of bias for all criterion assessed. Five of the included studies did not provide standardized diagnostic criteria, which led to a rating of high-risk of bias (Table 2.2).

2.3.2 Overall Estimates of Mood and Anxiety Disorders

Reported prevalence estimates for mood and anxiety disorders among migrant populations ranged from 1.5% to 32.6%, with the 90th percentile of studies ranging from 1.5% to 8.2%. All of the included studies provided information to calculate prevalence ratios, and none of the included studies provided incidence data to calculate risk ratios. The prevalence ratios from included studies ranged from 0.48 to 0.87 (Figure 2.2). Finally, the symmetrical appearance of the funnel plot suggests that there is no evidence of publication bias (Appendix 2.5). The results of the Egger's test were non-significant ($p=0.295$) indicating no statistical evidence of publication bias.

2.3.3 Risk Factors for Mood and Anxiety Disorders among Migrant Groups

- **Gender and Age:** Three studies presented various adjusted and stratified prevalence ratios, taking into consideration gender and age.^(19,40,43) Estimates were consistently higher for females and for younger migrants in both unadjusted and adjusted estimates. For example, the odds ratio for women compared men, after adjusting for other socio-demographic characteristics, was 1.47 (95%CI = 1.32, 1.62) for mood disorders and 1.62 (95%CI = 1.45, 1.80) for anxiety disorders.⁽⁴³⁾
- **Employment, Income, Education, Language, Marital Status:** Three studies provided prevalence estimates among migrant groups considering risk factors of employment, income, education, and language.^(21,40,43) Employment, higher income, understanding of English or French language, and being married were each shown to be protective against mood and anxiety disorders in three studies,^(21,40,43) whereas one study did not find a protective effect for education.⁽⁴⁰⁾
- **Years in Canada, Neighbourhood Migrant Concentration, and Neighbourhood Disadvantage Factor:** Five studies provided information on the relationship between

length of time in Canada and mood and anxiety disorders among migrant groups.^(18,34,37,38,43) Two studies provided information on the relationship between neighbourhood migrant concentration, and neighborhood disadvantage factor and mood and anxiety disorders among migrant groups.^(18,43) Recent migrant groups (less than 10 years in Canada) had consistently lower estimates of mood and anxiety disorders compared to long term migrant groups (more than 10 years in Canada).^(18,34,37,38) This is reinforced in an analysis by Menezes et al., which identified a higher odds of having a mood or anxiety disorder with increasing years in Canada among all age groups, except people over the age of 60.⁽⁴³⁾ There was also evidence that an increase in neighbourhood migrant concentration had a protective effect against depression among migrants. A 10% increase in the proportion of migrant residents in a neighbourhood was associated with a 10% decrease in the odds of depression (95%CI = 0.84, 0.95).⁽⁴³⁾ Finally, a neighbourhood disadvantage factor was developed by the study investigators and was based on: (i) percent below the low income cut-off, (ii) percent rental accommodation, and (iii) percent who moved in the last year. There was evidence that higher levels of neighborhood disadvantage were associated with an increased odds of mood disorders (OR = 1.23; 95%CI = 1.17, 1.29) and anxiety disorders (OR = 1.15; 95%CI = 1.09, 1.21).

Figure 2.1: Flow chart of the search strategy and exclusion process of the systematic review evaluating mood and anxiety disorders among migrant groups in Canada.

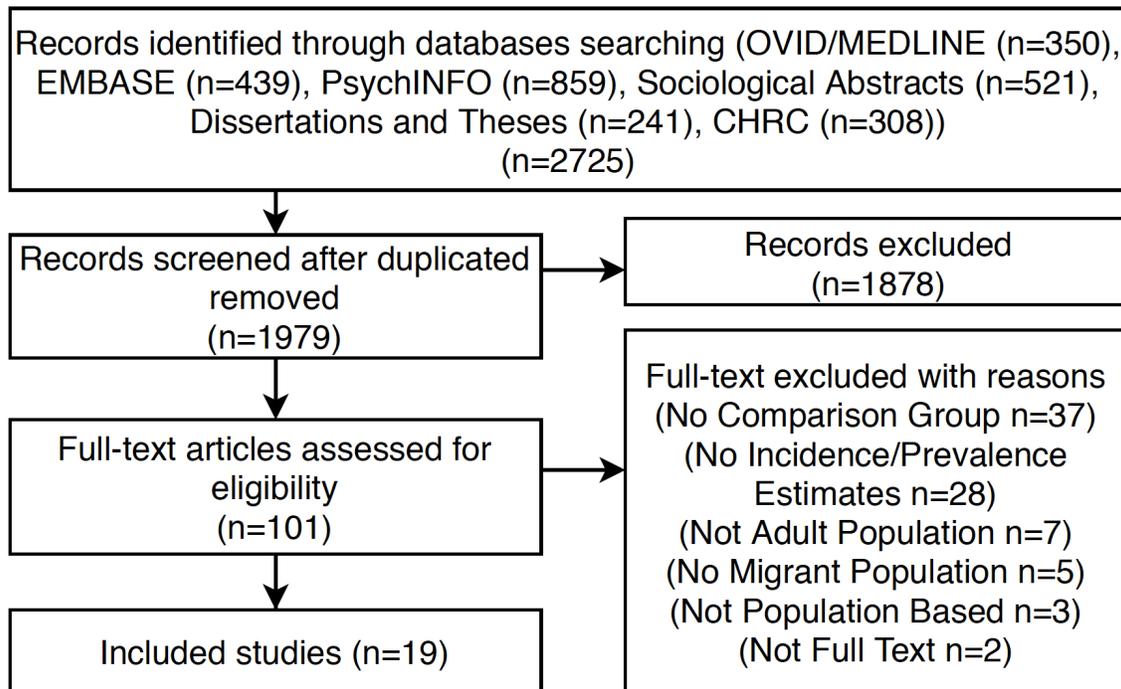


Figure 2.2: Prevalence ratios of mood and anxiety disorders among migrant groups and Canadian born/long term resident comparison groups.

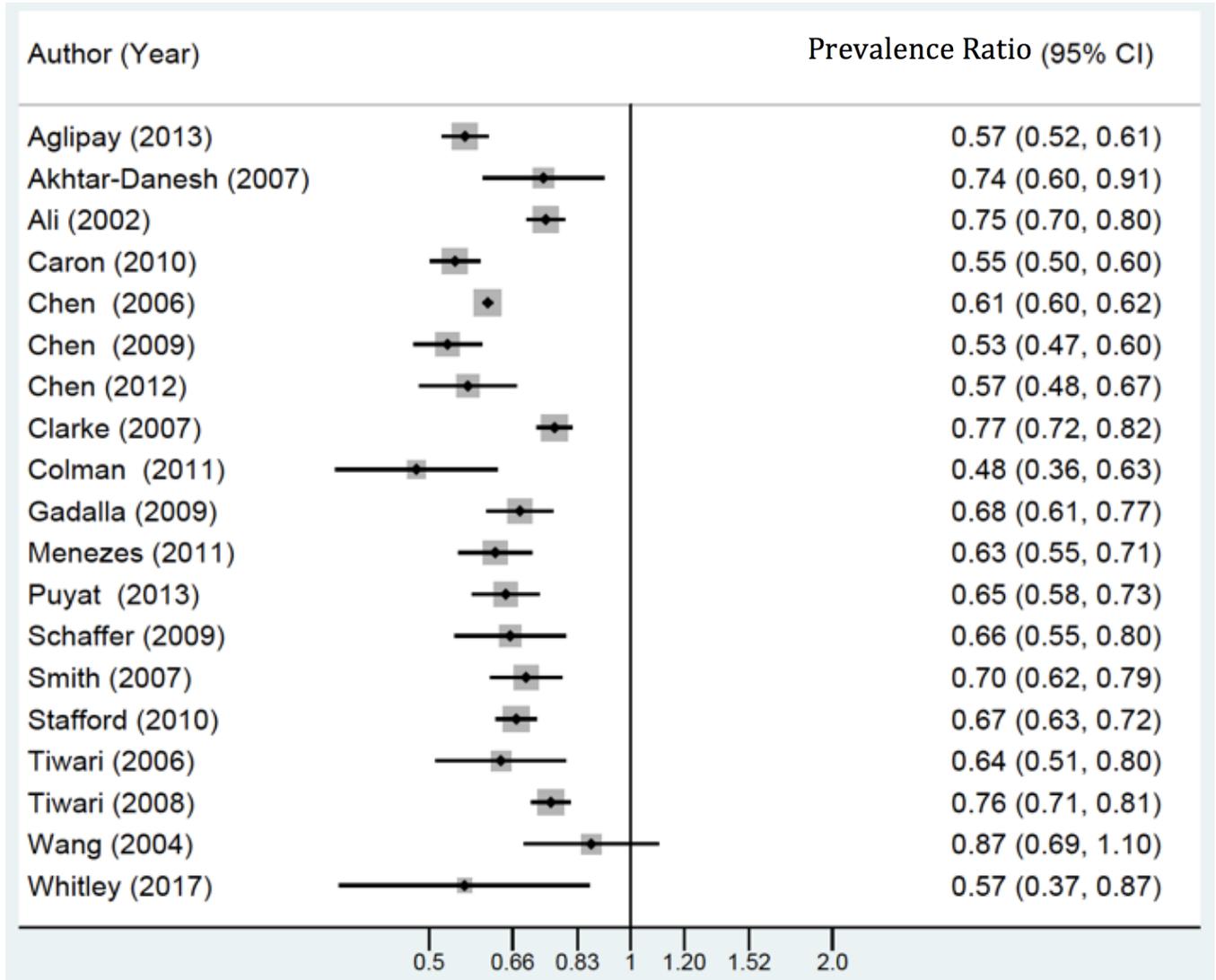


Table 2.1: Characteristics of studies included in the systematic review of mood and anxiety disorders among migrant groups in Canada (n=19).

Author	Year	Study Location	Data Source	Data Year	Age Range or mean	Gender (% Fem)	Sample of Migrants	Sample of Reference	Mood & Anxiety Disorder	Migrant Group (All=economic, family, refugee)	Measurement (SF=short form)	Prevalence Migrant	Prevalence Ratio
Aglipay	2013	Canada	CCHS 07/08	2007/2008	18+	53.2 ³	17308	99388	Any Anxiety	All	Survey	Recent 1.9 ⁵ Long 3.9 ⁶	0.29 0.61
Akhtar-Danesh	2007	Ontario	CCHS 1.2	2002	15+	54.3	2898	9417	Mood (Depression)	All	CIDI	4.0	0.74
Ali	2002	Canada	CCHS 1.1	2000/2001	15+	51 ⁶	14780	77599	Mood (Major Depression past 12 months)	All	CIDI-SF	6.2	0.75
Caron	2010	Canada	CCHS 1.2	2002	15-65	52	8192	28792	Mood or Anxiety (Major Depression, Mania, Panic Disorder, Social Phobia, Agoraphobia, Substance Dependence)	All	CIDI	6.7	0.55
Chen ¹	2009	British Columbia	Administrative Data	1992-2001	0+	48.9	148973	148973 ⁴	Anxiety or Depression	Economic/Family	ICD-9	11.7	0.61
Chen	2009	British Columbia	CCHS 1.1	2000/2001	12+	53.6	4241	13621	Mood (Depression)	All	CIDI-SF	8.1	0.61
Chen	2013	British Columbia	CCHS 07/08	2007/2008	12+	52.1	3816	12087	Any Mood Any Anxiety	All	Survey	5.1 3.3	0.57 0.51
Clarke	2007	Canada	CCHS 1.1	2000/2001	44.8	56.1	14555	46316	Mood (Depression)	All	CIDI-SF	8.2	0.77
Colman	2011	Canada	NPHS	2000/2001	43.7	44.3	1962	9531	Mood (Depression)	Economic/Family	Survey	2.7	0.48
Gadalla	2009	Canada	CCHS 2005	2005	12+	50.9	14475	94511	Any Mood Any Anxiety	All	Survey	3.2 1.6	0.82 0.57
Menezes	2011	Ontario	CCHS 1.2	2002	43.9	49	7784	27924	Any Mood Any Anxiety	All	CIDI	3.8 3.1	0.68 0.58
Puyat	2013	Canada	CCHS 2009 to 2010	2009/2010	12+	51	4670	37886	Any Mood or Any Anxiety	All	Survey	Recent 2.7 ⁵ Long 7.4 ⁶	0.28 0.78
Schaffer	2009	Canada	CCHS 1.2	2002	16+	37.2 ³	8192	28792	Mood (Bipolar)	All	CIDI	1.5	0.66
Smith	2007	Canada	CCHS 1.1	2000/2001	18+	50.8	3557	37590	Mood (Depression)	All	CIDI-SF	Recent 5.2 ⁵ Overall 7.0 ⁶	0.52 0.69
Stafford	2010	Canada	CCHS 1.1	2000/2001	12+	51	15128	92936	Mood (Depression)	All	CIDI-SF	Recent 4.2 ⁵ Long 6.5 ⁶	0.53 0.81
Tiwari ²	2006	Canada	CCHS 1.2	2002	15+	46.9 ³	1846	33399	Any Mood Any Anxiety Any Mood or Any Anxiety	All	CIDI	3.1 3.7 5.5	12M- 0.56 12M- 0.73 12M- 0.63
Tiwari	2008	Canada	CCHS 1.1	2000/2001	12+	51 ⁶	14709	108192	Mood (Major Depression past 12 months)	All	CIDI-SF	5.8	0.76
Wang	2004	Canada	NPHS 3 rd Cycle	1998/1999	12+	50.9	2270	14974	Mood (Major Depression past 12 months)	All	CIDI-SF	3.4	0.87
Whitley	2017	Montreal South-West	Survey	2007-2015	15-65	44.9 ³	441	1379	Mood (Depression) Anxiety (High Psychological Distress)	All	CIDI	5.2 32.6	0.57 0.83

Thesis

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Note: 1=Diagnosis data, 2=Chinese/South Asian, 3=Estimated, 4=long term resident group identified as migrants living in Canada for a minimum of 7 years, 5=Less than 10 years spent in Canada, 6=More than 10 years spent in Canada.

2.4 Discussion

This review provides the first comprehensive synthesis of the Canadian literature on the epidemiology of mood and anxiety disorders among migrant groups. Available evidence suggests that estimates of mood and anxiety disorders are consistently lower among migrant groups compared to Canadian-born/long-term resident comparison groups. Estimates of mood and anxiety disorders among migrants are less consistent across the globe. Similar to our findings, estimates from the US using a nationally representative survey found that first-generation migrants were significantly less likely than native-born Americans to be diagnosed with a mood or anxiety disorder.⁶ However, other international estimates have conflicting results; for example the pooled estimate from an international meta-analysis (Sweden, Denmark, UK, Netherlands, Israel, Germany, Australia, and the US) suggests higher estimates of mood and anxiety disorders among migrant groups, relative to native-born/long-term resident comparison groups.⁽⁵¹⁾ The differences observed across nations may reflect differences in global migrant flows (i.e. migrants entering or leaving given countries), illegal migration, immigration policies, and the availability of post-migration support of new migrants in the host-countries.^(43,52) Furthermore, differences may reflect variation in the composition of migrant groups within each country, who may differ by socio-economic status and in their distribution of pre- and post-migration risk factors for mood and anxiety disorders.^(53,54)

Though Canadian estimates are currently limited, there are a number of reasons why self-reported estimates of mood and anxiety disorders could be lower among migrant groups compared to host-country comparison groups. The first is selective migration, specifically positive migrant selection, where migrants are selected based on skills and education.⁽⁵⁵⁾

Canadian immigration policies result in an influx of healthier migrants compared to the general population.⁽⁵⁶⁾ This concept applies primarily to economic class migrants, which make up roughly 50% of new immigrants in Canada.⁽⁵⁷⁾ In the current review, we were unable to distinguish estimates of mood and anxiety disorders between migrant classes (economic, family reunification, or refugee). Prior evidence suggests that estimates of mood and anxiety disorders would be higher among refugee groups compared to immigrant groups.⁽²⁾ Another explanation for the lower estimates of mood and anxiety disorders we observed between migrant and host country groups is cultural differences. Differences in cultural practices, symptomatology, stigma, and diagnostic practices of mood and anxiety disorders may influence whether people are diagnosed with a mood or anxiety disorder, as well as whether they are willing to self-report a mood or anxiety disorder.^(53,58) As an example, in Japan there is a culturally common fear of conducting inappropriate social behaviour called *taijin kyofusho* (TKS). While this fear may be characterized as an anxiety disorder in a Canadian setting, it may not be seen as unreasonable to the sufferer as it is aligned with cultural values.⁽⁵⁸⁾ Present evidence suggests that migrant groups are less likely to seek out or be referred to mental health services, which would result in an underestimation of the prevalence of these disorders.^(2,14) Culture may influence expectations on appropriate avenues to seek help for mental health related symptoms, which may not include formal Western-style services (e.g. faith healers, family members).⁽²⁾ Our current Canadian estimates rely heavily on self-reported survey data. Previous Canadian research comparing self-report and diagnosed mood and anxiety disorders found consistently lower self-reported estimates.⁽⁵⁹⁾ As these trends may differ by migrant group, further exploration of diagnosed estimates of mood and anxiety disorders among migrant groups in Canadian is warranted.

We found variation in the prevalence estimates of mood and anxiety disorders among migrant groups in Canada. While much of this variation may have been due to the definitions of mood and anxiety disorders used to estimate prevalence, another potential source is time since migration. Our findings indicated that more recent migrant groups had lower estimates of mood and anxiety disorders. This trend aligns with the healthy immigrant effect, a phenomenon where migrant groups are shown to be healthier during the early years post-migration, and their health status subsequently worsens to more closely resemble that of the host country.⁽⁶⁾ It is important to note that evidence suggests that the healthy immigrant effect does not hold true for refugee groups, who likely have elevated pre-migratory stressors which contribute to elevated mental distress and higher reported mental illness.⁽⁶⁾ The vast majority (n=15) of the included studies did not present information on time spent in Canada or refugee status, and differences between samples may have contributed to the variation we observed.

A key finding of our review, which impacts our ability to both contextualize and translate our results, is that available Canadian data on mood and anxiety disorders among migrant groups are limited to prevalence estimates. Global evidence suggests that Canada is falling behind in its evaluation of the incidence of mood disorders among migrant groups.⁽⁵¹⁾ By considering the temporality and directionality of associations, measures of incidence provide insight into the role of migratory and postmigration experiences on rates of mood and anxiety disorders among migrants in Canada. In contrast, the prevalence estimates currently available in the Canadian literature combine both factors associated with disorder onset and factors associated with its persistence. Of the limited Canadian research that did explore factors associated with mood and anxiety disorders among migrant groups, findings aligned with those of the general Canadian population.^(32,43) Findings suggest that

female gender, younger age, unemployment status, low education, and being unmarried are all associated with a higher risk of mood and anxiety disorders among migrant groups.⁽³²⁾ Evidence from the US found similar results among Asian Americans.⁽⁶⁰⁾ Other risk factors, such as neighbourhood migrant concentration and neighborhood disadvantage, have not been widely studied among migrant groups.⁽⁴³⁾ Our results indicate a need to assess and solidify the relationships between key risk factors and mood and anxiety disorders among migrant groups in Canada.

The current body of evidence also highlights the need to broadly explore the factors that may impact the mental health of migrant groups – including factors related to pre-migration, migration, and post-migration – which may influence rates of mental illness.^(8,61) This would provide a more nuanced and informative understanding of the relationship between mood and anxiety disorders among migrant groups. Furthermore, there are a number of potentially important correlates related to mood and anxiety disorders that have not been previously explored among Canadian migrant groups, including ethnicity, country of origin, migrant class, and acculturation.⁽⁴³⁾ More detailed analyses could be conducted by pooling the various waves of CCHS to perform an individual data meta-analysis, as well as linking the CCHS with other administrative databases. Finally, there is a need to enhance our etiological understanding of mood and anxiety disorders among migrant groups. One approach would be to evaluate whether certain mood and anxiety disorders are prone to genetic influence or stress related factors, taking into consideration epigenetic contributions.

2.4.1 Limitations

We were limited in our ability to conduct subgroup analyses for specific risk factors (e.g. ethnicity, length of time in Canada, country of origin) due to a lack of data in the available literature. We were also limited in our ability to provide meaningful pooled estimates due to the high degree of homogeneity of the secondary data sources included in the review. Although the overall quality of the included studies was high, future research should use standardized diagnoses of mood and anxiety disorders, which would allow for greater comparability across studies.

There is currently a lack of prospective studies that present estimates of the incidence of mood and anxiety disorders in Canada. Future research should focus on estimating the incidence of these disorders to improve our understanding of mood and anxiety disorders among migrant groups.

2.4.2 Conclusions

We have demonstrated lower prevalence ratios of mood and anxiety disorders among first-generation migrant groups in Canada, relative to Canadian-born comparison groups. This review has identified key gaps in our current understanding of mood and anxiety disorders among migrants in Canada. We have identified a lack of incidence estimates, an over-reliance on cross-sectional and self-reported data, and a need to consider key risk factors, including migrant class, country of origin, neighbourhood migrant concentration, and neighbourhood disadvantage. As migration remains a key feature of the Canadian population and its growth, further research on migrant mental health is warranted.

2.5 References

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Chapter 3: Concordance Between Health Administrative Data and Survey-Derived Diagnoses for Mood and Anxiety Disorders²

3.1 Introduction

Mood and anxiety disorders are the two most common classes of mental disorders. While both classes of disorders have often been characterized as being a part of the regular human condition, evidence has demonstrated they have a major impact on morbidity and mortality.⁽¹⁾ Mood and anxiety disorders contribute significantly to the global burden of disease. The World Health Organization (WHO) has ranked depression as the world leading contributor to global disability, and anxiety disorders have been ranked as the 6th leading contributor.^(2,3) In Canadian settings, mood and anxiety disorders are the 6th and 7th leading contributors to years lived with disability.⁽⁴⁾ Furthermore, mood and anxiety disorder contribute to approximately three quarters of all mental health service use in Canada.⁽⁵⁾

The population prevalence of common mental disorders is most commonly estimated using either health administrative data or population health surveys. Both data sources offer divergent strengths and limitations for disease prevalence estimation. Most notably, these sources differ in their coverage of the population and in the validity and reliability of the data.⁽⁶⁾ Survey data can offer more depth by assessing symptoms of mental disorders, and provide a standardized and culturally sensitive tool for measuring mental disorders.⁽⁷⁻⁹⁾

² Edwards J, Thind A, Stranges S, Chiu M, Anderson KK. Concordance between health administrative data and survey-derived diagnoses for mood and anxiety disorders. *Acta Psychiatrica Scandinavica*. 2020 Apr;141(4):385-95.

Surveys, however, inherently suffer from various forms of selection and information bias including survivor and recall biases, as well as barriers to participation, which can deter certain vulnerable populations.⁽¹⁰⁾ In contrast, health administrative data typically offers a broader coverage of the population, at the cost of a shallow depth of information.⁽¹¹⁾

Importantly, what is captured in administrative data designed for physician compensation in a single payer health care system - as is present in Canada, Australia, and parts of Europe - is a help-seeking population who have come in contact with the healthcare system.

Similar to survey data, this data source may not capture certain marginalized and stigmatized populations.^(12,13) Furthermore, these data are limited due to non-standardized diagnostic criteria, leading to heterogeneity in diagnostic thresholds across clinicians and settings.⁽¹⁴⁾

Globally, there is little research directly comparing prevalence estimates of mood and anxiety disorders obtained separately from population health surveys and health administrative data.⁽¹⁵⁾ The majority of population prevalence estimates have been derived from survey data, and available work comparing multiple measures of mood and anxiety disorders has been concentrated on validation of various measures.^(16,17) Similar research gaps exist in Canadian settings.⁽¹⁸⁻²⁰⁾, where two of the main tools used to assess population estimates are the Canadian Community Health Survey (CCHS) – a nationally representative survey conducted annually^(21,22) – as well as health administrative data routinely collected through physician billings for compensation of services.⁽¹⁹⁾ Prior research in Canadian settings, suggests that these data sources yield comparable estimates of the 12-month prevalence of mood and anxiety disorders [survey = 10.1%⁽¹⁸⁾; administrative data = 10%⁽⁵⁾], but lower estimates than the global 12-month prevalence of mood and anxiety disorder of 17.6%.⁽¹⁷⁾ Furthermore, both measures have shown to have comparable psychometric

properties when comparing depressive disorders with a gold standard clinical diagnostic interview.^(16,23) Given that both measures provide comparable prevalence estimates and have similar psychometric properties, it might be assumed they are capturing a similar population. The emergence of more extensive data linkages in Ontario Canada, have provided an opportunity to directly evaluate the concordance between these data sources to test this assumption.

Accurate population-based prevalence estimates are important as they directly inform health service planning and resource allocation.⁽²⁴⁾ While available evidence from linked survey and administrative databases suggest there is high discordance for mental health service use, there is currently no available estimates of the concordance of diagnosed mental disorders in Canada.⁽²⁵⁾ This comparison has important implications for our understanding of the burden of mental illness in the population. Objective 1 was to assess whether estimates of survey structured interview diagnoses (henceforth: survey-derived diagnoses) of mood and anxiety disorders were concordant with diagnoses of these disorders obtained from health administrative data (henceforth: admin-derived diagnoses), and the socio-demographic characteristics that were associated with discordance between the measures. This will allow for the comparison of a survey derived *community prevalence* (people identified in a representative population sample) with an administrative data derived *administrative prevalence* (people receiving a clinical diagnoses in the population).⁽²⁶⁾ Objective 2 was to assess whether estimates of self-reported psychological distress from surveys were concordant with presentation to health services for any mental health reason.

3.2 Methods

3.2.1 Sample / Source of Data

Survey

The study sample was based on respondents to the 2012 Canadian Community Health Survey-Mental Health (CCHS-MH), which used a cross-sectional design to collect information on health status, health care utilization, and health determinants for a representative sample of the Canadian population. The information from the survey is captured via a telephone or in-person interview with staff from Statistics Canada.⁽²²⁾ The sample used a three-stage design to randomly select respondents for the survey. First, geographic regions (clusters) were selected, followed by households within each cluster, and finally one respondent aged 15 or older per household was randomly selected to participate. The survey attained a response rate of 68.9%.⁽²²⁾ The survey excluded people living on reserves or Aboriginal settlements, full-time members of the Canadian Forces, and institutionalized populations.⁽²²⁾ As Canada's healthcare is under provincial jurisdiction, and we do not yet have a pan-Canadian linked administrative database, our analysis was restricted to respondents who reside in the province of Ontario, the most populous province in Canada.

Linked Health Administrative Data

The Ontario CCHS-MH sample has been linked to health administrative databases at ICES (formerly known as the Institute for Clinical Evaluative Sciences), which holds all health administrative data for the province of Ontario. These datasets were linked using unique encoded identifiers and analyzed at ICES. The data holdings contain information on all services covered under the Ontario Health Insurance Program (OHIP), which includes

medically necessary inpatient hospitalizations, emergency department visits, and outpatient physician visits.

We accessed data on diagnosed mood and anxiety disorders for all people in the Ontario CCHS sample from the following databases: (1) the Ontario Mental Health Reporting System (OMHRS; 2006-2013), which contains information on adult inpatient hospitalizations to designated psychiatry beds⁽²⁷⁾; (2) the Discharge Abstract Database (DAD; 2006-2013), which contains records of all other inpatient hospitalizations⁽²⁸⁾; (3) the Ontario Health Insurance Plan (OHIP; 2006-2013), which provides universal coverage of all medically necessary services for (>96%) of the population of Ontario⁽²⁹⁾. OHIP captures information on all health care providers (including primary care physicians) who receive income from a fee-for-service model, as well as non-fee-for-service physicians who submit shadow billings for their services; and (4) the National Ambulatory Care Reporting System (NACRS; 2006-2013), which contains records on visits to the emergency department⁽³⁰⁾. The time span for each database reflects the lookback and follow-up period for our study design.

To obtain information on the demographic characteristics of the sample, we accessed data from the CCHS-MH in addition to the registered persons database (RPDB; 2006-2013), which contains information on people registered under OHIP. We followed the RECORD (Reporting of studies Conducted using Observational Routinely-Collected Health Data) guidelines for observational studies⁽³¹⁾. We provided a description of the codes and algorithms used to create study variables in Appendix 3.1, and the RECORD checklist in Appendix 3.2.

3.2.2 Outcome Measures

Structured Interview Diagnoses

Structured interview diagnoses of mood and anxiety disorders were obtained from the 2012

CCHS-MH. The survey uses the World Mental Health – Composite International Diagnostic Interview 3.0 (WHO-CIDI). Data captured in CCHS-MH on the WHO-CIDI was obtained via a personal interview.⁽²²⁾ This standardized instrument assesses mental disorders and conditions according to DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition) criteria, and is widely used. The tool in CCHS assesses 12-month (primary outcome) and lifetime depression, bipolar disorder, and generalized anxiety disorder by asking questions regarding symptoms of these disorders.^(7,32) As an example, the criterion used to diagnose major depressive disorder was the presence of five out of nine cardinal symptoms persisting for at least a two-week period. Symptoms must have been present for the majority of the day nearly every day causing significant distress and impairment.^(7,33) A validation study comparing the lifetime criterion for major depressive disorder in the CIDI compared to a structured clinical interview (SCID) estimated the measure had a sensitivity of 55.3%, specificity of 93.7, positive predictive value of 73.7%, and a negative predictive value of 86.8%.⁽¹⁶⁾

Health Administrative Diagnoses

Health administrative diagnoses of mood and anxiety disorders were obtained using a standardized algorithm where cases were identified as people receiving; (1) a hospitalization reported in OMHRS or DAD for a mood or anxiety disorder within the 5 year period prior to the survey; or (2) any visit to a psychiatrist for a mood or anxiety disorder within the 5-year period prior to the survey; or (3) at least two OHIP physician

billing claims or NACRS emergency department visits receiving a diagnosis code for a mood or anxiety disorder in any 24-month period during the 5-year period prior to the survey. Furthermore, for our primary analysis assessing 12-month prevalence, cases must have had at least one diagnosis code for a mood or anxiety disorder from any setting during the 1-year period prior to taking the CCHS. This algorithm is similar to a validated algorithm used to identify depressive disorders in other Canadian settings, which had a sensitivity of 62.9%, specificity of 93.8%, a positive predictive value of 68.3%, and a negative predictive value of 92.3%.^(23,34)

3.2.3 Socio-Demographic Factors

We obtained data on socio-demographic factors from CCHS, including age, gender, migrant status, level of education, marital status, and employment. We obtained data on neighbourhood-level income quintiles from the RPDB, which is supplemented by data from Statistics Canada and is held at ICES.

3.2.4 Statistical Analyses

Objective 1 was to assess the concordance between the survey and admin-derived diagnoses of mood and anxiety disorders. To do this, we classifying each person into one of four categories: (1) Administrative Diagnosis Only; (2) Survey Interview Diagnosis Only; (3) Both (Concordant); (4) Neither. We calculated the proportions for each concordance category with corresponding 95% confidence intervals (CI) using the total sample as the denominator.

We computed descriptive statistics using means and standard deviations for continuous data and counts and proportions for categorical data. We used standardized differences to

compare the distribution of baseline covariates between the four concordance categories. A <10% standardized difference has been shown to be equivalent to having a phi coefficient of 0.05, indicative of a non-significant difference across groups.⁽³⁵⁾

We used modified Poisson regression models with robust variance estimators to assess whether sociodemographic factors were associated with discordance between the measures. We separately compared “administrative diagnosis only” and “survey interview diagnosis only” groups with the concordant reference group. Note that the “neither” group was dropped, as this group was non-informative for our study objectives. We included age (continuous), gender (Female, Male), neighbourhood-level income (quintiles), employment (working last week, absent last week, no job last week, unable to work last week, N/A), education (less than secondary graduation, secondary graduation, other post-secondary graduation, post-secondary graduation), where secondary school in Canada is equivalent to high school, and migrant status (first-generation migrant, non-migrant) in our final model, as these variables have been hypothesized to influence discordance due to their relationships with people receiving a diagnosis of a mood or anxiety disorders from both survey and administrative data.^(32,34–36) Results are presented as prevalence ratios (PR) with corresponding 95% confidence intervals (CI). All analyses were conducted using SAS enterprise, and STATA (version 13).

3.2.5 Secondary Analyses

Objective 2 was to assess whether self-reported psychological distress from surveys were concordant with presentation to health services for any mental health reason. To accomplish this, we compared self-reported psychological distress using the K6 with any

presentation for mental illness to the healthcare system in the year prior to taking the CCHS. The K6 is a widely used screening tool for non-specific psychological distress, which screens for the presence of serious mental illness.⁽³⁷⁾ It is preferred over the longer version (K10) for screening DSM-IV mood or anxiety disorders due to its brevity and consistency.⁽³⁸⁾ We further obtained data on people who self-reported receiving mental health care treatment from a professional in the previous 12-months prior to taking the CCHS. We compared this estimate with people receiving a structured interview diagnosis of a mood or anxiety disorder during the past 12-months.

3.2.6 Sensitivity Analyses

We performed several sensitivity analyses using varying definitions of mood and anxiety disorders, which allowed us to evaluate the robustness of the conclusions drawn from our primary analysis. The following definitions have been ordered by decreasing strictness: (1) concordance between self-reported mood and anxiety disorders (binary) with administrative data diagnosed mood and anxiety disorders using an identical case definition to our primary analysis; (2) concordance between the CIDI lifetime measure of mood and anxiety disorders with administrative data diagnosed mood and anxiety disorders over a 5-year period. For this comparison we used the same case definition as our primary analysis, however, we removed the requirement for there to be a diagnostic code in the 12-month period prior to conducting the CCHS; (3) exploratory analysis comparing the survey structured interview diagnosis of 12-month mood or anxiety disorder with administrative data diagnoses that included a 1-year post-survey follow-up period. Extending the follow-up period allowed us to evaluate whether there was an increase in the use of mental health services following participation in the survey, as we hypothesized

that the survey might motivate help-seeking for mental health reasons. This comparison was identical to our primary analysis, with an extension added to the follow-up period in administrative data. Cases must have had at least one diagnosis code for a mood or anxiety disorder during the 1-year prior to or following completion of the CCHS survey.

3.3 Results

Prevalence

Our linked Ontario CCHS-MH sample consisted of 4,157 people, comprised of 1,943 men (46.7%) and 2,214 women (53.3%). The mean age of the sample was 48.0 (SD = 20.1) years. The 12-month community prevalence of any mood or anxiety disorder was 13.9% (n=579, 95%CI = 12.8%, 14.9%), the administrative prevalence was 10.4% (n=432, 95%CI = 9.5, 11.3), and the total prevalence from either data source was 20.4% (n=847, 95%CI = 19.2%, 21.6%) (see Figure 3.1).

Concordance

Our first objective was to calculate the concordance between survey and admin-derived diagnoses of mood and anxiety disorders. We found that only 19.4% (n=164) of the sample were identified as having a mood or anxiety disorder across both measures, which comprised our concordant group. Compared to people in the concordant group, people in the survey-derived diagnosis only group were more likely to be in the highest income quintile, working, and married (Table 3.1). Compared to people in the concordant group, people in the admin-derived diagnosis only group were older, more likely to be in highest income quintile, working, and less likely to be in the lowest income quintile, divorced, and single (Table 3.1). First-generation migrant groups had significantly lower estimates of any mood and anxiety disorders (16.0%) compared to non-migrant groups (22.0%). First-

generation migrant groups were significantly less likely to be in the survey only discordant group (7.0%) compared to the non-migrant comparison group (11.1%).

3.3.1 Regression

Survey-derived diagnosis

Results from our modified Poisson regression analyses suggest that the proportion of people with a higher income is 1.27 times greater (PR 1.27, 95%CI = 1.02, 1.57) in the survey only group compared to the concordant group. Furthermore, people who are older (PR 0.99, 95%CI = 0.99, 0.99), had no job (PR 0.74, 95%CI = 0.63, 0.87) or who are unable to work (PR 0.67, 95%CI = 0.49, 0.91) are less likely to be in the survey only group, compared to the concordant group. In our adjusted model, the effects of age were not statistically significant, however, a significant result remained for income and employment (see Table 3.2).

Administrative-derived diagnosis

We also found that the proportion of people identifying as a migrant was 1.3 times greater (PR 1.30, 95%CI = 1.04, 1.56) in the admin only group compared to the concordant group, and that the prevalence of persons in the admin only group increased with increasing age (PR 1.01, 95%CI = 1.01, 1.02). Both of these findings lost statistical significance in our adjusted analyses, though migrant status remained on the threshold of statistical significance (see Table 3.2).

3.3.2 Secondary Analyses

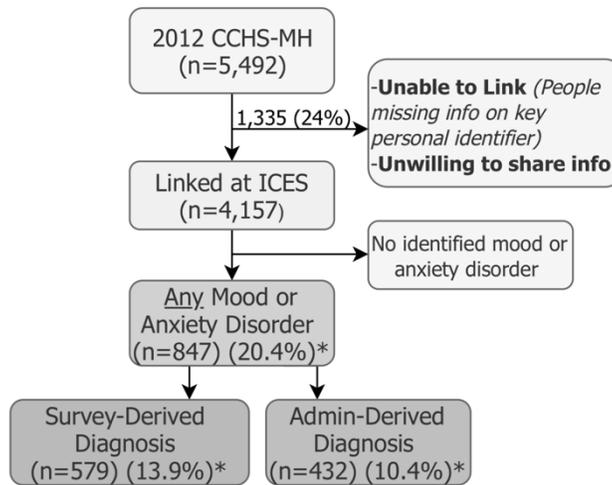
Our second objective was to determine whether estimates of self-reported psychological distress from surveys were concordant with presentation to health services for any mental health reason. We determined that receiving a mental health diagnosis increased with higher self-reported psychological distress (see Figure 3.2). Percentage concordance ranged from 10.3% to 58.3%. We further found that the mean psychological distress was the highest in the concordant group 8.96 (SD = 4.75), followed by the survey interview diagnosis only group 5.96 (SD = 4.75), and the administrative diagnosis only group 3.70 (SD = 3.82).

We identified 10.1% (n=419) of our sample self-reported receiving mental health care treatment from a professional in the previous 12-months. The concordance between 12-month structured interview diagnosed mood and anxiety disorders and self-reported contact for treatment for mental health was 41% (n=238).

3.3.3 Sensitivity Analyses

Our sensitivity analysis estimated the concordance for various definitions of survey-derived and admin-derived diagnosed mood and anxiety disorders. The concordance of the various definitions used ranged from 19.4% to 29.9% (see Appendix 3.4). Overall, our findings suggest there was consistently low levels of concordance for all definitions used in our sensitivity analysis. As such, the sensitivity analyses do not change the conclusion drawn from our primary outcome.

Figure 3.1: Flow chart of the data linkage and derivation of the study sample.



Note: Unwilling to share info for linkage loses of ~15 % of the sample, while unable to link makes up ~9% of the sample.⁽³⁹⁾ * indicates percentage of persons linked.

Figure 3.2: Percentage concordance between self-reported psychological distress (K-6) and any presentation for a mental illness in the 1-year prior to taking the CCHS survey.

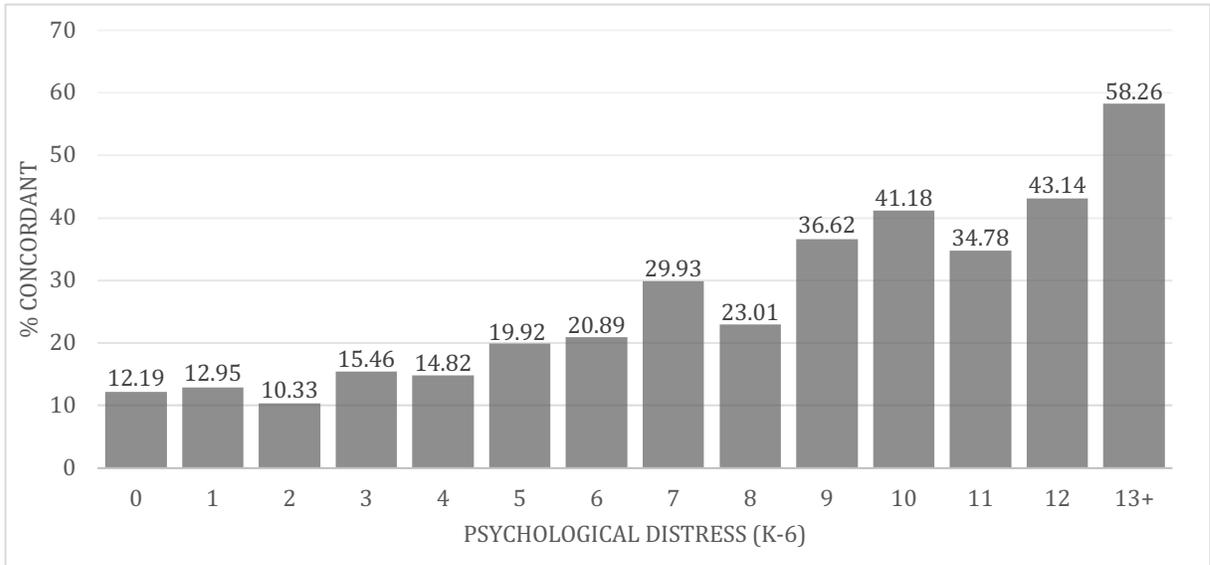


Table 3.1: Socio-Demographic characteristics of the discordance and concordance groups.

Variable	Survey-Derived + Admin-Derived n=164 (n,SD/%)	Survey-Derived Only n= 415 (n,SD/%)	Standardized Difference	Admin-Derived Only N=268 (n,sd/%)	Standardized Difference
Age (mean, SD)	45.98 (16.22)	45.22 (16.64)	0.05	50.80 (21.24)	0.26
Gender					
Female	107 (65.2%)	272 (65.5%)	0.01	175 (65.3%)	0.00
Male	57 (34.8%)	143 (34.5%)	0.01	93 (34.7%)	0.00
Income Quintile					
-5 (Highest)	21 (12.9%)	78 (18.9%)	0.17	53 (19.8%)	0.19
-4	27 (16.6%)	77 (18.7%)	0.06	47 (17.5%)	0.06
-3	33 (20.2%)	84 (20.4%)	0.00	49 (18.3%)	0.05
-2	30 (18.4%)	93 (22.6%)	0.10	56 (20.9%)	0.03
-1 (Lowest)	52 (31.9%)	80 (19.4%)	0.29	63 (23.5%)	0.19
Employment					
-Working last Week	60 (36.6%)	227 (54.7%)	0.37	111 (41.4%)	0.10
-Absent Last Week	9 (5.5%)	28 (6.7%)	0.05	9 (3.4%)	0.10
-No Job Last Week	62 (37.8%)	121 (29.2%)	0.18	89 (33.2%)	0.10
-Unable/Permanent	26 (15.9%)	27 (6.5%)	0.30	19 (7.1%)	0.28
-Not Applicable	7 (4.3%)	12 (2.9%)	0.07	40 (14.9%)	0.37
Education *					
-Less than Secondary Grad	15 (9.7%)	25 (6.2%)	0.13	26 (10.3%)	0.02
-Secondary Grad	21 (13.5%)	55 (13.7%)	0.00	38 (15.0%)	0.04
-Other Post-Sec	9 (5.8%)	27 (6.7%)	0.04	11 (4.3%)	0.07
-Post-Sec Grad	110 (71.0%)	295 (73.4%)	0.05	178 (70.4%)	0.01
Marital Status					
- Now Married	51 (31.5%)	158 (38.1%)	0.14	94 (35.1%)	0.08
- Common-Law	9 (5.6%)	28 (6.7%)	0.05	15 (5.6%)	0.00
- Widowed	11 (6.8%)	27 (6.5%)	0.01	39 (14.6%)	0.25
- Separated	14 (8.6%)	30 (7.2%)	0.05	20 (7.5%)	0.04
- Divorced	20 (12.3%)	37 (8.9%)	0.11	22 (8.2%)	0.14
- Single	57 (35.2%)	135 (32.5%)	0.06	78 (29.1%)	0.13
Migrant Status	32 (19.5%)	79 (19.0%)	0.01	70 (26.1%)	0.16

Note: Missing less than 6 people was ignored. * indicates missing more than 6 less than 30 people.

Table 3.2: Modified Poisson regression analyses assessing socio-demographic characteristics associated with each discordance group, compared to the concordant group (n=847).

Outcomes Variable	Survey-Derived Diagnosis Only (n=415)		Admin-Derived Diagnosis Only (n=268)	
	Unadjusted PR (95%CI)	Adjusted PR (95%CI)	Unadjusted PR (95%CI)	Adjusted PR (95%CI)
Age	0.99 (0.99, 0.99)	1.00 (0.99, 1.00)	1.01 (1.01, 1.02)	1.00 (0.99, 1.01)
Gender	1.01 (0.87, 1.16)	1.01 (0.82, 1.16)	0.99 (0.81, 1.23)	0.96 (0.75, 1.21)
Education				
- <Secondary Grad	Ref	Ref	Ref	Ref
-Secondary Grad	1.27 (0.89, 1.83)	1.09 (0.74, 1.62)	0.85 (0.57, 1.26)	0.91 (0.56, 1.46)
-Other Post-Sec	1.52 (1.02, 2.25)	1.34 (0.89, 2.01)	0.59 (0.33, 1.08)	0.54 (0.26, 1.13)
-Post-Sec Grad	1.34 (0.97, 1.84)	1.05 (0.73, 1.50)	0.78 (0.56, 1.07)	0.81 (0.53, 1.24)
Employment				
-Working last Week	Ref	Ref	Ref	Ref
-Absent Last Week	1.09 (0.85, 1.39)	1.03 (0.79, 1.33)	0.70 (0.38, 1.29)	0.70 (0.38, 1.29)
-No Job Last Week	0.74 (0.63, 0.87)	0.81 (0.69, 0.95)	1.17 (0.93, 1.48)	1.07 (0.83, 1.38)
-Unable/Permanent	0.67 (0.49, 0.91)	0.65 (0.46, 0.91)	0.95 (0.62, 1.44)	0.94 (0.59, 1.48)
Income				
-1 (Lowest)	Ref	Ref	Ref	Ref
-2	1.27 (1.02, 1.57)	1.30 (1.05, 1.63)	0.97 (0.72, 1.30)	0.81 (0.56, 1.16)
-3	1.23 (0.98, 1.55)	1.18 (0.93, 1.49)	0.91 (0.67, 1.25)	0.91 (0.64, 1.30)
-4	1.24 (0.99, 1.56)	1.16 (0.92, 1.47)	0.96 (0.70, 1.32)	0.97 (0.68, 1.38)
-5 (Highest)	1.25 (0.99, 1.57)	1.23 (0.97, 1.55)	1.08 (0.80, 1.45)	1.06 (0.75, 1.49)
Marital Status				
-Married/Common-Law	Ref	Ref	Ref	Ref
-Separated/Divorced/ Widowed	0.82 (0.68, 0.98)	0.94 (0.78, 1.13)	1.19 (0.95, 1.51)	0.98 (0.73, 1.32)
- Single	0.95 (0.82, 1.11)	0.96 (0.79, 1.15)	0.94 (0.74, 1.20)	0.97 (0.71, 1.31)
Migrant Status	0.87 (0.72, 1.04)	0.87 (0.72, 1.04)	1.30 (1.05, 1.62)	1.28 (0.99, 1.66)

3.4 Discussion

The findings of this study estimate there is a high level of discordance between survey-derived and admin-derived diagnoses of mood and anxiety disorders, and that there exist systematic differences between people identified by each measure. The results of our linkage expands on previous work comparing unlinked prevalence estimates obtained from survey and administrative data for mood and anxiety disorders, and adds to our understanding of the prevalence of mood and anxiety disorders in Canada ^(20,21,38,39). Our findings suggest that each measure may be identifying different samples of people with mood and anxiety disorders in the population. As such, using any one of these measures of mood and anxiety disorders alone may be insufficient for estimating the prevalence of these disorders, and current estimates may consequently be an underestimate of the true prevalence. We identified a combined prevalence estimate from either measure of 20.4%, which is larger than previous Canadian estimates of 11.5%.⁽⁴²⁾

Contextualizing prevalence estimates obtained from either survey or administrative databases is an important component of meaningful comparison and synthesis.⁽¹¹⁾ The goal of our prevalence estimation was to compare diagnosed prevalence estimates from both survey and administrative data, which involves estimating the number of people in the population who meet the criteria for a diagnosis of a mood or anxiety disorder.^(23,25,34,40)

There is currently no gold standard measure of diagnosed mood and anxiety disorders in the population. Our linkage of two of the highest quality measures that are commonly used and available with current data, has highlighted the need to re-evaluate our estimation of the prevalence of mood and anxiety disorders. An important missing component of current population measures is the integration of validated psychometric properties. An analytical

technique that may provide an opportunity to move this research forward is a Bayesian approach, which would allow for the integration of information from multiple measures and prior psychometric properties.⁽⁴³⁾ A movement away from point estimate comparisons to more informative probability distributions may serve as an opening to improving our estimation of the burden of mental illness in the population.

We found systematic differences between people identified as having a mood or anxiety disorder between survey versus health administrative data. This may be an indication of variations in mental health care needs, or differences in the likelihood of disclosing symptoms of, or seeking care for, mood and anxiety disorders across different groups.^(6,41) We found that people who were identified as having a mood or anxiety disorder in both survey and administrative data had higher mean psychological distress scores and were generally more likely to be in the lowest income quintile, out of work, divorced, and in higher material deprivation quintiles compared to people in either discordance group. Our findings build on previous work, which found that people with more severe mental disorders may be less likely to self-report accessing mental health services.⁽⁶⁾ Specifically, the severity of mental illness may be playing a role in the concordance of different measures of mood and anxiety disorders. Our findings suggest that both measures of mood and anxiety disorders may potentially be used in combination to identify more severe cases who have the highest mental health care needs. As an alternative to the notion that both population measures are capturing different groups of people, it is possible they are capturing a single group of people with disorders at varying stages of illness and treatment. Future research using detailed clinical information may be useful to further characterize people identified using these two population-based measures of mood and anxiety disorders.

3.4.1 Explanations for the Discordance

Our finding of high discordance between survey and administrative data for mood and anxiety disorders is similar to previous work conducted in other Canadian settings comparing mental health service use between survey and administrative data.^(6,25,44) High discordance may be the result of trends in help-seeking behavior, heterogeneity of outcomes, and bias.⁽⁴⁵⁾

Firstly, our findings of high discordance may be the result of a lack or fragmentation of mental health services provided to, or accessed by, people who are identified as having a mood or anxiety disorder in the survey structured interview. Our findings suggest that two-fifths of people with a mood or anxiety disorder identified in CCHS, reported they had accessed mental health care treatment in the prior 12-months. There is a clear disconnect between people meeting the criteria for a structured interview diagnosis of a mood or anxiety disorder and people self-reporting having accessed mental health care treatment. This discrepancy helps explain the discordance identified between our measures of mood and anxiety disorders. It is also important to consider the potential impact of our inability to identify services rendered from psychologists and other community mental health care workers not covered under the provincial health insurance program. This may have led to an underestimation of cases identified in administrative data, which may have contributed to discordance.

The high discordance that we observed may also be due to the heterogeneity of our outcome measures in survey and administrative data. Neither measure is considered to be

a “gold standard” for diagnosing mood or anxiety disorders, both likely capture people at different stages of their mental health trajectory in addition to people with various levels of sub-clinical symptomatology. Specifically, the CIDI may be more likely to pick up people early in their trajectory of mental illness, whom have not yet come in contact with the health care system for their mental health needs. Furthermore, administrative data may be more likely to capture sub-clinical cases of mood and anxiety disorder due to the nature of physician compensation in Canada, where in most settings, diagnostic codes are mandatory for billing.⁽⁴⁶⁾ However, a contrasting limitation is that clinicians are restricted to one diagnosis per billing, which may lead to missed cases of mood and anxiety disorders if the diagnosis occurred in the context of a visit for other reasons.

Finally, our estimates of discordance may have been influenced by social desirability bias, which may occur if respondents are reluctant to disclose a mental illness or associated symptoms due to stigma.⁽²⁵⁾ This may be one reason why we identified more older people in the administrative only discordant group, a trend which has been identified in previous comparisons of self-reported and administrative data.⁽²⁵⁾ It is important to consider that social stigma may also be influencing help-seeking behaviors, which may influence our estimates obtained from health administrative data.⁽⁴⁷⁾

There are many reasons why we may have observed high discordance between people captured in our estimates of community and administrative prevalence. Regardless, it is clear that these measures are capturing separate populations with a mood or anxiety disorder or the same population with disorders at different stages of illness and treatment.

3.4.2 Limitations

A limitation to our work is that our assessment of administrative data is based on billing codes rather than a clinical or standardized research diagnosis. There is a lack of standardization in the way that diagnoses are established and recorded, and thresholds for diagnoses will vary across clinicians and settings.⁽¹⁴⁾ Furthermore, our current use of billing codes to estimate the prevalence of mood and anxiety disorders may lead to an inflation of prevalence due to the option to use a fee code for a mental health condition to enable lengthier counselling visits.⁽¹⁴⁾ Another limitation is that our findings may have been affected by multiple forms of selection bias, including: (1) non-response bias; and (2) potential differences in the characteristics of survey respondents who participated in the survey and agreed to have their data released for linkage, and those who did not.⁽⁴⁸⁾ Moreover, the generalizability of our findings may be limited as we included results from one province of a nationwide survey. We did not receive access to data on prescription medication use, which may have aided in defining the presence of a mood or anxiety disorder from both the survey and administrative data sources. We were also limited in our ability to compare certain high-risk groups including various migrant groups, homeless and institutionalized population, as well as indigenous peoples living on indigenous communities, due to limited sample coverage and sizes. We decided not to stratify the results by diagnostic category, as we are not confident in our ability to definitively tease apart the two diagnostic categories in health administrative data, due to the lack of specificity in the diagnostic codes.⁽⁴⁹⁾

Another potential limitation is the variable lookback windows used in the comparison of psychological distress and contact for a mental illness. Psychological distress was measured in the previous month, while contact for a mental illness was evaluated during

the past 12-months. Though our administrative data lookback window was purposefully extended, to be inclusive, there is a potential that treatment received for a mental illness within the 12-months prior to taking the CCHS may have alleviated problematic symptoms, which would have been reflected in self-reported psychological distress scores.

3.4.3 Conclusion

Our findings highlight the need to re-examine current estimates of mood and anxiety disorders in Canada. Given that we found high discordance between survey and administrative derived diagnoses, our current estimation of the 12-month prevalence of these disorders using either tool may be underestimating the true population prevalence of mood and anxiety disorders in Canada. To reduce our uncertainty, researchers must work closer with linked health data to develop a valid measure for population surveillance of mood and anxiety disorders. The development of a population measure which reflects the range of symptoms associated with common mental disorders may be a useful foundation for future measure design.⁽⁵⁰⁾ Linked population-based measures offer a platform to build on our current measurement and begin to better quantify the frequency of common mental disorders.

3.6 References

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Chapter 4: A Bayesian approach to estimating the prevalence of common mental disorders at the population level using multiple measures.³

4.1 Introduction

When it comes to population-based estimates of disease frequency, individual point estimates with confidence intervals are regularly used to inform research and policy. The accuracy of these individual estimates is a product of the strengths and limitations of the measures and samples used. Theoretically, a more informative population estimate would incorporate prior information on measurement properties and would leverage the strengths of multiple measures to increase accuracy. This integration of multiple sources of data could be useful in improving estimates for population surveillance and research. A good example is the measurement of common mental disorders, depression and anxiety, which are among the leading contributors of global morbidity.⁽¹⁾ Accurate, population-based estimates of these disorders are important for our understanding of disease burden and for health service planning and resource allocation.⁽²⁾

Currently, Bayesian methodology is being used in the estimation of the global burden of disease by the WHO.⁽³⁾ There are two aspects of a Bayesian analysis that can be used to estimate uncertainty and improve the accuracy of population estimates of the frequency of mood and anxiety disorders. The first is to use prior information from existing studies – for example, evidence from validation studies – which provide the psychometric properties of specific measures of mood and anxiety disorders. These prior psychometric properties can be used to inform the prevalence and uncertainty surrounding estimates of the proportion

³ A version of this manuscript has been submitted to *Epidemiology and Psychiatric Sciences*.

of people meeting the criteria for a clinical diagnosis in the population.⁽⁴⁾ The second approach is to integrate the results of multiple population-based measures of common mental disorders into one estimate. Two ways that we estimate the prevalence of common mental disorders is the use of structured interview data from surveys (i.e. survey-derived diagnoses) and fee-for-service billing codes from health administrative databases (i.e. administrative-derived diagnoses).

Both of these sources of data provide distinctive population estimates; survey-derived community prevalence (people identified in a representative population sample) and an administrative data derived prevalence (people receiving a clinical diagnosis in the entire population).⁽⁵⁾ These estimates are influenced by the characteristics of the sources of data.⁽⁶⁻¹²⁾ Generally, surveys offer standardized measures with more limited coverage of the population, whereas administrative data have a greater coverage of the population with a shallower depth of information.^(8,13) Previous work suggests that the use of either of these measures alone may identify a selected subgroup of people with a mood or anxiety disorder in the population, thus leading to an over- or under- estimation of the true prevalence.⁽¹⁴⁾

To overcome the limitation of using either one of these population measures in isolation, the integration of multiple measures can accomplish using a Bayesian analysis. This allows for inferences regarding the prevalence and measurement properties of a combined estimate using two population based-measures.^(15,16) Recent work from Ontario, Canada estimating the concordance between survey- and administrative-derived diagnoses of mood or anxiety disorders using a recent linkage between national survey and provincial health administrative data, provides a platform for this analysis.⁽¹⁴⁾

Our objective was to use a Bayesian approach to derive a more informative estimate of the population prevalence of mood and anxiety disorders in Ontario, Canada. By using primary data from an analysis assessing the concordance of two population measures of mood and anxiety disorders ⁽¹⁴⁾, along with prior estimates of the measurement properties of the two measures ^(17,18), we may be able to produce more informed estimates of population prevalence.

4.2 Methods

4.2.1 Sample and Source of Data

Our sample was based on the respondents to the Ontario portion of a national population health survey, the 2012 Canadian Community Health Survey-Mental Health (CCHS-MH). This cross-sectional survey collects information on people's health status, health care utilization, as well as factors related to the determinants of health, and data collection is done via a telephone or in-person interview with staff from Statistics Canada. The respondents to this survey were individually linked to health administrative databases at ICES (formerly known as the Institute for Clinical Evaluative Sciences), which holds all health administrative data covered under the Ontario Health Insurance Plan (OHIP) and covers nearly the entire population of Ontario (>96%).⁽¹⁴⁾ ICES houses provincial data on inpatient hospitalization, outpatient physician visits (including primary care), and emergency department visits. The use of data in this project was authorized under Section 45 of Ontario's Personal Health Information Protection Act, which does not require review by a Research Ethics Board.

4.2.2 Outcome Measures

Survey-Derived Diagnoses: World Mental Health – Composite International Diagnostic Interview 3.0 (WHO-CIDI). This standardized instrument assesses mental disorders and conditions according to DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition) criteria. We used the 12-month measures of depression, bipolar disorder, and generalized anxiety disorders, which are derived from questions regarding symptoms of these disorders.^(19,20)

Administrative-Derived Diagnoses: We obtained billing data on mood and anxiety disorders from the linked health administrative data using a standardized algorithm, which was similar to a validated algorithm used to identify depressive disorders in other Canadian settings.^(17,21) Cases were identified as people with either: (1) a hospitalization for a mood or anxiety disorder; or (2) a visit to a psychiatrist for a mood or anxiety disorder; or (3) at least two physician billing claims (including primary care physicians) or emergency department visits for a mood or anxiety disorder within any 24-month period. Additionally, cases must have had at least one diagnosis code for a mood or anxiety disorder within the 12-month period prior to completing the survey to ensure that the observation period was aligned for survey- and administrative-derived diagnoses. We used a 5-year lookback period prior to completion of the survey to identify cases.

4.2.3 Psychometric Properties

We used prior estimates of the psychometric properties of both measures, which included a validation of the WHO-CIDI structured interview tool compared to the Structural Clinical Interview for DSM (SCID)⁽¹⁸⁾, as well as a validation of provincial health administrative billing data using electronic medical records and medical chart review.⁽¹⁷⁾ Both of these

validation studies assessed the psychometric properties of the measurement of depressive disorders. The survey-derived diagnoses had a sensitivity of 55.3%, specificity of 93.7%, positive predictive value of 73.7%, and a negative predictive value of 86.8%.⁽¹⁸⁾ Evidence suggests that the psychometric properties for survey-derived diagnoses of anxiety disorder are similar to depressive disorders (sensitivity 54.4%, specificity 90.7%, positive predictive value 74.5%, negative predictive value 80%).⁽¹⁸⁾ The administrative-derived diagnoses had a sensitivity of 62.9%, specificity of 93.8%, positive predictive value of 68.3%, and a negative predictive value of 92.3% (see Table 4.1).⁽¹⁷⁾ We did not find a validation of administrative-derived diagnoses of anxiety disorders as a comparison, hence we performed a sensitivity analyses to explore the impact of varying psychometric properties on our combined estimate.

4.2.4 Data Analysis

Prior estimates of the prevalence, concordance, and psychometric properties of mood and anxiety disorders using multiple measures has provided us the opportunity to apply a Bayesian analytic approach. This flexible approach uses prior information from two population measures to inform the conditional probability of a combined prevalence estimate.⁽¹⁶⁾ This analysis has been described in detail in a previous publication.⁽¹⁶⁾

We estimated the posterior densities of all parameters using a Hamiltonian Monte Carlo (HMC) is a Markov chain Monte Carlo technique.^(22,23) HCM is used to generate random samples from the posterior densities of each parameter, which in turn can be used to compute expectations, quantiles, and Bayesian credible intervals. It is preferred over the Gibbs sample, originally used by Joseph et al., as it does not require beta priors and allows us to specify the prior. Values for our priors were selected by using the asymptotic sampling distribution for each statistic, as described in previous studies.^(17,18) Summaries of

posterior distributions, including the means and 95% equally tailed posterior credible intervals (95%CI), were used for interpretation of the results. Credible intervals are Bayesian analogs to 95% confidence intervals. To assess model fit and performance we performed posterior predictive checks and diagnostics using Stan.⁽²⁴⁾ Twelve chains were used to sample 2000 samples per chain (1000 warmup, 1000 post warmup). All analyses were conducted using R.⁽²⁶⁾ The script used for this project is available in supplementary material (Appendix 4.1).

4.2.5 Sensitivity Analyses

To assess how prior misspecification would impact our results, we performed sensitivity analyses that altered the means of our prior distributions for the sensitivities and specificities of both the survey-derived and administrative-derived measures, while holding the variances constant. We varied the prior sensitivities and specificities to 5% smaller, and 5% larger than the values we used in our final model.^(17,18)

4.3 Results

The total Ontario sample completing the 2012 CCHS-MH was 5,492 people, of whom 1,335 (24%) were unable to be linked (~9%) or were unwilling to share their information (~15%) for data linkage.⁽²⁷⁾ As such, our linked sample included 4,157 people, comprised of 1,943 men (46.7%) and 2,214 women (53.3%). The mean age of the sample was 48.0 (SD = 20.1) years. Using a frequentist approach, the survey-derived prevalence from our sample was 13.9% (95%CI = 12.8%, 14.9%), the administrative-derived prevalence was 10.4% (95%CI = 9.5%, 11.3%), and the concordance between the two measures was 19.4%, which has been reported previously.⁽¹⁴⁾

The results of the Bayesian analysis suggest that the combined prevalence mean was 8.6% with a credible interval of 6.8% to 10.6% (See Figure 4.1, Table 4.1). This combined estimate sits between our prior informed estimates from administrative-derived diagnoses (mean 7.4%, 95%CI = 5.4%, 9.6%) and the survey-derived diagnoses (mean 13.9%, 95%CI = 1.2%, 25.0%). In our results, the mean estimates were similar to the posterior medians. These estimates differ from the prior prevalence estimate used to inform the model that were derived using a frequentist approach. The large difference in sample size of the prior validation studies for the psychometric properties of the administrative-derived (n=3,362) and our survey-derived (n=325) estimates contributed to the wider posterior distribution for the prior informed survey estimate. The findings in Figure 4.1 suggest that results from administrative data alone may be providing an underestimate of the true population prevalence of mood and anxiety disorders, whereas estimates from surveys may be overestimating the population prevalence.

Additionally, the posterior distribution of our combined estimate suggests that administrative-derived estimates have a similar sensitivity (95%CI = 59% to 67%) compared to the survey-derived estimates (95%CI = 55% to 73%). Furthermore, there is high specificity for both administrative- (95%CI = 93% to 95%) and survey-derived (95%CI = 89% to 92%) estimates (See Table 4.1). The survey-derived estimates have a higher sensitivity than the administrative-derived estimates, though the results of our posterior distribution suggest administrative-derived estimates may have a higher specificity than survey-derived estimates.

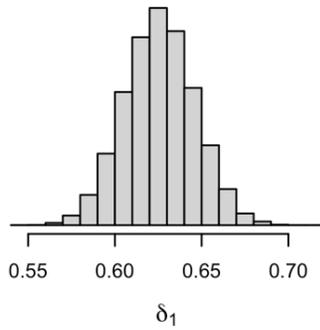
The results of our sensitivity analyses suggest that changes to the means of the prior psychometric properties of our administrative-derived measure do not shift our combined

prevalence estimate in any significant way. Our sensitivity analysis does suggest, however, that while changes in the sensitivity of our survey-derived measure do not appreciably change our combined posterior prevalence estimate, changes in the specificity of the survey-derived measure highlighted by colored lines in Figure 4.2 have an appreciable impact on the combined posterior prevalence estimate. Specifically, when the mean of the posterior specificity is increased from 88% to 98%, there is roughly a 7.5% increase in the combined posterior prevalence estimate. (See Figure 4.2).

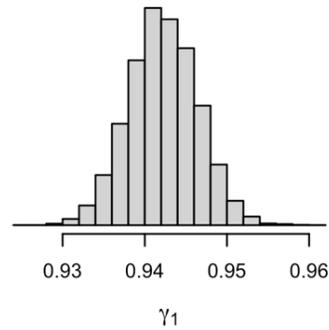
Stan monitors diagnostics, none of which detected problematic HMC behaviour (0 divergences, all Gelman-Rubin diagnostics < 1.01 , smallest effective sample size ratio was 55%). The findings from our posterior predictive checks, using simulated data (see Figure 4.3), suggest that the mean of our data (x-axis) is similar to the mean of the posterior predictive distribution (y-axis), which indicates our model can reliably recreate our data.⁽²⁵⁾

Figure 4.1: Marginal posterior density for the prevalence of mood or anxiety disorders in Ontario, Canada, using data from both survey and administrative data combined.

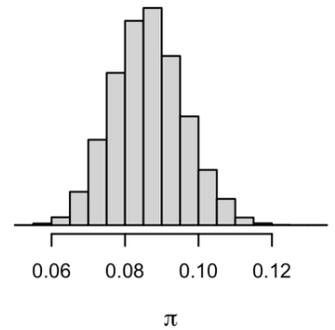
Posterior Admin Sensitivity



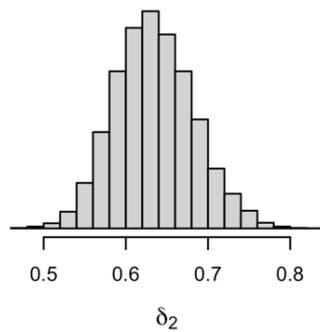
Posterior Admin Specificity



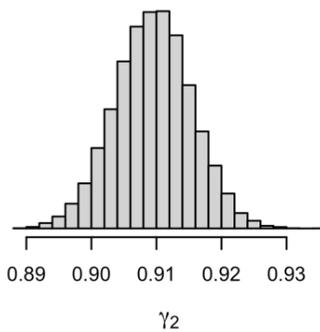
Posterior Prevalence



Posterior Survey Sensitivity

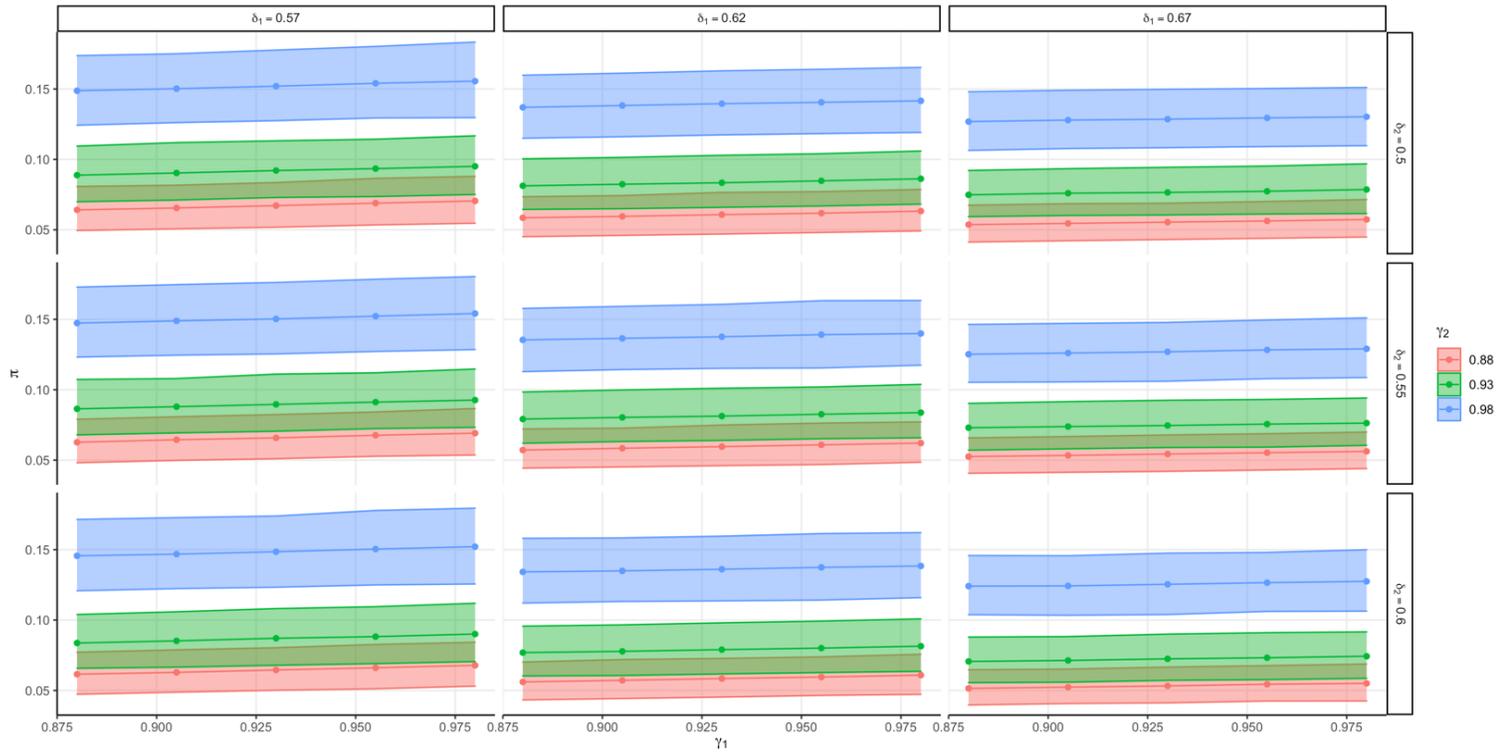


Posterior Survey Specificity



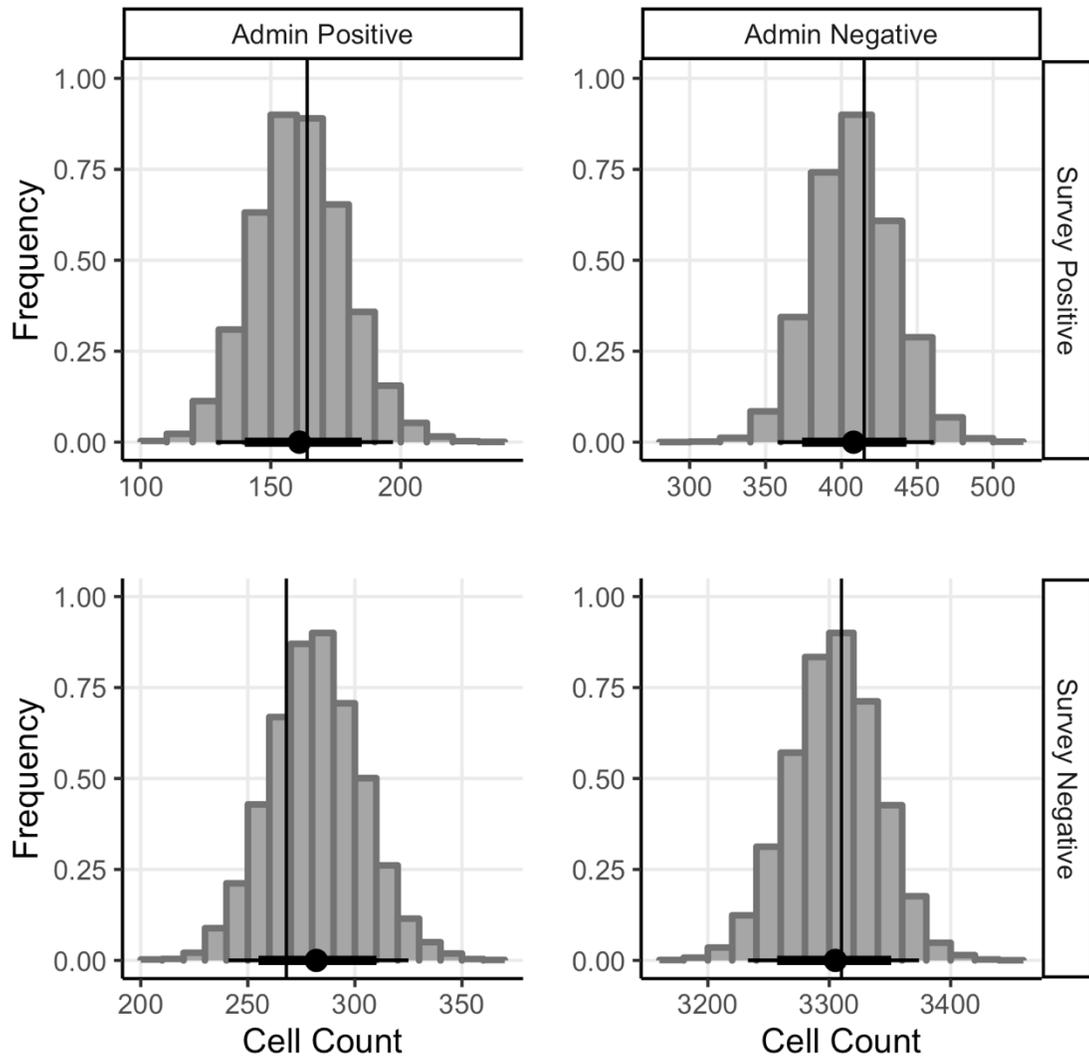
Note: π represents posterior prevalence using both administrative and survey data, δ_1 represents sensitivity for administrative data, and γ_1 represents specificity for administrative data, δ_2 represents sensitivity for survey data, and γ_2 represents specificity for survey data.

Figure 4.2: Results from the sensitivity analysis testing the impact of variation in psychometric properties on the posterior prevalence.



Note: π represents posterior prevalence using both administrative and survey data, δ_1 represents sensitivity for administrative data, and γ_1 represents specificity for administrative data, δ_2 represents sensitivity for survey data, and γ_2 represents specificity for survey data. We find that changes in the prior expectation for the sensitivities of both survey and administrative data, as well as the specificity of the administrative data do not appreciably change the expected prevalence. We do find that changes to the specificity of the survey data have a considerable influence on the expected prevalence. The colored intervals represent the credible intervals of the expected prevalence with three different values of the specificity for the survey data. Red represent a prior expectation for the specificity of 88%, green 93%, and blue 98%.

Figure 4.3: Posterior predictive checks to assess model reliability.



Note: Our model estimates for the expected count in each cell is shown as a black dot. Associated 95% credible intervals are indicated. The vertical lines indicate the observed counts in each cell. We note that since our expectations are close to the observations, that our model is capable of reproducing our data.

Table 4.1: Concordance between survey structured interview and administrative data diagnosed mood and anxiety disorders in Ontario, Canada.⁽¹⁴⁾

	(+) <i>Admin-Derived Diagnosed</i>	(-) <i>Admin-Derived Diagnosis</i>	
(+) <i>Survey-Derived Diagnosis</i>	164 (3.9%)	415 (9.9%)	579 (13.9%)
(-) <i>Survey-Derived Diagnosis</i>	268 (6.4%)	3310 (79.6%)	3578 (86.1%)
	432 (10.4%)	3725 (89.6%)	4157 (100.0%)

Table 4.2: Marginal prior and posterior medians and 95% CI of the posterior equally tailed 95%CI for the prevalence (π) and sensitivities (δ_1 , δ_2) and specificities (γ_1 , γ_2) for each measure of mood and anxiety disorder and the combination of the two measures.

	<i>Prior Information</i>		<i>Admin-Derived Diagnosis</i>		<i>Survey-Derived Diagnosis</i>		<i>Both Measures</i>	
	<i>Mean</i>	<i>95%CI</i>	<i>Mean</i>	<i>95%CI</i>	<i>Mean</i>	<i>95%CI</i>	<i>Mean</i>	<i>95%CI</i>
	π		7.4	5.4-9.6	13.9	1.2-25.0	8.6	6.8-10.6
-Admin- Derived	δ_1	62.9 59.9-66.8	62.9	58.8-66.8			62.6	58.6-66.6
	γ_1	93.8 92.8-94.7	93.8	93.0-94.6			94.2	93.4-95.0
-Survey- Derived	δ_2	55.3 41.9-68.6*			55.2	51.3-59.1	63.5	54.6-73.4
	γ_2	93.7 89.9-97.4*			93.0	86.5-99.4	91.0	89.8-92.1

Note: π represents posterior prevalence, δ_1 represents sensitivity for administrative data, and γ_1 represents specificity for administrative data, δ_2 represents sensitivity for survey data, and γ_2 represents specificity for survey data. *Estimated from (se).⁽¹⁵⁾

4.4 Discussion

The findings of this study estimate that the combined prevalence, using both survey and health administrative data sources in Ontario, was 8.6% (95%CI = 6.8% to 10.6%), which sits between estimates from administrative data-derived diagnoses (mean 7.4%) and the survey-derived diagnoses (mean 13.9%). A discussion on the reasons why estimates from survey and health administrative data may differ can be found elsewhere.⁽¹⁴⁾ Estimating the population prevalence of mood and anxiety disorders is a challenging endeavour.⁽²⁸⁾

Current estimates have been constrained by the properties of the measurement tools and samples collected. We have demonstrated how the use of Bayesian approaches may provide a more informed and accurate estimate by making use of linked survey and health administrative data, combined with prior information on the psychometric properties of these measures.

There are three reasons why we believe our combined estimate may align more closely with a true population prevalence, compared to the use of either measure alone. Firstly, our prior work suggests that survey- and administrative-derived diagnoses may identify different sub-groups of people with a mood or anxiety disorder.⁽¹⁴⁾ As such, if both measures are identifying a discrete group of people with a spectrum of disorders at varying stages of illness and treatment, the use of both measures would provide an estimate informed by a broader distribution of the spectrum of common mental disorders in the population. Secondly, our estimate was the first to use prior information on established psychometric properties of the measures to inform the combined estimate. Finally, our findings align with previous research, which suggest that the true population prevalence of mood and anxiety disorders may reside between estimates derived from both measures due to the characteristics of each measure. Specifically, the depression module of the CIDI has

been found to have a high false-positive rate, which may result in a falsely elevated prevalence estimate.⁽²⁹⁾ Furthermore, compared to estimates of depression obtained from clinical chart reviews, estimates from linked health administrative data were lower, resulting in an underestimate of the prevalence.⁽¹⁷⁾ As such, it is likely that the true prevalence of mood and anxiety disorders may reside between estimates attained from survey- and administrative-derived diagnoses, which we have demonstrated in the current study. Our findings also suggest that prior estimates of mood and anxiety disorders in Ontario, Canada using either administrative or survey data alone may be insufficient for reliably estimating a population prevalence, which has important implications for policy-makers.

The Bayesian analysis used in this work was developed more than two decades ago.⁽¹⁶⁾ It has been used to estimate prevalence in various clinical settings, however forward citation searches of the seminal paper suggest there is limited use of this analytical technique for the analysis of population-level data.⁽¹⁶⁾ Although we have been successful in adapting this approach, the increasing availability of linked data sources using multiple measures presents opportunities to build on this work going forward. While there is a need to test the performance of this methodology in other settings with other linked measures, we believe this Bayesian approach is flexible and adaptable. The code available at GitHub provides a platform for comparing newly available linked data. Also, the ability to test model fit in Stan is a straightforward process. One potential challenge for the use of this method in other settings is deciding on priors to inform the model. This process relies on the researcher's ability to search and identify the highest quality validation studies available. We suggest the continued use of a sensitivity analysis to test the robustness of the findings with variable psychometric properties.

One of the inherent limitations of Bayesian modeling is its reliance on prior information, which in our case was the prior prevalence, concordance, and psychometric estimates obtained from our linked data and external sources. As such, our analyses are limited by the accuracy of the survey- and administrative-derived diagnoses of mood and anxiety disorders. Our findings may not be generalizable to certain marginalized populations within Canada⁽¹⁴⁾, as the data limits our ability to identify some migrant groups, the homeless, institutionalized populations, and Indigenous people living on reserves.⁽¹⁴⁾ Furthermore, our sample may have been affected by survey non-response bias, in addition to respondents of the survey who agreed to have their data released for linkage, and those that did not.⁽³¹⁾ Also, the generalizability of the findings may be limited as results were only derived from one province of a nationwide survey. As new data linkages become available, however, the ability to provide more granular estimates for various high-risk groups will become possible. Another limitation to this study is that prior information on the psychometric properties of the administrative data algorithm were based on depressive disorders only, which may differ from the psychometric properties for identifying anxiety disorders. This was less of a concern for our survey-derived estimates, as the psychometric properties of our measure of anxiety disorders was similar to that for depressive disorders. Furthermore, we used a validation study of the CIDI measuring lifetime depression, which may also have different psychometric properties than a 12-month measure. However, our sensitivity analysis evaluating the impact of a range of psychometric properties did suggest that if the true psychometric properties were different (<10%), with the exception of the specificity of our survey data measure, they would not appreciably impact our combined estimate. There has been an ongoing debate regarding the reliability and validity of structured interviews being administered by lay interviewers compared to clinicians in the

collection of survey data.⁽³²⁾ While are unaware of any formal assessment of the inter-rater reliability of the interviewers in the 2012 CCHS-MH, we are confident in the results of the CIDI as it is a highly structured measure that has been shown to be reliability in many settings.⁽³³⁾

In conclusion, accurate population-based estimates of disease are the cornerstone of health service planning and resource allocation. The current lack of a universally accepted measure of population surveillance for mood and anxiety disorders has provided an opportunity to use a unique data linkage and novel analytical techniques to improve our estimates of the prevalence of these common mental disorders. We have demonstrated how the use of Bayesian approaches may provide a more informed and accurate estimate of mood and anxiety disorders in the population. This work provides a blueprint for future population-based estimates of disease using linked health data sources.

4.5 References

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Chapter 5: Examining Variations in the Prevalence of Diagnosed Mood or Anxiety Disorders Among Migrant Groups in Ontario, 1995-2015: A Population-based, Repeated Cross-sectional Study⁴

5.1 Introduction

Mood and anxiety disorders are leading contributors to the global burden of disease.^(1,2) In Canada, these common mental disorders contribute to substantial morbidity and mortality.^(3,4) Mood and anxiety disorders are responsible for three in every four contacts with the health care system for mental health reasons, and are currently ranked as the 6th and 7th leading contributors to years lived with disability in Canada.^(4,5)

Immigrants and refugees often have unique experiences that can affect their mental health, which require culturally adapted mental health services and support.^(6,7) Although migration is a global phenomenon, evidence points to geographical trends in the prevalence of mood or anxiety disorders among migrant groups compared to native-born populations. Evidence from outside of North America suggests that first-generation migrant status is associated with an increased risk of both mood and anxiety disorders.^(8,9) Research from North America, including evidence from Canada, suggests the opposite trend, where first-generation migrant groups have a lower frequency of mood or anxiety disorders compared to the native born population.^(4,10-12)

A recent systematic review identified that in Canadian settings, most research estimating the prevalence of mood and anxiety disorders among migrant groups has relied on population health survey data, and there is limited research estimating prevalence using health administrative databases.⁽¹²⁾ This is an important gap, as recent work evaluating the concordance between survey and health administrative data sources suggest that the use of either survey or health administrative data sources alone may be insufficient in providing accurate estimates of mood and anxiety disorders at the population level.⁽¹³⁾ A strength of health administrative data for estimating the prevalence of mental disorders among migrant

⁴ A version of this chapter will be submitted for publication to the *Journal of Affective Disorders*.

groups is the availability of large samples to enable more granular analyses, which can help avoid misleading inferences drawn from higher-level aggregated analyses.^(13,14) Current Canadian estimates have been limited in their evaluation of the characteristics of migrant groups, including differences in mood or anxiety disorders between migrant classes, as well as differences by region of birth.^(14,15) These factors have shown to be associated with mood and anxiety disorders in other settings.⁽¹⁶⁾ Another key consideration is length of time spent in Canada.⁽¹⁷⁾ Research in Canadian settings suggest that recent migrants have lower estimates of depression both within 5 years of migration and within 10 years of migration, relative to long-term migrants arriving 10 to 30 years prior.^(12,18) Health administrative data also provide the opportunity to track estimates of mood or anxiety disorders over time. This can be used to study the relationship between recent migrant status and mood or anxiety disorders at various time points, which can provide insight into the mental health and mental health service delivery for newly arrived migrants to Ontario over the past two decades.

The goal of this work was to estimate variation in diagnosis of mood or anxiety disorders among migrant groups using linked population-based health administrative data. Specifically, our objectives were to: (1) estimate trends in diagnosis of mood or anxiety disorders among first-generation migrant groups between 1995 and 2015; and (2) compare age- and sex-adjusted estimates of the prevalence of mood or anxiety disorders among recent (<5 years in Canada) and settled (5 to 10 years in Canada) migrant groups, relative to the general population. We additionally examined the role of important risk factors, including migrant class and region of birth.

5.2 Methods

5.2.1 Sample

Using health administrative data from 1995 to 2015, we created four separate cross-sections of data, each five years in length. This allowed us to compare four consistent exposure groups over the 20-year period. We included all Ontarians who were between the ages of 16 and 64 years at the start of each repeated cross-section. Using these cross-sections, we were able to examine trends in 5-year prevalence estimates among migrant

groups, relative to the general population, across the four time periods. Figure 5.1 presents the flow chart of our repeated cross-sectional design.

5.2.2 Source of Data

We obtained data from ICES, which is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement. We accessed data on mood and anxiety disorders from the following databases: (i) Ontario Health Insurance Plan (OHIP; 1994-2015), which covers (>96%) of the population of Ontario with universal coverage of all medically necessary services.⁽¹⁹⁾ OHIP contains physician billing data, including billings from primary care and emergency department physicians; (ii) Ontario Mental Health Reporting System (OMHRS; 2005-2014), which includes data on adult inpatient psychiatric hospitalizations to designated psychiatric beds⁽²⁰⁾; (iii) Discharge Abstract Database (DAD; 1995-2014), which captures data on all inpatient hospitalizations, including psychiatric hospitalizations not captured in OMHRS⁽²¹⁾. We also linked data from the Immigration, Refugees, and Citizenship Canada (IRCC) Permanent Resident Database (1985-2014), which contains information on all permanent and temporary residents landing in Ontario, Canada, dating back to 1985. For demographic information, we used the Registered Persons Database (RPDB; 1995-2014), which contains information on people registered for OHIP, including date of birth, sex, and neighbourhood-level income quintile.

We followed the RECORD guidelines (REporting of studies Conducted using Observational Routinely-collected health Data; Appendix 5.1).⁽²²⁾

5.2.3 Case Ascertainment

Diagnoses of mood or anxiety disorders were identified using the following standardized algorithm: (1) one hospitalization reported in OMHRS or DAD for a mood or anxiety disorder within a given 5-year cross-section; or (2) one visit to a psychiatrist for a mood or anxiety disorder within a 5-year cross-section; or (3) at least two outpatient OHIP physician billing claims (including billing from general practitioners and emergency department physicians) with a diagnosis code for a mood or anxiety disorder in any 12-month period

during the 5-year cross-section, where one of the codes must be within the 5-year window. This algorithm is similar to a validated algorithm used to identify depressive disorders in other Canadian settings, which had a sensitivity of 61.4%, specificity of 94.3%, a positive predictive value of 69.7%, and a negative predictive value of 92.0%.^(23,24) A list of diagnostic codes used to identify cases of mood or anxiety disorders is available in Appendix 5.2.

5.2.4 Exposure Classification

Our exposure of interest was first-generation migrant status, stratified by time spent in Canada. We compared recent migrant groups (less than 5 years in Canada), with settled migrant groups (between 5 and 10 years in Canada), and the general population (including native born Canadians, second generation migrant groups, long-term residents of Canada for more than 10 years). Exposure status was identified at the beginning of each of our four cross-sections and was identified using data from the IRCC Permanent Resident Database. We further explored trends in prevalence of diagnosed mood or anxiety disorders by migrant class (economic, family reunification, refugee), as well as by region of birth (European, Caribbean, South Asian, East Asian, Latin American, North African/Middle Eastern, African). We excluded data from the “other” migrant class (~1% of all migrants), as this categorization is inconsistent between cross sections. These categorization are further defined in Table 5.1.^(25,26)

5.2.5 Socio-Demographic Factors

We obtained data on socio-demographic factors from RPDB and IRCC databases. For migrant groups, we obtained information on country of birth and migrant class. For both the migrant groups and the general population, we obtained data on age, sex, urban vs rural place of residence (greater or less than a core population of 10,000), and neighborhood-level income quintiles.

5.2.6 Data Analysis

We computed descriptive statistics using means and standard deviations for continuous data and counts and proportions for categorical data. We used standardized differences to

compare the distribution of baseline covariates between groups. A <10% standardized difference has been shown to be equivalent to having a phi coefficient of 0.05, indicative of a non-significant difference across groups.⁽²⁷⁾ We calculated 5-year prevalence estimates of mood or anxiety disorders for each of our cross-sections stratified by our groups of interest. The stratification groups included: 1) migrant status (recent migrants, settled migrants, general population); 2) migrant class (economic, family reunification, refugee); and 3) region of birth.

We also calculated weighted mean prevalence estimates with weighted 95% confidence intervals (CIs) combining estimates from our four cross sections. We tested differences between our groups of interest using weighted Welch's two-tailed t-tests, which were used to calculate weighted mean differences and standard errors. We used an alpha of 0.05, and the null hypothesis was equal means between groups.

We used modified Poisson regression models with robust variance estimators to estimate the prevalence ratios (PRs) and 95% CIs for mood and anxiety disorders in recent and settled migrant groups, relative to the general population. PRs were adjusted for age, sex, rural residence, and neighbourhood-level income.⁽²⁸⁾ (See Table 5.3) Estimates from our four repeated cross-sections were assessed separately.

To explore differences between our four cross sections, we performed a generalized estimating equation (GEE) adjusting for the correlation between people included in multiple cross sections. We analyzed differences between our groups of interest over the four cross sections adjusting for age, sex, rural residence, and neighbourhood-level income.

As a secondary analysis, we conducted a within-migrant analysis assessing differences between recent, settled, and long-term migrants living in Canada for more than 10 years, adjusting for migrant class and region of birth (See Table 5.5). Estimates were obtained from cross-sections 2-4, as we were unable to differentiate between the general population and long-term migrants in cross-section 1.

5.3 Results

5.3.1 Sample Characteristics

Our samples increased from cross-section #1 to cross-section #4, ranging from 7,357,862 to 9,502,713 people. The samples comprised approximately 50% men and women in each cross-section, with the mean age ranging from 38 (SD = 13) to 40 (SD = 14). First-generation recent and settled migrant groups between the ages of 16 and 64 made up between 8.1% and 9.3% of the samples. Trends throughout all four cross-sections suggest that compared to the general population, recent and settled migrant groups were younger and more likely to be living in areas with the lowest income quintiles. Recent and settled migrant groups were also less likely to live in rural settings. Table 5.2 provides our descriptive statistics for the socio-demographic characteristics of cross-section 2, which was similar to those from the other cross-sections (see Appendix 5.3 for data from all cross-sections). There was minimal missing data (<1%) for our variables of interest.

5.3.2 5-year prevalence

The 5-year prevalence of mood or anxiety disorders in the Ontario population ranged from 6.74% to 7.57%. Figure 5.2 presents 5-year prevalence estimates across our four cross-sections by migrant group. The prevalence of mood or anxiety disorders was significantly lower in recent migrant groups (weighted mean = 4.10%, 95%CI = 3.59%, 4.60%), and settled migrant groups (weighted mean = 4.77%, 95%CI = 3.94%, 5.61%), relative to the general population (weighted mean = 7.39%, 95%CI = 6.83%, 7.94%). We did not find a statistically significant difference in the weighted prevalence estimates for recent and settled migrants (See Table 5.3).

Within migrant groups, there were differences among migrant classes. The prevalence of mood and anxiety disorders was lowest in economic migrant groups (weighted mean 4.20%, 95%CI = 3.85%, 4.55%), followed by family reunification migrant groups (weighted mean 4.77%, 95%CI = 4.32%, 5.21%) and was highest in refugee groups (weighted mean 7.02%, 95%CI = 6.01%, 8.03%). Refugee groups had significantly higher weighted prevalence compared to economic and family reunification migrants. Family

reunification migrants had significantly higher weighted prevalence compared to economic migrants (See Table 5.3).

Furthermore, the prevalence of mood or anxiety disorders varied by region of birth, with the lowest prevalence observed among migrants born in East Asian countries (weighted mean = 2.57%, 95%CI = 2.2%, 2.93%), and the highest among migrants born in North African/Middle Eastern countries (weighted mean = 7.68%, 95%CI = 7.49%, 7.88%). Migrants from all regions, apart from people born in North African/Middle Eastern countries, had significantly lower weighted prevalence of mood or anxiety disorder compared to the general population (weighted mean = 7.49, 95%CI = 7.01%, 7.98%) (See Table 5.3).

5.3.3 Regression Analyses: Migrant Status

Results from our modified Poisson regression analyses with robust variance estimators suggests that the prevalence of mood or anxiety disorder is lower in the recent migrant group (Range: PR = 0.47, 95%CI = 0.46, 0.48; PR = 0.52, 95%CI = 0.51, 0.53) and in the settled migrant groups (Range: PR = 0.53, 95%CI = 0.52, 0.54; PR = 0.66; 95%CI = 0.65, 0.67) compared to the general population, when adjusting for age, sex, neighbourhood-level income quintile, and rural residence (See Table 5.4).

5.3.4 Generalized Estimating Equation

The findings from our 5-year prevalence estimates indicated we should test whether there was a significant increase in the prevalence of mood or anxiety disorders among refugee groups over the four cross sections. We tested the interaction between migrant class and our four cross sections, adjusting for the correlation between people identified in multiple cross sections, as well as age, sex, rural residence, and neighborhood level income. We found there was a significant increase in the prevalence of mood or anxiety disorders among refugee groups from the first cross section to the second (PR = 1.12, 95%CI = 1.09, 1.17), third (PR = 1.12, 95%CI = 1.09, 1.16), and the four cross section (PR = 1.27, 95%CI = 1.23, 1.31). For comparison, the results of an adjusted modified Poisson regression would have produced slightly inflated findings (second cross section (PR = 1.15, 95%CI =

1.11, 1.19), third (PR = 1.12, 95%CI = 1.08, 1.16), and fourth (PR = 1.29, 95%CI = 1.26, 1.34)).

5.3.5 Secondary Analyses

For our migrant specific analyses, adjusting for region of birth, we found that both recent migrants (Range: PR = 0.67, 95%CI = 0.66, 0.69; PR = 0.77, 95%CI = 0.75, 0.79) and settled migrants (Range: PR = 0.76, 95%CI = 0.75, 0.78; PR = 0.91, 95%CI = 0.89, 0.93) had significantly lower prevalence than migrants living in Canada for more than 10 years (see Table 5.5). Similar findings were observed when adjusting for migrant class (See Table 5.5).

Table 5.1: Description of migrant classes and regions of birth used to categorize migrant groups.

Migrant Class	
Classes	Description
	Migrant classes are based on categories in the Immigration, Refugees and Citizenship Canada Permanent Resident database. We didn't focus on migrants who were not categorized into one of the following categories, ~1%, due to their high lack of homogeneity as a group. ⁽⁵⁰⁾
<i>Economic</i>	Economic migrant groups are the most common in Canada making up ~60% of migrants in 2015. ⁽⁵⁰⁾ Applying for economic migrant status in Canada is done online by submitting a profile, under one of three federal Canada immigration programs or a provincial immigration program.
<i>Family Reunification</i>	These migrants are sponsored by family members in Canada consisting of ~24% of all migrants in 2015. ⁽⁵⁰⁾ All Canadian citizens and permanent residents are able to sponsor family members to immigrate to Canada.
<i>Refugees</i>	Refugee status in Canada is determined by the Immigration and Refugee Board of Canada. Refugees make up ~13% of all migrants in Canada in 2015. ⁽⁵⁰⁾ Successful refugee claimants are grouped into two separate categories: (1) convention refugees, which consist of people unable to return to their host country due to the threat of persecution, and (2) people in need of protection, which are groups of migrants who cannot return to their host countries due to the threat of physical harm.
Regions of Birth	
Regions of Birth	Description
	All categories of are based on country of birth obtained from the IRCC Permanent Resident database. Classifications of country of birth were developed by Statistics Canada ⁽²⁶⁾ , and were further condensed to be consistent with prior research. ⁽²⁵⁾
<i>General Population</i>	Canada, North America. Second Generation migrant groups, migrants in Canada for more than 10 years, and first-generation migrants who landed outside of Ontario.
<i>European</i>	Northern European (e.g. England, Scotland), Southern European (e.g. Italy, Greece), Western European (e.g. France, Germany) and Eastern European (e.g. Poland), and USSR (former) (e.g. Russia).
<i>Caribbean</i>	Caribbean (e.g. Jamaica, Cuba, Haiti, Puerto Rico, and Bermuda)
<i>South Asian</i>	South Asia (e.g. India, Pakistan, Bangladesh, Nepal, Sri Lanka)
<i>East Asian</i>	East/ Southeast Asian (e.g. China, Japan, Philippines, Korea, Thailand, Taiwan, Vietnam)
<i>Latin American</i>	Central/South American (e.g. Mexico, Argentina, Brazil)
<i>North African & Middle Eastern</i>	Middle Eastern/North African (e.g. Egypt, Morocco, Turkey, Israel, Syria, Afghanistan)
<i>African</i>	Central, East, Southern, Western African (e.g. Kenya, Ethiopia, Ghana, Nigeria, Zimbabwe).

Table 5.2: Socio-Demographic characteristics of migrant groups and the general population.

Cross-Section 2 - Followed: 2000-2005						
Variable		General Population n=7,222,605 (n,SD/%)	Recent Migrant n= 336,098 (n,SD/%)	Standardized Difference	Settled Migrant n=406,744 (n,SD/%)	Standardized Difference
Age	<i>mean (SD)</i>	38.91(12.99)	34.88 (11.12)	0.33	36.64 (11.38)	0.19
Sex	Female	49.9%	51.2%	0.02	50.2%	0.00
	Male	50.1%	48.8%		49.8%	
Income Quintile	-5 (Highest)	21.0%	9.8%	0.32	10.4%	0.29
	-4	20.3%	13.0%	0.20	13.6%	0.18
	-3	20.4%	17.1%	0.08	17.7%	0.07
	-2	20.0%	23.6%	0.09	23.6%	0.09
	-1 (Lowest)	18.4%	36.6%	0.42	34.7%	0.38
Rural	-Urban	86.3%	99.1%	0.51	98.9%	0.50
	-Rural	13.7%	0.9%		1.1%	

Table 5.3: Weighted Welch's t-tests comparing weighted mean prevalence estimates of mood or anxiety disorders between stratified migrant groups.

Comparison	Absolute Weighted Mean Difference	Std. Err	p-value
Recent v Settled	0.67	0.29	0.066
Recent v General	3.29	0.22	<0.001*
Settled v General	2.61	0.29	<0.001*
Economic v Refugee	2.82	0.32	0.001*
Economic v Family	0.57	0.17	0.016*
Family v Refugee	2.25	0.33	0.002*
General v European	1.38	0.23	0.0012*
General v Caribbean	2.54	0.22	<0.001*
General v South Asian	3.09	0.21	<0.001*
General v East Asian	4.93	0.18	<0.001*
General v Latin American	1.07	0.17	0.0014*
General v North African & Middle Eastern	0.19	0.15	0.298
African	2.36	0.20	<0.001*

*Indicates $p < 0.05$.

Table 5.4: Modified Poisson regression analyses assessing prevalence of diagnosed mood or anxiety disorders between recent migrant groups, settled migrant groups, and the general population.

Outcomes	General Population PR (95%CI)	Recent Migrant PR (95%CI)	Settled Migrant PR (95%CI)
Cross-Section 1			
Unadjusted	Ref	0.56 (0.55,0.57)	0.73 (0.72,0.74)
Adjusted	Ref	0.49 (0.49,0.50)	0.66 (0.65,0.67)
Cross-Section 2			
Unadjusted	Ref	0.58 (0.58,0.59)	0.65 (0.64,0.66)
Adjusted	Ref	0.52 (0.51,0.53)	0.58 (0.57,0.59)
Cross-Section 3			
Unadjusted	Ref	0.54 (0.53,0.55)	0.67 (0.66,0.68)
Adjusted	Ref	0.48 (0.47,0.49)	0.61 (0.60,0.62)
Cross-Section 4			
Unadjusted	Ref	0.54 (0.53,0.55)	0.59 (0.58,0.59)
Adjusted	Ref	0.47 (0.46,0.48)	0.53 (0.52,0.54)

Adjusted: adjusted for age, sex, income, rural status.

Table 5.5: Modified Poisson regression analyses assessing prevalence of diagnosed mood or anxiety disorders between recent migrant groups, settled migrant groups, and migrants living in Canada for >10 years.

Outcomes	Migrants >10 yrs in Canada PR (95%CI)	Recent Migrant PR (95%CI)	Settled Migrant PR (95%CI)
Cross-Section 2			
Unadjusted	Ref	0.74 (0.73,0.76)	0.83 (0.81,0.84)
Adjusted 1	Ref	0.77 (0.75,0.79)	0.85 (0.83,0.87)
Adjusted 2	Ref	0.75 (0.73,0.76)	0.81 (0.79,0.83)
Adjusted 3	Ref	0.79 (0.77,0.81)	0.85 (0.83,0.87)
Cross-Section 3			
Unadjusted	Ref	0.70 (0.69,0.71)	0.89 (0.87,0.91)
Adjusted 1	Ref	0.72 (0.70,0.73)	0.91 (0.89,0.93)
Adjusted 2	Ref	0.72 (0.71,0.74)	0.92 (0.90,0.94)
Adjusted 3	Ref	0.76 (0.74,0.77)	0.95 (0.93,0.97)
Cross-Section 4			
Unadjusted	Ref	0.67 (0.66,0.68)	0.75 (0.74,0.76)
Adjusted 1	Ref	0.67 (0.66,0.69)	0.76 (0.75,0.78)
Adjusted 2	Ref	0.66 (0.64,0.67)	0.76 (0.75,0.77)
Adjusted 3	Ref	0.68 (0.67,0.69)	0.78 (0.77,0.79)

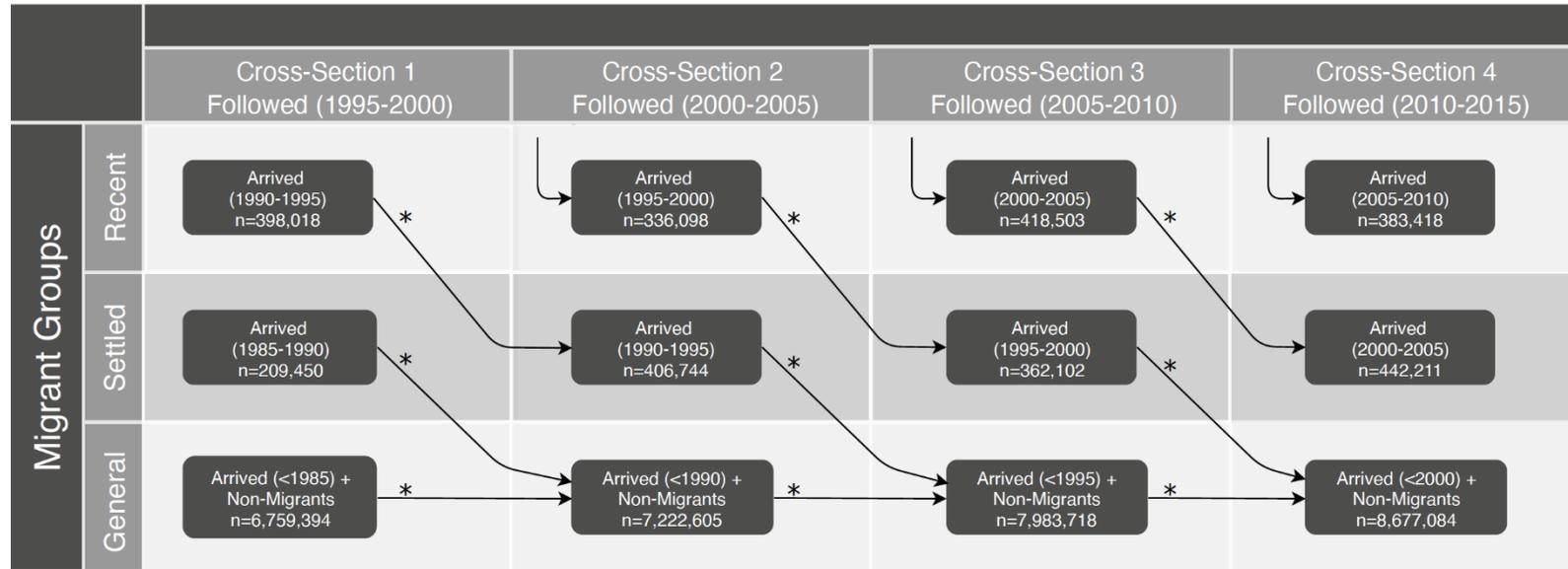
Adjusted 1: adjusted for age, sex, income, rural status, region of birth.

Adjusted 2: adjusted for age, sex, income, rural status, migrant class.

Adjusted 3: adjusted for age, sex, income, rural status, migrant class, region of birth.

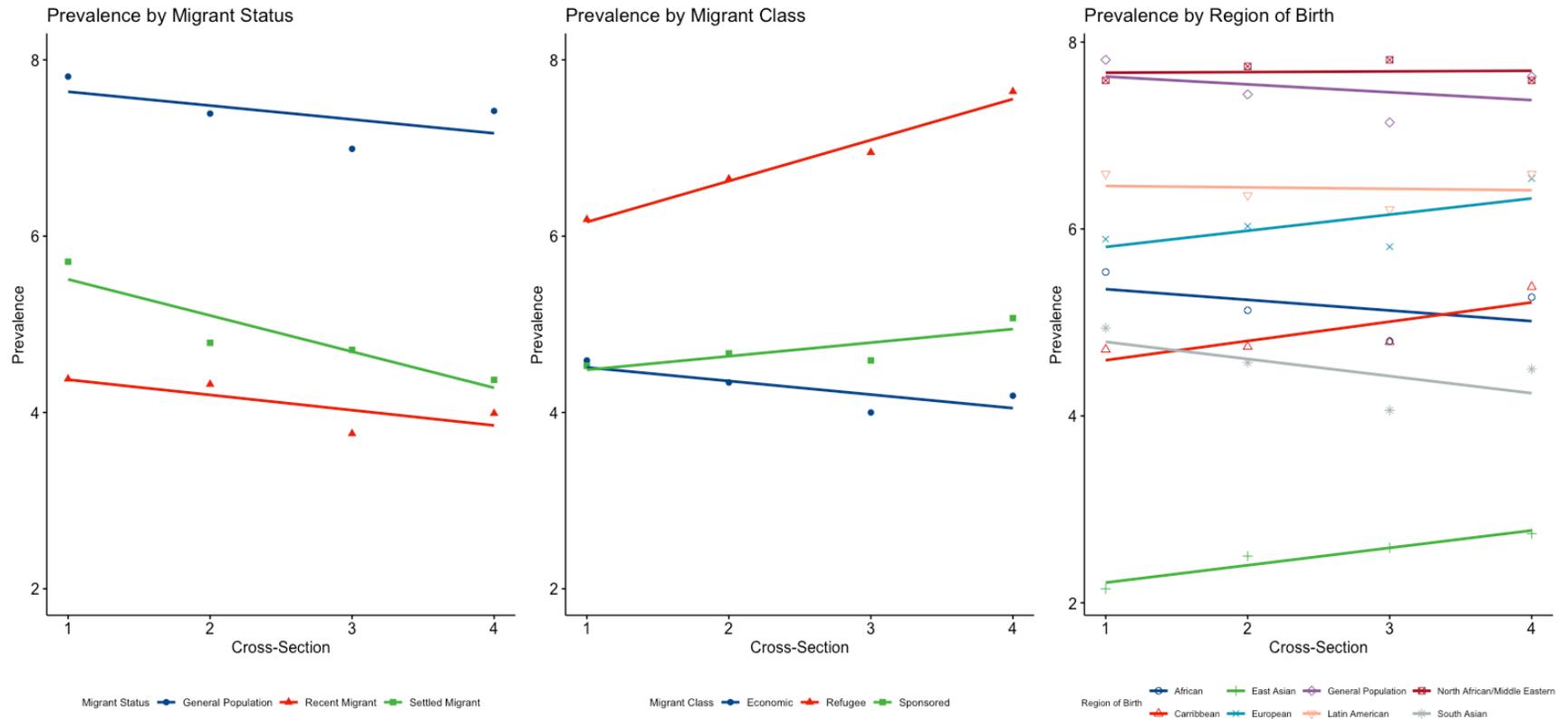
*Not possible due a lack of migrant groups in the reference category >10 yrs.

Figure 5.1: Study Flow-Chart.



*Indicates potential inflow and outflow of people between cross-sections as they meet or are excluded by our inclusion criteria.

Figure 5.2: 5-year prevalence estimates across our four cross-sections by migrant status, migrant class, and region of birth.



5.4 Discussion

Our findings suggest that the majority of migrant groups in Ontario, Canada, have a lower prevalence of diagnosed mood or anxiety disorders, relative to the general population. Although this finding aligns with prior North American research ^(4,12), our work builds on this evidence by providing a detailed description of the relationship between migrant status, migrant class, and region of birth with mood or anxiety disorders using health administrative data. Our analyses highlight the complex relationship between migrant status and mood and anxiety disorders, and how estimates vary by time spent in Canada, region of birth, and migrant class. Taken together with other Canadian and international evidence ^(12,29), our findings confirm that not all migrant groups share the same burden of mood and anxiety disorders. As such, our findings highlight the importance of providing context when analyzing the prevalence of mood or anxiety disorders among migrant groups. It is important to note that various migrant groups may face the same burden, however, cultural factors may influence how people manifest anxiety and depression and how/if they seek help.⁽⁷⁾

Prevalence estimates were highest among refugee groups, compared to both family reunification migrants and economic migrants. Similar trends have been observed in prior Canadian research assessing primary care contacts for common mental disorders among Canada's migrant population.^(3,30) We also found variation in 5-year prevalence estimates of mood and anxiety disorders by region of birth, which align with prior work using self-reported population health survey data from Ontario.⁽¹⁵⁾ The findings from this survey suggest that people born in European countries had a higher prevalence of mood or anxiety disorders than people born in African and Caribbean countries, who had higher prevalence than people from South Asian countries, and people from East Asian countries having the lowest estimates.⁽¹⁵⁾ Our analyses enabled an examination of more granular groups, and the findings suggest that people born in North African/Middle Eastern countries had a consistently higher prevalence of mood and anxiety disorders compared to migrants from other regions. These findings were similar to those from the Longitudinal Survey of Immigrants to Canada, which also found that migrants from Africa and the Middle East had among the highest levels of reported emotional problems.⁽³¹⁾

Our findings also suggest that the prevalence of mood or anxiety disorders increases with longer time spent in Canada. These findings align with other Canadian research using survey methodology, which found lower estimates of depression both within 5 years of migrating and within 10 years of migrating to Canada, compared to migrants arriving in Canada between 10 to 30 years prior.⁽¹⁸⁾ Our findings are also consistent with the results from our recent systematic review, which identified that recent migrant groups in Canada had lower prevalence estimates compared to long-term migrant groups.⁽¹²⁾ Although prevalence estimates from settled migrants were consistently higher than those from recent migrant groups, the differences between weighted means were not statistically significant. This suggests that migrant groups may be healthier at arrival until at least 10 years spent in Canada. It is important to note that although certain migrant groups may be at a lower risk of mood or anxiety disorders upon arrival, they may still have higher risks for other mental health conditions, including psychosis, compared to the general population.^(32,33)

Though this work was not designed to follow trajectories, our findings align with the phenomenon of the healthy migrant effect, where migrant groups are generally healthier during the early years following migration, followed by a general deterioration in health status to more closely align with the health status of the host country.⁽⁴⁾ Further research on mental health trajectories post-migration could be used to test for the healthy migrant effect, which may vary by migrant class and region of birth due to variation in pre-migratory stressors. This healthy migrant effect may be due to positive migrant selection, which arises when migrant groups are selected on a number of criteria related to skills and education,⁽³⁴⁾ leading to migrant groups being healthier than the general population.⁽³⁵⁾ In Canada, economic migrants, who make up roughly 50% of all new Canadians, are subject to a human capital model of immigration.^(32,36) This system favours people who are young, educated, and proficient in English or French.⁽³²⁾ Furthermore, all migrants are subject to a pre-arrival medical exam, though only a small fraction ~0.001% are denied entry on this basis.⁽³⁷⁾ The healthy migrant effect may also be due to the phenomenon known as “salmon bias”, where migrants may return to their home country through illness, while the healthier migrants remain in the host nation.⁽³⁸⁾ It is important to note that this effect may be less pronounced in Canada compared to European nations, due to relative geographical isolation.

We identified temporal trends across the four cross-sections. Although there were consistent prevalence estimates for time spent in Canada, region of birth, and among economic and family reunification migrant classes, we observed a steady and significant increase in 5-year prevalence estimates of mood or anxiety disorders among refugees across the four cross-sections. There has been a number of specific targeted resettlements to Canada between 1995 and 2015, however there is no indication that these specific changes to refugee policy have changed the health status of refugees.⁽³⁹⁾ This trend may also reflect a possible detection bias driven by an increase in the access and utilization of mental health services for refugee groups in Canada. This trend may not be consistent across the range of refugee groups arriving in Canada, who may differ on pre-migratory risk factors and post-migratory social and medical support. As such, there is a need for future work to perform a more detailed assessment of trends among the various refugee groups.

5.4.1 Limitations

A limitation to this work is that our use of health administrative data is centered on billing codes and not standardized clinical or research diagnoses. As such, thresholds for diagnoses vary by clinician and setting.⁽⁴⁰⁾ There may also be racial bias in mental health diagnostic practices in Canada, which may lead to an under or overestimate of the prevalence of mood or anxiety disorders among various migrant groups.⁽⁴¹⁾

Our use of billing codes to estimate the prevalence of mood or anxiety disorders will under-estimate the prevalence compared to estimates obtained from population-based surveys.⁽¹³⁾ These estimates should not be confused with the overall true estimates of mood or anxiety disorders. Evidence suggests that contact rates (identified in health administrative data) and population rates (identified in population-surveys) may not align due to barriers that exist in accessing mental health care and receiving a diagnosis of a mood or anxiety disorder.^(3,42,43) Research from Ontario suggests that 90% of people with depressive disorders have had contact with a primary care clinician for mental health reasons, however, only 50% have received a mental health diagnosis.^(44,45)

Another limitation is that data from IRCC will allow us to identify people landing in Ontario but will misclassify migrants who land in other parts of Canada and moved to

Ontario. Our general population comparison group will also include people who migrated prior to 1985 as well as second-generation migrants (~22.5% of the population), who have been shown to have different frequency of mood and anxiety disorders compared to both first generation migrant and the general population.^(29,46,47) In the US, population estimates of major depression among second-generation migrant groups were in-between estimates from first-generation migrant groups and the generation population.⁽⁴⁾ We will also lose migrants who were unable to be linked to the administrative data holdings, which represents approximately 15% of migrants.⁽³²⁾ Evidence suggests that the linkage rates are not equal across ethnic groups, with East Asian immigrants having the lowest proportion of successful linkage.⁽⁴⁸⁾ Consequently, our results may not be generalizable to migrants who are underrepresented in the health administrative data. In order to maintain consistency between our cross sections, we used billings to identify emergency department visits, rather than an emergency department database, which led to a loss of approximately 17% of all emergency department visits. This may have also contributed to an underestimate of the prevalence of mood or anxiety disorders in our cross sections. We were also limited in the covariates that are available in the administrative data. Other potential confounding factors, which we were unable to evaluate, include reason for migration, family history of mood or anxiety disorder, history of trauma, and behavioural risk factors including diet, sleep, and physical activity.^(47,49) Future research should also assess the relationship between physical comorbidities, mood and anxiety disorders, and migration. Potential variation in physical comorbidities for various migrant groups may help reveal patterns of health care use, including mental-health related service use.⁽³⁾

5.4.2 Conclusion

Our findings highlight the complexity of the relationship between migration and mood or anxiety disorders and suggest that not all migrant groups share the same burden of mood or anxiety disorders. Prevalence of mood or anxiety disorders among migrant groups varies greatly by migrant class and region of birth. Furthermore, our findings suggest an increasing trend in the prevalence of mood or anxiety disorders among refugee groups over time. These results can be used to help inform health service allocation and the development of supportive programs for specific migrant groups in Ontario. There is a

need to better understand migrant specific risk factors influencing the risk of mood or anxiety disorders and time-to-diagnosis post-migration.

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Chapter 6: Discussion, Conclusion

The overarching goal of this dissertation was to improve the mental health services and outcomes for Canada's diverse population, which is a strategic direction in the national mental health strategy from the Mental Health Commission of Canada.⁽¹⁾ This work represents progress towards a better understanding of the estimation of mood or anxiety disorders in the population of Ontario and among diverse population subgroups. We have identified and filled important gaps in the current literature and have provided guidance for future research.

The recurring theme across this body of work is that context is the foundation of well-informed epidemiologic estimates. We must work within the confines of our data and characterizing these data and understanding their strengths and limitations is a key foundation for progress in psychiatric epidemiology in Canada. Throughout this thesis, we have leveraged the strengths of various population-based data sources available in Ontario to answer new research questions. Specifically, our use of health administrative data sources coupled with novel data linkages and methodology has created a foundation for future research on common mental disorders in Ontario. We have filled knowledge gaps in our understanding of the relationship between migration and mood or anxiety disorders in Canada by using health administrative data, and by taking into consideration key migrant-specific factors, such as migrant class, that have not previously been accounted for in prior epidemiologic estimates.

6.1 Key Findings

i. There are a number of important gaps in the Canadian literature regarding our understanding of the relationship between migration and mood or anxiety disorders.

Findings from our systematic review (Manuscript I), as well as the thesis literature review chapter, revealed a number of gaps in the Canadian literature. First, the vast majority of available evidence comparing estimates of mood or anxiety disorders between migrants and the general population rely on survey data, in particular the Canadian Community Health Survey. As such, there was a need to evaluate whether the findings identified in the survey population were consistent with other data sources. This thinking led us to identify another gap in the literature of whether estimates derived from surveys align with those from health administrative data. Also, if estimates derived from these two data sources were not in alignment, which data source, or combination of data sources, would most closely reflect a true population estimate of mood or anxiety disorders? Furthermore, how would this influence our interpretation of estimates among migrant groups, obtained from either surveys or health administrative data alone?

Another key gap identified in our systematic review (Manuscript I) was that current estimates of mood or anxiety disorders among migrant groups lacked granularity, as current Canadian literature routinely groups migrants from different countries of origin and migrant class together. As such, there is limited Canadian evidence assessing the influences of key socio-demographic and migrant specific factors on estimates of mood or anxiety disorders.

ii. Estimates of mood or anxiety disorders from surveys have low to moderate overlap with those from health administrative data.

Estimating the prevalence of common mental disorders at the population level is a challenging endeavour. Currently, global evidence relies heavily on estimates derived from surveys, however there has been an increased interest in the use of health administrative data for surveillance of mental disorders.(2–4) In Canada, both survey and health administrative data sources have been used interchangeably to estimate the prevalence of common mental disorders to inform health services and health policy. Furthermore, the existence of new data linkages has provided epidemiologists the opportunity to ask novel questions and challenge prior assumptions regarding the measurement of mood or anxiety disorders at the population level. One idea we tested was that estimates of mood or anxiety disorders obtained from surveys align with those from health administrative data. This is foundational to our understanding of the burden of mood or anxiety disorders among migrant groups using these data sources, as current evidence relies heavily on survey data.

Evidence from Manuscript II suggests that the prevalence of mood or anxiety disorders derived from survey data were higher than those from health administrative data, and that there was a lack of concordance between these measures. This finding was consistent for both migrant and non-migrant groups, and the results are in line with prior work, which found that self-reported mental health care contacts were higher than those observed in health administrative data.(5–7) Although, these data sources may be identifying *different* people with a mood or anxiety disorder, they may also be identifying the *same group of people at varying stages of illness or treatment seeking times*.

Our finding of a lack of concordance is an important point of reference for future research, as making use of both survey and health administrative data together may provide a more complete view of population prevalence. Understanding how estimates from each of these

sources of data relate to one another is still a work in progress. We have found that people identified in both survey and health administrative databases with a mood or anxiety disorder were more likely to self-report higher levels of mental distress, compared to people identified in either administrative data or survey data alone. People identified as having a mood or anxiety disorder in the survey alone had the lowest levels of psychological distress. These findings suggest that there may be a severity gradient dependent on the source of data used to identify people with a mood or anxiety disorder. Our findings also suggest that income and employment are related to being identified in both survey and administrative data, compared to being identified in the survey alone. Specifically, people reporting being unemployed or unable to work were less likely to be identified in the survey only group, compared to being identified in both the survey and health administrative data. As people with more severe mood or anxiety disorders may be less likely to work, this finding supports the theory that the combined measure may be identifying people with higher severity of mental disorder.

The findings from our concordance work further revealed an interesting trend among migrant groups. Specifically, our results suggest that migrant groups were less likely to be identified in survey data alone, compared to being identified in both survey and health administrative data (PR: 0.82, 95%CI: 0.72,1.04). Furthermore, migrant groups were more likely to be identified in the health administrative data only group, relative to both survey and health administrative data (PR: 1.28, 95%CI: 0.99, 1.66). This suggests there may be variation in the ability of both measures to identify less severe cases of mood or anxiety disorders for migrant groups. Future work using multiple population-based measures of mood or anxiety disorders in migrants should take into consideration migrant status whenever possible. Furthermore, there may be added value in assessing estimates of mood

or anxiety disorders among migrant groups using multiple population-based data sources. It is important to note that the confidence intervals for these findings do include the possibility of a null effect.

iii. Using multiple population-based data sources simultaneous may improve our ability to estimate the population prevalence of mood or anxiety disorders.

Prior evidence has proposed that in the absence of a gold standard estimate of disease, the use of multiple measures simultaneously may be a useful tool for improving our estimates of disease prevalence.⁽⁸⁾ The gold standard measure for diagnosing mood or anxiety disorders is the clinical diagnostic interview; however, at the population-level, evidence from both survey and health administrative data are used to inform policy. Evidence on the concordance of these measures suggest that both measures may identify different populations at varying stages of illness and treatment. As such, we decided to use information from both data sources to estimate a combined prevalence. A strength of this approach is that it incorporates information regarding the psychometric properties of each measure, relative to a gold-standard diagnostic interview. Findings from Manuscript III suggest that the true population prevalence of mood and anxiety disorders may reside between estimates obtained from survey data and health administrative data. The combined prevalence of 8.6% (95%CI: 6.8%, 10.6%) was closer to the mean estimate from health administrative data (7.4%; 95%CI: 5.4%, 9.6%) compared to estimates from survey data (13.9%; 95%CI: 1.2%, 25%). This suggests that estimates from survey data alone may be overestimating of the prevalence of mood or anxiety disorders in the population. This methodology could be replicated for other disorders where there are no gold-standard for population-based measures.

The results of our Bayesian analyses highlight the strength of using multiple population-level sources of data simultaneously to estimate prevalence. An important component of the interpretation of these results is that the reference was the clinical diagnostic interview. If we step away from this point of reference and consider the findings from either survey or health administrative data as being relevant for our broader understanding of the burden of mood or anxiety disorders, our findings suggest that the use of either measure alone may be underestimating this burden. The prevalence of people with a mood or anxiety disorders using either measure was 20.4%, which was much higher than our estimate of a combined prevalence from our Bayesian analysis. There is currently much debate in the literature on the best way to measure the frequency of common mental disorders in the population. There is a need to establish a standardized measure for population prevalence of mood or anxiety disorders, as estimates are highly dependent on the source and structure of the data used. Future research may depart from point prevalence estimates based on binary cut-offs to work towards the presentations of dimensional aspects of mental health at the population level. These may include information from various factors including symptomatology, measures of function, health care contacts, and pharmaceutical use.(9,10)

We believe our work using linked survey and health administrative data will provide a guide for future analyses of other mental disorders. Using this linkage to compare self-reported assessments of mental health care needs and service use will be a useful tool to identify gaps in mental health care delivery. Working towards closing the gap between mental health care needs and service delivery is a key component of reducing the prevalence of mental illness in Canada. The findings from our concordance work also suggests that both measures may be identifying people at different stages of their mental

illness. Quantifying these stages of mental illness and how they relate to each measurement tool may provide insight on how we can use these tools to identify and reduce unmet mental health care needs.

iv. The relationship between migration and mood or anxiety disorders is dependent on migrant specific factors.

One of the primary objectives of this thesis was to improve our understanding of the relationship between migration and mood or anxiety disorders in Canada. This was accomplished by identifying and filling gaps in the Canadian literature. Our work provided one of the first uses of health administrative data to assess mood or anxiety disorders among migrant groups in Canada. The available data linkage from Immigration, Refugees, and Citizenship Canada (IRCC) Permanent Resident Database provided a strong platform to assess variation in mood or anxiety disorders among migrant groups in Ontario. This approach offered a number of strengths including a large sample size and the ability to assess a number of migrant-specific factors, including migrant class.⁽¹¹⁾ Our work builds on limited available North American evidence, which focuses on individual aspects of migration (i.e. time since arrival, ethnicity/country of birth) with and without a general population comparison group.^(11–15) Prior to this thesis, available evidence from Canadian settings, which has largely relied on survey data, suggested that migrant groups have lower prevalence of mood or anxiety disorders compared to the general population.⁽¹¹⁾

Findings from Manuscript IV suggest that estimates of mood or anxiety disorders are not consistent for all migrant groups. Specifically, trends in diagnosed mood or anxiety disorders vary by migrant class, time spent in Canada, and region of birth, with a number

of groups having similar or higher prevalence of mood or anxiety disorders compared to the general population. These findings highlight the importance of taking into consideration migrant-specific factors when researching mental health among migrant groups. Furthermore, the differences in prevalence of mood or anxiety disorders between migrant groups and the general population may reflect a number of factors, including cultural and system-level barriers to access mental health care.(12) Findings from a recent systematic review suggests there is higher stigma related to common mental disorders among ethnic minority groups compared to ethnic majority groups.(16) Elevated stigma among migrant groups in Canada may be contributing to lower estimates of mood or anxiety disorders in both survey and health administrative data. Future research is needed to understand the effects of stigma on mental health diagnoses in Canada,(16) and the impacts on epidemiologic estimates.

Additionally, cultural differences in how symptoms of mood and anxiety disorders are perceived and presented may vary. (17,18) For example, there is a propensity for Chinese people to emphasize somatic symptoms of depression, which can lead to greater challenges in diagnosing mood disorders. (18,19) If culturally sensitive guides for diagnosing mood and anxiety disorders were consistently used by clinicians (i.e. the CFI), there may be a reduction in the observed variation in the prevalence of mood or anxiety disorders among migrant groups. (20,21)

Our use of stratified analyses also suggests an increase in the prevalence of diagnosed mood or anxiety disorders among refugee groups between 1995 and 2015, whereas the prevalence in other migrant classes remained relatively stable. These findings may be an indication of an increase in access and service use for mood or anxiety disorders or could be due to an influx of less healthy refugee groups or increases in mental distress among

these groups over time. Shifts in immigration policies may be important to consider. There is a potential that increases in family separation, immigration detention, transportation loans, as well as shorter turnaround times for refugee hearings may be leading to higher psychological distress among refugee groups in Canada.(22) There remain many barriers to seeking mental health care for refugee groups in Canada. Furthermore, there are many components of immigration policy in Canada, which may influence stress and mental health.(22) Future work aimed at understanding these barriers and which policies may be helpful for reducing stress upon arrival is required to inform policy decision-makers.

Our findings suggest there is a need for Canadian researchers to collect data on factors surrounding the entire migration process. There remain many gaps in our knowledge on pre-migratory factors that may influence the mental health of new Canadians. Although we are not able to intervene on stressors that migrants face prior to arrival, we can use this information to help inform the development of specialized support programs for high-risk migrant groups following arrival.

6.2 Summary and Conclusion

The measurement of common mental disorders presents unique challenges. Making use of available population-level data sources and leveraging their strengths was an important component of this thesis. Both survey and health administrative data sources will continue to be used to estimate the prevalence of mood or anxiety disorders at the population-level. These estimates are important to understand disease burden and to inform resource allocation for mental health services. We believe researchers must thoroughly contextualize estimates drawn from these data sources to accurately inform policy.

Migrant groups in Canada do not share the same risk for mood or anxiety disorders. Experiences prior to, during, and following migration have led to large variation in the prevalence of mood or anxiety disorders by migrant class, region of birth, and time spent in Canada. Health administrative data is a useful tool for studying the complexity of the relationship between migration and mental health. We believe these data sources will continue to be a key component of future work assessing risk of various mental illnesses among migrant groups in Canada.

Reducing the mental health disparities that exist among new Canadians is important for the current and future success of the country. Work aimed at unraveling the intricacies of the relationship between migration and common mental disorders should remain a priority, as these disorders contribute significantly to the burden of mental illness in Canada. Providing supportive programs for high risk migrant groups upon arrival can reduce the negative effects of living with an untreated mental disorder. As researchers, we must continue to strive for accurate and well-informed measures of mental illness in the population to best serve policy makers and knowledge users. This dissertation has identified and addressed gaps in the current literature. We have been able to lay the groundwork for future studies using multiple population-based measures and have produced some of the first evidence that takes migrant-specific factors into consideration when estimating the prevalence of mood or anxiety disorders.

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Appendix 1: Migrant mental health, Hickam's dictum, and the dangers of oversimplification⁵

The process of migration – including the reasons for migration, the migratory process, and post-migration resettlement – can cause extraordinary stress, which can influence mental well-being and rates of mental illness (Hollander 2013). In this editorial, we will discuss the challenges of addressing migrant mental health needs and highlight the shortcomings in the over-simplification of this issue.

Challenges for Health Care Systems

There has been an increase in the global awareness of the public health relevance of mental disorders and poor mental well-being among migrant groups. This is highlighted by the current migrant crisis in Europe, where massive migrant influxes, many of whom are fleeing conflict ridden nations, are presenting with acute mental health care needs (Abbott 2016). These migrants and others with mental health needs pose numerous challenges for health care systems around the globe. Although barriers to accessing mental health services among migrant groups have decreased, there remain many gaps in mental health support (Close et al. 2016). Even among the most affluent nations, there remain challenges with mental health treatment for migrant groups, as cultural differences, language, discriminatory practices, health care coverage, and costs all influence help-seeking and health care utilization (Kirmayer et al. 2011; Priebe et al. 2016; Borraccino et al. 2018). These challenges are compounded in less affluent nations where a lack of health

⁵ A version of this manuscript was published in the *International Journal of Public Health*. Citation: Edwards, J., Anderson, K.K. & Stranges, S. *Int J Public Health* (2019) 64: 477. <https://doi.org/10.1007/s00038-018-1194-3>

professionals and infrastructure, as well as limited mental health service investment and availability, leave many mental health needs unaddressed (Kirkbride et al. 2017). Migrant health and health promotion initiatives have increased; however, evidence suggests that there has been an increase in the divide between policy and practice for migrant mental health (Zimmerman et al. 2011). There is a need for greater communication between policy-makers, researchers, and clinicians to develop context-specific practices to improve mental health outcomes for migrant groups (Zimmerman et al. 2011).

Need for Evidence

Research on migrant mental health has increased over the past few decades, though there remain gaps in both health services and etiological research on the topic (Zimmerman et al. 2011). Although research aimed at improving health services typically requires a higher-level approach that ensures effective knowledge translation and implementation, there is conversely a need to expand research that adequately contextualizes various migrant groups to enable policy decision-makers to understand the heterogeneity that exists within these groups to further inform their work (Zimmerman et al. 2011). Areas of future research include the evaluation of novel strategies for providing adequate mental health care for migrant groups, with a particular emphasis on primary care settings (Kirmayer et al. 2011).

Research on the etiology of mental disorders and mental well-being requires a more detailed evaluation of the pathways that lead to negative mental health outcomes (Nesterko et al. 2018). There is a need for etiological research to explore differences by various immigrant and refugee groups, variation in risk factors, and to isolate the effects of specific migratory experiences.

Mental illness and mental wellbeing may represent two different but correlated means of assessing migrant mental health (Close et al. 2016). There is a need to compare these constructs and evaluate them. Another gap in the literature is the current lack of research assessing pre-migratory risk factors, as well as geographic variation, ethnic density, migrant generation, time since immigration, and post-migratory socioeconomic disadvantage, in relation to rates of mental illnesses and poor mental well-being among migrant groups (Khanlou and Jackson 2010).

Hickam's Dictum

As a counterbalance to the more popular Occam's razor, which contends the simplest solution tends to be the right one, Hickam's dictum asserts that we should assume multiple causes for multiple outcomes, without unnecessary additional assumptions. Migrant mental health is a multi-dimensional topic with many internal and external influences; it is inherently a study of multiple causes. Researchers must recognize the inherent dangers of making broad assumptions when defining migrant groups, and the limitations of providing aggregate results when further detail is not available. When we delve into the examination of disparate migrant groups, who have vastly different migratory experiences, it is to be expected that mental health outcomes will diverge. For example, it is intuitive that there will be a large degree of dissimilarity between economic or family class migrant groups and refugee groups, though they are commonly grouped together (Kirmayer et al. 2011). This variation can entirely change one's conclusions of whether migrant status is a risk or protective factor for numerous mental illnesses (Kirmayer et al. 2011). Aggregate results may be drowning out opposing signals present in less prevalent migratory classes.

Researchers should recognize that the relationship between migration and mental health is dynamic and highly dependent on context, and the associated risk and protective factors. Where possible, researchers should differentiate between migrant groups to provide more focused results. Policy-makers will always be tasked with the challenge of striking a balance between specificity and feasibility of creating and implementing public health interventions. Nevertheless, more focused research will allow policy-makers to create more informed and sensitive mental health care policies for diverse migrant groups.

Migrant mental health is a global discussion. As such, we must make efforts in all areas of research and policy development to define outcomes in sufficient detail in order to promote research transparency and transferability, with an ultimate goal of more effectively addressing the mental health needs of all migrant groups.

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Appendix 2.1: MOOSE.

MOOSE (Meta-analyses Of Observational Studies in Epidemiology) Checklist

A reporting checklist for Authors, Editors, and Reviewers of Meta-analyses of Observational Studies. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Reporting Criteria	Reported (Yes/No)	Reported on Page No.
Reporting of Background		
Problem definition	Yes <input type="text"/>	3
Hypothesis statement	Yes <input type="text"/>	N/A
Description of Study Outcome(s)	Yes <input type="text"/>	4
Type of exposure or intervention used	Yes <input type="text"/>	4
Type of study design used	Yes <input type="text"/>	4
Study population	Yes <input type="text"/>	5/6
Reporting of Search Strategy		
Qualifications of searchers (eg, librarians and investigators)	Yes <input type="text"/>	4
Search strategy, including time period included in the synthesis and keywords	Yes <input type="text"/>	4/5
Effort to include all available studies, including contact with authors	Yes <input type="text"/>	5
Databases and registries searched	Yes <input type="text"/>	4/5
Search software used, name and version, including special features used (eg, explosion)	Yes <input type="text"/>	4/5, Appendix 3
Use of hand searching (eg, reference lists of obtained articles)	Yes <input type="text"/>	5
List of citations located and those excluded, including justification	Yes <input type="text"/>	Appendix 3
Method for addressing articles published in languages other than English	Yes <input type="text"/>	N/A
Method of handling abstracts and unpublished studies	Yes <input type="text"/>	5
Description of any contact with authors	Yes <input type="text"/>	5
Reporting of Methods		
Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	Yes <input type="text"/>	5/6
Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	Yes <input type="text"/>	5/6
Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)	Yes <input type="text"/>	6/7
Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	Yes <input type="text"/>	N/A

Reporting Criteria	Reported (Yes/No)	Reported on Page No.
Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results	Yes ▾	7
Assessment of heterogeneity	Yes ▾	8/9
Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	Yes ▾	8/9
Provision of appropriate tables and graphics	Yes ▾	9/10
Reporting of Results		
Table giving descriptive information for each study included	Yes ▾	19
Results of sensitivity testing (eg, subgroup analysis)	Yes ▾	10/11
Indication of statistical uncertainty of findings	Yes ▾	10
Reporting of Discussion		
Quantitative assessment of bias (eg, publication bias)	Yes ▾	10
Justification for exclusion (eg, exclusion of non-English-language citations)	Yes ▾	
Assessment of quality of included studies	Yes ▾	14
Reporting of Conclusions		
Consideration of alternative explanations for observed results	Yes ▾	14/15
Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	Yes ▾	15
Guidelines for future research	Yes ▾	15
Disclosure of funding source	Yes ▾	16

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

Appendix 2.2: Electronic and grey literature search strategy for the systematic review of mood and anxiety disorders among migrant groups in Canada.

Electronic Search

OVID / Medline		
	Search Term	Returns
1	exp Ethnic Groups/	416358
2	exp human migration/	
3	exp "transients and migrants"/	
4	exp "emigrants and immigrants"/	
5	exp "emigration and immigration"/	
6	foreigner*.mp.	
7	alien*.mp.	
8	border crossing*.mp.	
9	resettlement*.mp.	
10	migration*.mp.	
11	migrant*.mp.	
12	refugee*.mp.	
13	immigrant*.mp.	
14	immigration.mp.	
15	emigration*.mp.	
(1*)	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 using OR	655561
16	exp Mood Disorders/	
17	exp Anxiety Disorders/	
18	Depression/	
19	exp "Bipolar and Related Disorders"/	
20	mood disorder*.mp.	
21	affective disorder*.mp.	
22	anxiety disorder*.mp.	
23	anxiety*.mp.	
24	depress*.mp.	
25	bipolar disorder*.mp.	
(2*)	16,17,18,19,20,21,22,23,24,25 using OR	209907
26	exp Canada/	
27	Canad*.mp.	
28	Nova scoti*.mp	
29	Albert*.mp.	
30	British Columbia*.mp.	
31	Manitoba*.mp.	
32	New Brunswick*.mp.	
33	Newfoundland*.mp.	
34	Northwest territories.mp.	

35	Nunavut.mp.	
36	Ontari*.mp.	
37	Prince Edward island*.mp.	
38	Quebec.mp.	
39	Saskatchewan.mp	
40	Yukon territory.mp.	
(3*)	26,27,28,29,30,31,32,33,34,35,36,37,38,39,40 using OR	
	1*,2*,3* using AND	351
EMBASE		
1	exp Ethnic Groups/	524466
2	exp human migration/	
3	exp "transients and migrants"/	
4	exp "emigrants and immigrants"/	
5	exp "emigration and immigration"/	
6	foreigner*.mp.	
7	alien*.mp.	
8	border crossing*.mp.	
9	resettlement*.mp.	
10	migration*.mp.	
11	migrant*.mp.	
12	refugee*.mp.	
13	immigrant*.mp.	
14	immigration.mp.	
15	emigration*.mp.	
(1*)	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 using OR	
16	exp Mood Disorders/	1003578
17	exp Anxiety Disorders/	
18	Depression/	
19	exp Bipolar Disorder/	
20	mood disorder*.mp.	
21	affective disorder*.mp.	
22	anxiety disorder*.mp.	
23	anxiety*.mp.	
24	depress*.mp.	
25	bipolar disorder*.mp.	
(2*)	16,17,18,19,20,21,22,23,24,25 using OR	
26	exp Canada/	285728
27	Canad*.mp.	
28	Nova scoti*.mp	
29	Albert*.mp.	
30	British Columbia*.mp.	
31	Manitoba*.mp.	
32	New Brunswick*.mp.	
33	Newfoundland*.mp.	

34	Northwest territories.mp.	
35	Nunavut.mp.	
36	Ontari*.mp.	
37	Prince Edward island*.mp.	
38	Quebec.mp.	
39	Saskatchewan.mp	
40	Yukon territory.mp.	
(3*)	26,27,28,29,30,31,32,33,34,35,36,37,38,39,40 using OR	
	1*,2*,3* using AND	437
PsycINFO		
1	MAINSUBJECT.EXACT.EXPLODE("Immigration")	173,397
2	MAINSUBJECT.EXACT.EXPLODE("Human Migration")	
3	MAINSUBJECT.EXACT.EXPLODE("Refugees")	
4	MAINSUBJECT.EXACT.EXPLODE("Racial and Ethnic Groups")	
5	(all(immigrant*))	
6	(all(immigration*))	
7	(all(migration*))	
8	(all(migrant*))	
9	(all(emigration*))	
10	(all(refugee*))	
11	(all(foreigner*))	
12	(all(alien*))	
13	(all(border crossing*))	
14	(all(resettlement*))	
1*	1,2,3,4,5,6,7,8,9,10,11,12,13,14 using OR	
15	MAINSUBJECT.EXACT.EXPLODE("Affective Disorders")	521,374
16	MAINSUBJECT.EXACT.EXPLODE("Anxiety Disorders")	
17	(all("mood disorder*"))	
18	(all("affective disorder*"))	
19	(all("anxiety disorder*"))	
20	(all(bipolar disorder*))	
21	(all(anxiety*))	
22	(all(depress*))	
23	(all(phobia*))	
2*	15,16,17,18,19,20,21,22,23 using OR	
	(all(Canad*))	232,030
24	(all(Nova Scoti*))	
25	(all(British Columbia*))	
26	(all(Albert*))	
27	(all(Manitoba*))	
28	(all(New Brunswick*))	
29	(all(Newfoundland*))	
30	(all(Northwest Territories))	
31	(all(Nunavut))	

32	(all(Ontari*))	
33	(all(Prince Edward Island*))	
34	(all(Quebec))	
35	(all(Saskatchewan))	
36	(all(Yukon Territory))	
3*	24,25,26,27,28,29,30,31,32,33,34,35,36 using OR	
	1*,2*,3* using AND	<u>867</u>
Canadian Health Research Collection (Call number Medicine)		
1	immigration OR migration OR refugee OR migrant OR immigrant	
2	mood disorder OR anxiety disorders OR depression OR anxiety OR bipolar disorder	
	1,2 using AND	<u>308</u>
Dissertations and Theses		
1	Foreigner*, alien*, border crossing*, resettlement*, migration*, migrant*, refugee*, immigrant*, immigration, emigration	
2	mood disorder*, affective disorder*, anxiety*, depress*, bipolar disorder*	
3	Canad*, Nova scoti*, Albert*, British Columbia*, Manitoba*, New Brunswick*, Newfoundland*, Northwest territories, Nunavut, Ontari*, Prince Edward island*, Quebec, Saskatchewan, Yukon territory.	
	1,2,3 using AND	<u>241</u>
Sociological Abstracts		
1	noft(Foreigner*,) OR noft(alien*,) OR noft(border crossing*,) OR noft(resettlement*,) OR noft(migration*,) OR noft(migrant*,) OR noft(refugee*,) OR noft(immigrant*,) OR noft(immigration,) OR noft(emigration)	
2	noft(mood disorder*,) OR noft(affective disorder*,) OR noft(anxiety*,) OR noft(depress*,) OR noft(bipolar disorder*)	
3	(noft(Canad*,) OR noft(Nova scoti*,) OR noft(Albert*,) OR noft(British Columbia*,) OR noft(Manitoba*,) OR noft(New Brunswick*,) OR noft(Newfoundland*,) OR noft(Northwest territories,) OR noft(immigration,) OR noft(Nunavut,)) OR noft(Ontari*,) OR noft(Prince Edward island*,) OR noft(Quebec,) OR noft(Saskatchewan,) OR noft(Yukon territory.)	
	1,2,3 using AND	<u>521</u>

Grey Literature Search

Grey Matter Checklist exploring headings of “health statistics” and “Canada”		
Cites Reviewed	Records Reviewed	Relevant Records
Canadian Institute for Health Information	3	-
Health Canada	300	-
Institute of Clinical	137	1 (Previously Included)

Evaluative Sciences		
New Brunswick Ministry of Health	3	-
Public Health Agency of Canada	150	-
Statistics Canada	85	-
Total	678	-

Appendix 2.3: Full text exclusion list for the systematic review of mood and anxiety disorders among migrant groups in Canada.

Title	Authors	Published Year	Journal	Notes
Stressors, coping resources, and mental distress among Korean Canadians	Yang, Manseung	1993	ProQuest Dissertations and Theses	Exclusion reason: No Comparison Group ;
Southeast Asian refugees in Canada: Gender differences in adaptation and mental health	Edwards, Roger Gary	1994	ProQuest Dissertations and Theses	Exclusion reason: No Comparison Group ;
Acculturation strategies and its effect on depressive symptoms in the Brazilian immigrant community in the Greater Toronto Area	Costa, Iara Regina Da	2008	ProQuest Dissertations and Theses	Exclusion reason: Not Population Based;
Risk and protective predictors of depression trajectories among adolescents from immigrant backgrounds	Nguyen, Hien	2010	ProQuest Dissertations and Theses	Exclusion reason: No Incidence/Prevalence Estimates ;
Trajectories of emotional problems in an ethnically diverse sample of immigrants	Kumar, Aarti	2015	ProQuest Dissertations and Theses	Exclusion reason: No Comparison Group ;
Measuring psychiatric disorder among Southeast Asian refugees.	Beiser, M; Fleming, J A	1986	Psychological medicine	Exclusion reason: No Incidence/Prevalence Estimates ;
Changing time perspective and mental health among Southeast Asian refugees.	Beiser, M	1987	Culture, medicine and psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
Influences of time, ethnicity, and attachment on depression in Southeast Asian refugees.	Beiser, M	1988	The American journal of psychiatry	Exclusion reason: No Comparison Group ;
Catastrophic stress and factors affecting its consequences among Southeast Asian refugees.	Beiser, M; Turner, R J; Ganesan, S	1989	Social science & medicine (1982)	Exclusion reason: No Incidence/Prevalence Estimates ;
A pilot study assessing the health status of the Hispanic American community living in Vancouver.	Palacios, C; Sheps, S	1992	Canadian journal of public health = Revue canadienne de sante publique	Exclusion reason: No Comparison Group ;
Depression in Korean immigrants in Canada. I. Method of the study and prevalence of depression.	Noh, S; Speechley, M; Kaspar, V; Wu, Z	1992	The Journal of nervous and mental disease	Exclusion reason: No Comparison Group ;

Depression in Korean immigrants in Canada. II. Correlates of gender, work, and marriage.	Noh, S; Wu, Z; Speechley, M; Kaspar, V	1992	The Journal of nervous and mental disease	Exclusion reason: No Comparison Group ;
Unemployment, underemployment and depressive affect among Southeast Asian refugees.	Beiser, M; Johnson, P J; Turner, R J	1993	Psychological medicine	Exclusion reason: No Incidence/Prevalence Estimates ;
The prevalence of seasonal affective disorder is low among descendants of Icelandic emigrants in Canada.	Magnusson, A; Axelsson, J	1993	Archives of general psychiatry	Exclusion reason: No Comparison Group ;
Refugees' time perspective and mental health.	Beiser, M; Hyman, I	1997	The American journal of psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
Perceived racial discrimination, depression, and coping: a study of Southeast Asian refugees in Canada.	Noh, S; Beiser, M; Kaspar, V; Hou, F; Rummens, J	1999	Journal of health and social behavior	Exclusion reason: No Comparison Group ;
The Quebec Adolescent Refugee Project: psychopathology and family variables in a sample from 35 nations.	Tousignant, M; Habimana, E; Biron, C; Malo, C; Sidoli-LeBlanc, E; Bendris, N	1999	Journal of the American Academy of Child and Adolescent Psychiatry	Exclusion reason: Not Adult Population;
Prevalence of depression among the elderly Chinese in Canada.	Lai, D W	2000	Canadian journal of public health = Revue canadienne de sante publique	Exclusion reason: No Comparison Group ;
Language acquisition, unemployment and depressive disorder among Southeast Asian refugees: a 10-year study.	Beiser, M; Hou, F	2001	Social science & medicine (1982)	Exclusion reason: No Comparison Group ;
Poverty, family process, and the mental health of immigrant children in Canada.	Beiser, Morton; Hou, Feng; Hyman, Ilene; Tousignant, Michel	2002	American journal of public health	Exclusion reason: No Comparison Group ;
Determinants of depression among Ethiopian immigrants and refugees in Toronto.	Fenta, Haile; Hyman, Ilene; Noh, Samuel	2004	The Journal of nervous and mental disease	Exclusion reason: No Comparison Group ;
Trauma, time and mental health: a study of temporal reintegration and Depressive Disorder among Southeast Asian refugees.	Beiser, M; Wickrama, K A S	2004	Psychological medicine	Exclusion reason: No Comparison Group ;
Impact of culture on depressive symptoms of elderly Chinese immigrants.	Lai, Daniel W L	2004	Canadian journal of psychiatry. Revue canadienne de psychiatrie	Exclusion reason: No Comparison Group ;

Prevalence and correlates of depressive symptoms in older Taiwanese immigrants in Canada.	Lai, Daniel W L	2005	Journal of the Chinese Medical Association : JCMA	Exclusion reason: No Incidence/Prevalence Estimates ;
Ethnic identity, resettlement stress and depressive affect among Southeast Asian refugees in Canada.	Beiser, Morton N M N; Hou, Feng	2006	Social science & medicine (1982)	Exclusion reason: No Comparison Group ;
The epidemiology of psychological problems in the elderly.	Streiner, David L; Cairney, John; Veldhuizen, Scott	2006	Canadian journal of psychiatry. Revue canadienne de psychiatrie	Exclusion reason: No Incidence/Prevalence Estimates ;
Use of treatment services and pharmacotherapy for bipolar disorder in a general population-based mental health survey.	Schaffer, Ayal; Cairney, John; Cheung, Amy H; Veldhuizen, Scott; Levitt, Anthony J	2006	The Journal of clinical psychiatry	Exclusion reason: No immigrant/refugee population ;
[Current pathologies among asylum seekers in Montreal: prevalence and associated risk factors].	Ouimet, Marie-Jo; Munoz, Marie; Narasiah, Lavanya; Rambure, Vanessa; Correa, Jose A	2008	Canadian journal of public health = Revue canadienne de sante publique	Exclusion reason: No Comparison Group ;
Remission from depressive symptoms among older adults with mood disorders: findings of a representative community sample.	Fuller-Thomson, Esme; Battiston, Marla	2009	Journal of gerontological social work	Exclusion reason: No Incidence/Prevalence Estimates ;
The deterioration of health status among immigrants to Canada.	De Maio, Fernando G; Kemp, Eagan	2010	Global public health	Exclusion reason: No Comparison Group ;
Regional effects on the mental health of immigrant children: results from the New Canadian Children and Youth Study (NCCYS).	Beiser, Morton; Zilber, Nelly; Simich, Laura; Youngmann, Rafael; Zohar, Ada H; Taa, Busha; Hou, Feng	2011	Health & place	Exclusion reason: Not Adult Population;
Age at immigration to Canada and the occurrence of mood, anxiety, and substance use disorders.	Patterson, Beth; Kyu, Hmwe Hmwe; Georgiades, Katholiki	2013	Canadian journal of psychiatry. Revue canadienne de psychiatrie	Exclusion reason: No Comparison Group ;
Profiles and mental health correlates of alcohol and illicit drug use in the Canadian population: an exploration of the J-curve hypothesis.	Dumais, Alexandre; De Benedictis, Luigi; Joyal, Christian; Allaire, Jean-Francois; Lesage, Alain; Cote, Gilles	2013	Canadian journal of psychiatry. Revue canadienne de psychiatrie	Exclusion reason: No Incidence/Prevalence Estimates ;

Predictors of immigrant children's mental health in Canada: selection, settlement contingencies, culture, or all of the above?.	Beiser, Morton; Goodwill, Alasdair M; Albanese, Patrizia; McShane, Kelly; Nowakowski, Matilda	2014	Social psychiatry and psychiatric epidemiology	Exclusion reason: Not Adult Population;
Ethnic and gender differences in the association between discrimination and depressive symptoms among five immigrant groups.	Kim, Il-Ho; Noh, Samuel	2014	Journal of immigrant and minority health	Exclusion reason: No Comparison Group ;
Acculturation, gender, and mental health of Southeast Asian immigrant youth in Canada.	Hilario, Carla T; Vo, Dzung X; Johnson, Joy L; Saewyc, Elizabeth M	2014	Journal of immigrant and minority health	Exclusion reason: Not Adult Population;
Immigrating to Canada During Early Childhood Associated with Increased Risk for Mood Disorders.	Islam, Farah	2015	Community mental health journal	Exclusion reason: No Comparison Group ;
Racial/ethnic variations in the main and buffering effects of ethnic and nonethnic supports on depressive symptoms among five ethnic immigrant groups in Toronto.	Kim, Il-Ho; Noh, Samuel	2016	Ethnicity & health	Exclusion reason: No Comparison Group ;
Neighborhood settings, types of social capital and depression among immigrants in Toronto.	Daoud, Nihaya; Haque, Nasim; Gao, Meiyin; Nisenbaum, Rosane; Muntaner, Carles; O'Campo, Patricia	2016	Social psychiatry and psychiatric epidemiology	Exclusion reason: No Comparison Group ;
The mental health status of ethnocultural minorities in Ontario and their mental health care.	Grace, Sherry L; Tan, Yongyao; Cribbie, Robert A; Nguyen, Han; Ritvo, Paul; Irvine, Jane	2016	BMC psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
The use of diagnosis-specific rates of mental hospitalization to estimate underutilization by immigrants.	Morgan, P; Andrushko, E	1977	Social science & medicine	Exclusion reason: No Incidence/Prevalence Estimates ;
First-generation immigrants and hospital admission rates for psychosis and affective disorders: an ecological study in Ontario.	Durbin, Anna; Lin, Elizabeth; Taylor, Lawren; Callaghan, Russell C	2011	Canadian journal of psychiatry. Revue canadienne de psychiatrie	Exclusion reason: No Comparison Group ;
Tuberculosis and common	Bender, Amy;	2012	The Canadian	Exclusion reason: No

mental disorders: international lessons for Canadian immigrant health.	Guruge, Sepali; Hyman, Ilene; Janjua, Martyn		journal of nursing research = Revue canadienne de recherche en sciences infirmieres	Incidence/Prevalence Estimates ;
Characteristics of Social Support Among Teenage, Optimal Age, and Advanced Age Women in Canada: An Analysis of the National Longitudinal Survey of Children and Youth.	Kim, Theresa H M; Rotondi, Michael; Connolly, Jennifer; Tamim, Hala	2017	Maternal and child health journal	Exclusion reason: No Incidence/Prevalence Estimates ;
Differences in Mental Health Diagnoses between Recent Chinese Immigrants and a Comparison Population in British Columbia.	Chen, Alice W; Kazanjian, Arminee; Wong, Hubert; Reid, Robert J	2009	Healthcare policy = Politiques de sante	Exclusion reason: No Incidence/Prevalence Estimates ;
Rural-urban migration patterns and mental health diagnoses of adolescents and young adults in British Columbia, Canada: a case-control study.	Maggi, Stefania; Ostry, Aleck; Callaghan, Kristy; Hershler, Ruth; Chen, Lisa; D'Angiulli, Amedeo; Hertzman, Clyde	2010	Child and adolescent psychiatry and mental health	Exclusion reason: Not Population Based;
Mothering here and mothering there: international migration and postbirth mental health.	Bouris, Stephanie S; Merry, Lisa A; Kebe, Amy; Gagnon, Anita J	2012	Obstetrics and gynecology international	Exclusion reason: No Comparison Group ;
How are new refugees doing in Canada? Comparison of the health and settlement of the Kosovars and Czech Roma	Redwood-Campbell L.; Fowler N.; Kaczorowski J.; Molinario E.; Robinson S.; Howard M.; Jafarpour M.	2003	Canadian Journal of Public Health	Exclusion reason: No Comparison Group ;
Depression among elderly Chinese-Canadian immigrants from Mainland China	Lai D.W.L.	2004	Chinese Medical Journal	Exclusion reason: No Comparison Group ;
Impact of culture on depressive symptoms of elderly Chinese immigrants	Lai D.W.L.	2004	Canadian Journal of Psychiatry	Exclusion reason: No Comparison Group ;
Burden of dysthymia and comorbid illness in adults in a Canadian primary care setting: High rates of psychiatric illness	Bell B.; Chalklin L.; Mills M.; Browne G.; Steiner M.; Roberts J.; Gafni A.;	2004	Journal of Affective Disorders	Exclusion reason: No immigrant/refugee population ;

in the offspring	Byrne C.; Wallik D.; Kraemer J.; Webb M.; Jamieson E.; Whittaker S.; Dunn E.			
Prevalence and correlates of depressive symptoms in older immigrants (from Taiwan and Mainland China) in Canada	Su T.-P.	2005	Journal of the Chinese Medical Association	Exclusion reason: No Comparison Group ;
Prevalence and correlates of depressive symptoms in older Taiwanese immigrants in Canada	Lai D.W.L.	2005	Journal of the Chinese Medical Association	Exclusion reason: No Comparison Group ;
Use of health care services for psychological distress by immigrants in an urban multicultural milieu	Kirmayer L.J.; Weinfeld M.; Burgos G.; Du Fort G.G.; Lasry J.-C.; Young A.	2007	Canadian Journal of Psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
Factors influencing attitudes towards seeking professional help among east and Southeast Asian immigrant and refugee women	Fung K.; Wong Y.-L.R.	2007	International Journal of Social Psychiatry	Exclusion reason: No Comparison Group ;
Socio-cultural determinants of mental health of elderly immigrants: Lessons learned from Canada	Lai D.	2010	European Psychiatry	Exclusion reason: Not Full Text ;
From low income to deep poverty: A small step in wealth, a large drop in health	Fang R.; Kmetz A.; Jayatilaka D.; Randall E.; Drasic L.; Millar J.	2010	American Journal of Epidemiology	Exclusion reason: No Incidence/Prevalence Estimates ;
Stresses of passage, balms of resettlement, and posttraumatic stress disorder among Sri Lankan Tamils in Canada	Beiser M.; Simich L.; Pandalangat N.; Nowakowski M.; Tian F.	2011	Canadian Journal of Psychiatry	Exclusion reason: No Comparison Group ;
Pilot study of the prevalence of alcohol, substance use and mental disorders in a cohort of Iraqi, Afghani, and Iranian refugees in Vancouver	Miremadi S.; Ganesan S.; McKenna M.	2011	Asia-Pacific Psychiatry	Exclusion reason: Not Population Based;
Social anxiety disorder in the Canadian population: Exploring gender differences in sociodemographic profile	MacKenzie M.B.; Fowler K.F.	2013	Journal of Anxiety Disorders	Exclusion reason: No immigrant/refugee population ;
Associations between anxiety, depression, antidepressant medication, obesity and weight	Grundy A.; Cotterchio M.; Kirsh V.A.; Kreiger N.	2014	PLoS ONE	Exclusion reason: No immigrant/refugee population ;

gain among Canadian women				
Migration and young peoples mental health in Canada: A scoping review	Hilario C.T.; Oliffe J.L.; Wong J.P.-H.; Browne A.J.; Johnson J.L.	2015	Journal of Mental Health	Exclusion reason: Not Adult Population;
Emergency Department as a First Contact for Mental Health Problems in Children and Youth	Gill P.J.; Saunders N.; Gandhi S.; Gonzalez A.; Kurdyak P.; Vigod S.; Guttman A.	2017	Journal of the American Academy of Child and Adolescent Psychiatry	Exclusion reason: Not Adult Population;
Cross cultural perspective on mental health and immigrant adaptation	Lasry J.C.	1977	Social Psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
Ethnic differences in mental illness severity: A population-based study of Chinese and south asian patients in Ontario, Canada	Chiu M.; Lebenbaum M.; Newman A.M.; Zaheer J.; Kurdyak P.	2016	Journal of Clinical Psychiatry	Exclusion reason: Not Full Text ;
Race, Ethnicity, and Depression in Canadian Society	Wu, Zheng; Noh, Samuel; Kaspar, Violet; Schimmele, Christoph M.	2003	Journal of Health and Social Behavior	Exclusion reason: No Incidence/Prevalence Estimates ;
Is mental health in the Canadian population changing over time?	Simpson, Keith R. S.; Meadows, Graham N.; Frances, Alien J.; Patten, Scott B.	2012	The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie	Exclusion reason: No immigrant/refugee population ;
A comparison of psychiatric disorder in different cultures: Depressive typologies in Southeast Asian refugees and resident Canadians	Beiser, Morton; Cargo, Margaret; Woodbury, Max A.	1994	International Journal of Methods in Psychiatric Research	Exclusion reason: No Incidence/Prevalence Estimates ;
The resettlement blues: The role of social support in newcomer women's mental health	Killian, Kyle D.; Lehr, Sabine	2015	Women's mental health: Resistance and resilience in community and society	Exclusion reason: No Incidence/Prevalence Estimates ;
SÍntomas psicofisiolÁgicos predictores del estrÁs en inmigrantes mexicanos en CanadÁ	Pozos-Radillo, Elizabeth; Preciado-Serrano, Lourdes; Plascencia-Campos, Ana	2015	Ansiedad y EstrÁs	Exclusion reason: No Comparison Group ;
Cultural distance and emotional problems among immigrant and refugee youth in Canada: Findings from the New Canadian	Beiser, Morton; Puente-Duran, Sofia; Hou, Feng	2015	International Journal of Intercultural Relations	Exclusion reason: Not Adult Population;

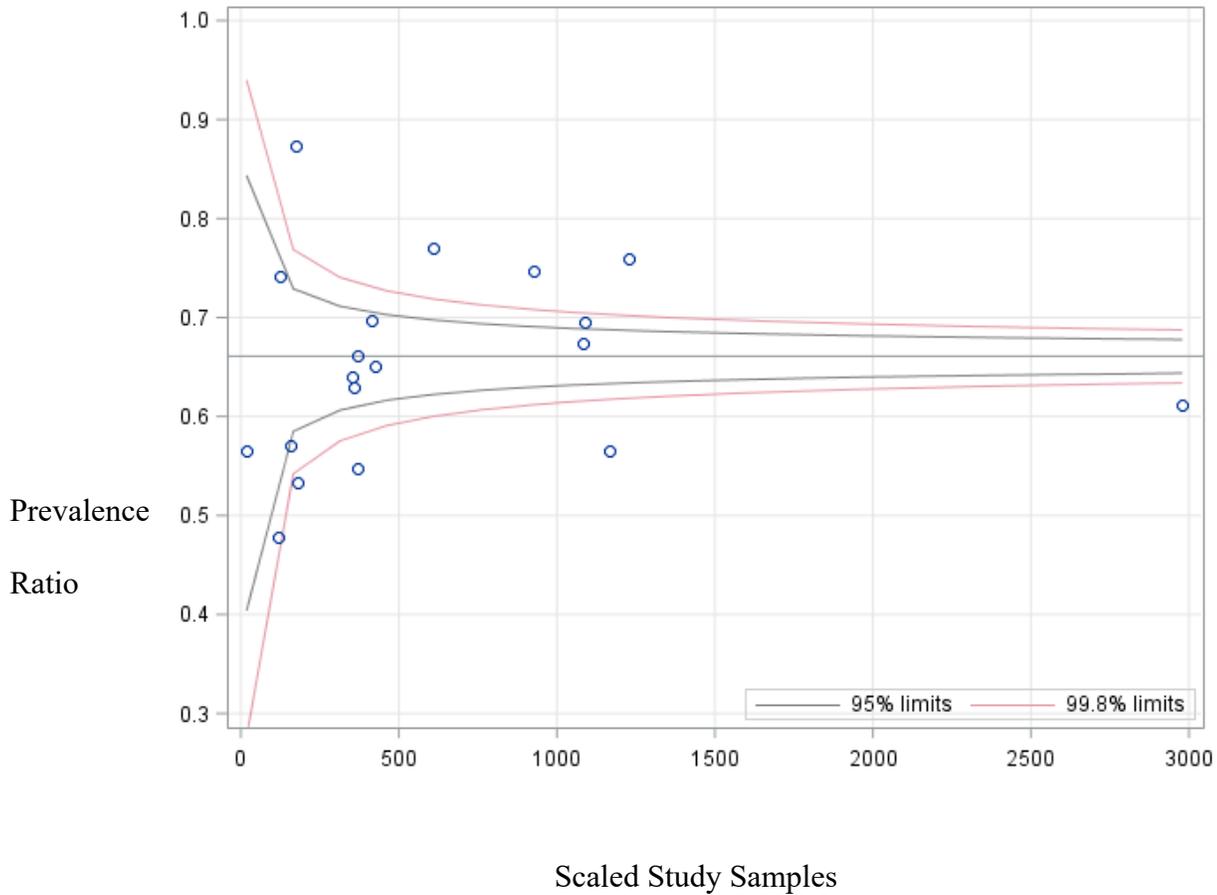
Child and Youth Study (NCCYS)				
Posttraumatic stress disorder in Syrian refugees: A review	Ghumman, Usman; McCord, Carly E.; Chang, Jessica E.	2016	Canadian Psychology/Psychologie canadienne	Exclusion reason: No Comparison Group ;
Somatic symptoms in a community sample of Ethiopian immigrants in Toronto, Canada	Fenta, Haile; Hyman, Ilene; Rourke, Sean B.; Moon, Miera; Noh, Samuel	2010	International Journal of Culture and Mental Health	Exclusion reason: No Comparison Group ;
Depression literacy among older Chinese immigrants in Canada: A comparison with a population-based survey	Tieu, Yvonne; Konnert, Candace; Wang, JianLi	2010	International Psychogeriatrics	Exclusion reason: No Incidence/Prevalence Estimates ;
Emotional problems among recent immigrants and parenting status: Findings from a national longitudinal study of immigrants in Canada	Browne, Dillon T.; Kumar, Aarti; Puente-Duran, Sofia; Georgiades, Katholiki; Leckie, George; Jenkins, Jennifer	2017	PLoS ONE	Exclusion reason: No Comparison Group ;
Prevalence of psychological distress and mental disorders, and use of mental health services in the epidemiological catchment area of Montreal South-West	Caron J.; Fleury M.-J.; Perreault M.; Crocker A.; Tremblay J.; Tousignant M.; Kestens Y.; Cargo M.; Daniel M.	2012	BMC psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
Mental health of Latin Americans in Canada: A literature review	Ginieniewicz, Jorge; McKenzie, Kwame	2014	International Journal of Social Psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
Rates of mental illness and suicidality in immigrant, refugee, ethnocultural, and racialized groups in Canada: A review of literature	Hansson, Emily K.; Tuck, Andrew; Lurie, Steve; McKenzie, Kwame	2012	Canadian Journal of Psychiatry	Exclusion reason: No Incidence/Prevalence Estimates ;
South Asian populations in Canada: migration and mental health.	Islam, Farah; Khanlou, Nazilla; Tamim, Hala	2014	BMC psychiatry	Exclusion reason: reference group second generation migrants (Classified as No Comparison Group)
What characteristics are associated with earlier onset of first depressive episodes: A 16-year follow-up of a national population-based cohort	Meng X.	2017	Psychiatry Research	Exclusion reason: No Incidence/Prevalence Estimates ;
Economic development of	Montazer, Shirin;	2016	The Social Science	Exclusion reason: No

countries of origin and distress among married immigrant men and women in Toronto	Wheaton, Blair; Noh, Samuel		Journal	Incidence/Prevalence Estimates ;
Migration and social determinants of mental health: Results from the Canadian Health Measures Survey.	Salami, Bukola; Yaskina, Maryna; Hegadoren, Kathleen; Diaz, Esperanza; Meherali, Salima; Rammohan, Anu; Ben-Shlomo, Yoav	2017	Canadian Journal of Public Health	Exclusion reason: No Incidence/Prevalence Estimates ;

Appendix 2.4: Data extraction form for the systematic review of mood and anxiety disorders among migrant groups in Canada.

Author
Year
Study Design
Study Duration
Study Location (<i>region</i>)
Inclusion Criteria (<i>incl. age range</i>)
Exclusion Criteria
Data Source
Sampling
Study Population (<i>definition</i>)
Migrant Population (<i>definition</i>)
Comparison Population (<i>definition</i>)
Self-report/diagnosed (<i>binary</i>)
Mood, Anxiety, Mood + Anxiety Disorders (<i>categorical</i>)
Definition of Mood, Anxiety, Mood + Anxiety Disorder (<i>measurement tool used/description</i>)
Sample Size
Sample of Migrant Population
Sample of Comparison Population
Prevalence Estimates of Migrant Groups
95% Confidence Intervals of Prevalence Estimates among Migrant Groups
Prevalence Estimates of Comparison Groups
95% Confidence Intervals of Prevalence Estimates among Comparison Groups
Prevalence Ratio
Incidence Estimate Migrant Groups
Incidence Estimate Comparison Groups
Incidence Rate Ratio
Alternative Analyses
Mean Age of Migrant Groups
Mean Age of Comparison Groups
Mean Age Overall
Gender of Total Migrant Population (<i>%male</i>)
Gender of Comparison Population (<i>%male</i>)
Gender of Total Sample (<i>%male</i>)
List of Risk Factors Captured Considering Migrant Status

Appendix 2.5: Funnel plot of included studies.



Note: Funnel plot of the included studies for the systematic review of mood and anxiety disorders among migrant groups in Canada. The 95% and 99.8% confidence bounds are pseudo estimates based on studies with no heterogeneity. We scaled the sample sizes by a factor of 100 to create confidence bounds that are wider to increase the interpretability of the asymmetry of the included studies.

Appendix 3.1: Primary concordance groups by migrant status.

Variable	Migrant n=1134 (27.1%)	Non-Migrant n=3047 (72.9%)	Standardized Difference
Any Mood or Anxiety	181 (16.0%)	666 (22.0%)	0.15
Concordance/Discordance			
-Interview (+), Admin (+)	32 (2.8%)	132 (4.4%)	0.08
-Interview (+), Admin (-)	79 (7.0%)	336 (11.1%)	0.14
-Interview (-), Admin (+)	70 (6.2%)	268 (6.4%)	0.02

Appendix 3.2: Details of variable creation for variables used in the analysis.

Variable Name	Source of Data	Description	Variable Name in Database	Values and Database Codes
Baseline Socio-Demographic Characteristics				
Age	CCHS	Age at index date	DHH_AGE	Continuous variable
Gender	CCHS	Recorded sex	DHH_SEX	1 = Male 2 = Female
Employment	CCHS	Recorded Employment Status	LBSDWSS	1= Working last Week, 2= Absent Last Week, 3= No Job Last Week, 4= Unable/Permanent, 5= Not Applicable
Education	CCHS	Recorded Educational Level	ED_QUA	1= <Secondary Grad 2 = Secondary Grad 3 = Other Post-Sec 4 = Post-Sec Grad
Marital Status	CCHS	Recorded Marital Status	DHH_MS	1 = Married/Common-Law 2 = Separated/Divorced/ 3 = Widowed 4 = Single
Migrant Status	CCHS	Recorded Migrant Status	SDCFIMM	1= First-generation Migrant 2= Non first-generation Migrant
Income Quintile	RPDB	Neighborhood level income quintile	INCQUINT	1=lowest income quintile 5=highest income quintile
Outcome Variables				
Admin-Derived Diagnosis	OHIP NACRS DAD OMHRS	Used to capture people with mood and anxiety disorders using administrative data	FEEDCODE (OHIP) Dx10Code (NACRS) DXCODE, DX10CODE (DAD) AXIS1_DSM4CODE_ DISCH1 (OMHRS)	1 = ICD-9-CA: 296 = MANIC DEPRESSIVE PSYCHOSIS 300 = ANXIETY DISORDERS 309 = ADJUSTMENT REACTION 311 = DEPRESSIVE DISORDERS 313 = BEHAVIOUR DISORDERS OF CHILDHOOD AND ADOLESCENCE -ICD-10-CA: F30, F31, F32, F33, F34, F38, F39, F53.0; F40, F41, F42, F43, F48.8, F48.9, F93.1, F93.2; -DSM-IV: 296.x (all 296codes), 300.4x, 301.13; 300, 300.0x, 300.2x, 300.3x, 308.3x, 309.0x, 309.24, 309.28, 309.3x, 309.4x, 309.8x, 309.9x. 2 = No presentations for a mood or anxiety disorder.
Survey-Derived Diagnosis	CCHS	Used to capture people with mood and anxiety disorders using survey data (past year)	GADDDY DEPDYA <u>BIPDY</u>	1 = Structured interview diagnosed major depression, generalized anxiety disorder, bipolar disorder. 2 = No structured interview diagnosed major depression, generalized anxiety disorder.

Appendix 3.3: The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Pages 1 and 2	<p>RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included.</p> <p>RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract.</p> <p>RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.</p>	<p>Record 1.1. Page 1: Title was used to state the study uses administrative data.</p> <p>Record 1.2. Page 2, stated in abstract.</p> <p>Record 1.3. Page 2, data linkage mentioned in abstract.</p>
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 3 and 4		
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4 and 5		
Methods					
Study Design	4	Present key elements of study design early in the paper	Page 5. Key methods can be		

			found at the end of the background section.		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pages 5 and 6		
Participants	6	<p><i>(a) Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i> - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p><i>(b) Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	a) Pages 5 and 6	<p>RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.</p> <p>RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.</p> <p>RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.</p>	<p>6.1 Pages 5 and 6 and Appendix 3</p> <p>6.2 Pages 6 and 7</p> <p>6.3 Figure 1</p>
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Pages 6 and 7	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be	Data dictionary available in Appendix 3.

				reported, an explanation should be provided.	
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pages 6 and 7, Appendix 3		
Bias	9	Describe any efforts to address potential sources of bias	Pages 8 and 9		
Study size	10	Explain how the study size was arrived at	N/A. Total Linked Sample Used		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Pages 7 and 8		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	Pages 7 and 8		

Data access and cleaning methods		..		<p>RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.</p> <p>RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>12.1 Described in acknowledgments section</p> <p>N/A</p>
Linkage		..		<p>RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.</p>	<p>Page 5: Individual level data used.</p> <p>Figure 1: 24% unlinked</p>
Results					
Participants	13	<p>(a) Report the numbers of individuals at each stage of the study (<i>e.g.</i>, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed)</p> <p>(b) Give reasons for non-participation at each stage.</p> <p>(c) Consider use of a flow diagram</p>	Figure 1	<p>RECORD 13.1: Describe in detail the selection of the persons included in the study (<i>i.e.</i>, study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.</p>	Figure 1
Descriptive data	14	<p>(a) Give characteristics of study participants (<i>e.g.</i>, demographic, clinical, social) and information on exposures and potential confounders</p> <p>(b) Indicate the number of participants with missing data for each variable of interest</p> <p>(c) <i>Cohort study</i> - summarise follow-up</p>	<p>Table 1</p> <p>b) We had negligible missing data.</p> <p>c) Not applicable</p>		

		time (e.g., average and total amount)			
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> - Report numbers of outcome events or summary measures	Page 9 Tables 1 and 2		
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	a) Pages 9 and 10 b) Table 2 c) N/A		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	N/A		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Pages 11-12		
Limitations	19	Discuss limitations of the study, taking into account sources of potential or imprecision. Discuss both direction and magnitude of any potential bias	Pages 13-14	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and	Pages 13-14

				changing eligibility over time, as they pertain to the study being reported.	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 11-14		
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 14		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Described in acknowledgement section		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Addressed in acknowledgements section.

Appendix 3.4: Sensitivity Analysis Concordances.

Outcome	Concordance Groups			
	Survey-Derived + Admin-Derived (n, % of outcome)	Survey-Derived Diagnosis Only (n, % of outcome)	Admin-Derived Diagnosis Only (n, % of outcome)	Either (n, % of total)
Self-Reported Concordance	219 (29.9%)	299 (40.9%)	213 (29.1%)	731 (17.6%)
Structured Interview 12-month Concordance (Primary Outcome)	164 (19.4%)	415 (48.9%)	268 (31.6%)	847 (20.4%)
Exploratory Follow-up Concordance	240 (22.2%)	339 (31.4%)	497 (11.9%)	1079 (25.9%)
Structured Interview Lifetime Concordances	401 (27.8%)	492 (34.0%)	552 (38.2%)	1,445 (34.7%)

Appendix 4.1: Bayesian Script

Script for R available at: https://github.com/Dpananos/bayes_multiple_measures

Appendix 5.1: The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Pages 1 and 2	<p>RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included.</p> <p>RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract.</p> <p>RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.</p>	<p>Record 1.1. Page 1: Title was used to state the study uses administrative data.</p> <p>Record 1.2. Page 2, stated in abstract.</p> <p>Record 1.3. Page 2, the use of health administrative databases mentioned in abstract.</p>
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 3 and 4		
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4		
Methods					
Study Design	4	Present key elements of study design early in the paper	Page 4. Key methods can be		

			found at the end of the background section.		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pages 4 and 5		
Participants	6	<p><i>(a) Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i> - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p><i>(b) Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	a) Pages 4 and 5	<p>RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.</p> <p>RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.</p> <p>RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.</p>	<p>6.1 Pages 5 and Appendix 1</p> <p>6.2 Pages 5</p> <p>6.3 Figure 1</p>
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Pages 4,5, and 6	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be	Data dictionary available in Appendix 1.

				reported, an explanation should be provided.	
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pages 4 and 5, Appendix 1		
Bias	9	Describe any efforts to address potential sources of bias	Pages 6 and 7		
Study size	10	Explain how the study size was arrived at	N/A. Total Linked Sample Used		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Pages 6 and 7		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	Pages 6 and 7		

Data access and cleaning methods		..		<p>RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.</p> <p>RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>12.1 Described in acknowledgments section</p> <p>N/A</p>
Linkage		..		<p>RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.</p>	<p>Page 5: Individual level data used.</p> <p>Page 12: 15% unlinked migrants.</p>
Results					
Participants	13	<p>(a) Report the numbers of individuals at each stage of the study (<i>e.g.</i>, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed)</p> <p>(b) Give reasons for non-participation at each stage.</p> <p>(c) Consider use of a flow diagram</p>	Figure 1	<p>RECORD 13.1: Describe in detail the selection of the persons included in the study (<i>i.e.</i>, study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.</p>	Figure 1
Descriptive data	14	<p>(a) Give characteristics of study participants (<i>e.g.</i>, demographic, clinical, social) and information on exposures and potential confounders</p> <p>(b) Indicate the number of participants with missing data for each variable of interest</p> <p>(c) <i>Cohort study</i> - summarise follow-up</p>	<p>Table 2</p> <p>b) We had negligible missing data.</p> <p>c) Not applicable</p>		

		time (e.g., average and total amount)			
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> - Report numbers of outcome events or summary measures	Page 9 Tables 1 and 2		
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	a) Pages 7,8, and 9 b) Table 3,4,5. c) N/A		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Page 9		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Pages 9-10		
Limitations	19	Discuss limitations of the study, taking into account sources of potential or imprecision. Discuss both direction and magnitude of any potential bias	Pages 11-12	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and	Pages 11-12

				changing eligibility over time, as they pertain to the study being reported.	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 12		
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 12		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Described in acknowledgement section		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Addressed in acknowledgements section.

Appendix 5.2: Description of diagnostic codes used to identify cases of mood or anxiety disorders.

DAD/OMHRS: Hospital Discharge Diagnoses

- ICD-10-CA: F30, F31, F32, F33, F34, F38, F39, F40, F41, F42, F43, F48.9, F48.9
- DSM-IV: 296.x, 300, 300.0x, 300.2x, 300.3x, 300.4x, 300.9x, 301.1x, 308.3x, 309.x, 311.x.

OHIP

296 = MANIC DEPRESSIVE PSYCHOSIS

300 = ANXIETY DISORDERS

309 = ADJUSTMENT REACTION

311 = DEPRESSIVE DISORDERS

Appendix 5.3: Socio-demographic characteristics of migrant groups by cross-section.

Supplement 3: Socio-Demographic characteristics of migrant groups by cross-section.						
Cross-Section 1 - Followed: 1995-2000						
Variable		General Population n=6,759,394 (n,SD/%)	Recent Migrant n= 389,018 (n,SD/%)	Standardized Difference	Settled Migrant n=209,450 (n,SD/%)	Standardized Difference
Age	(mean, SD)	(38.03,12.98)	(34.79,11.43)	0.27	(35.52,11.14)	0.21
Sex	Female	(50.1%)	(50.7%)	0.01	(46.9%)	0.06
	Male	(49.9%)	(49.3%)		(53.1%)	
Income Quintile	-5 (Highest)	(20.9%)	(9.6%)	0.32	(10.3%)	0.29
	-4	(20.6%)	(11.9%)	0.24	(13.2%)	0.20
	-3	(20.3%)	(16.3%)	0.10	(16.7%)	0.09
	-2	(19.7%)	(23.4%)	0.09	(23.3%)	0.09
	-1 (Lowest)	(18.6%)	(38.8%)	0.46	(36.4%)	0.41
Rural	-Urban	84.9%	98.8%	0.53	97.9%	0.48
	-Rural	15.1%	1.2%		2.1%	
Cross-Section 2 - Followed: 2000-2005						
Variable		General Population n=7,222,605 (n,SD/%)	Recent Migrant n= 336,098 (n,SD/%)	Standardized Difference	Settled Migrant n=406,744 (n,SD/%)	Standardized Difference
Age	(mean, SD)	(38.91,12.99)	(34.88,11.12)	0.33	(36.64,11.38)	0.19
Sex	Female	(49.9%)	(51.2%)	0.02	(50.2%)	0.00
	Male	(50.1%)	(48.8%)		(49.8%)	
Income Quintile	-5 (Highest)	(21.0%)	(9.8%)	0.32	(10.4%)	0.29
	-4	(20.3%)	(13.0%)	0.20	(13.6%)	0.18
	-3	(20.4%)	(17.1%)	0.08	(17.7%)	0.07
	-2	(20.0%)	(23.6%)	0.09	(23.6%)	0.09
	-1 (Lowest)	(18.4%)	(36.6%)	0.42	(34.7%)	0.38
Rural	-Urban	86.3%	99.1%	0.51	98.9%	0.50
	-Rural	13.7%	0.9%		1.1%	
Cross-Section 3 - Followed: 2005-2010						
Variable		General Population n=7,983,718 (n,SD/%)	Recent Migrant n= 418,503 (n,SD/%)	Standardized Difference	Settled Migrant n=362,102 (n,SD/%)	Standardized Difference
Age	(mean, SD)	(38.91,12.99)	(34.88,11.12)	0.33	(36.64,11.38)	0.19
Sex	Female	(49.9%)	(52.1%)	0.04	(50.6%)	0.01
	Male	(50.1%)	(47.9%)		(49.4%)	
Income Quintile	-5 (Highest)	(20.9%)	(8.4%)	0.36	(10.9%)	0.28
	-4	(20.2%)	(13.0%)	0.20	(16.0%)	0.11
	-3	(19.8%)	(17.3%)	0.06	(19.6%)	0.01
	-2	(19.9%)	(23.5%)	0.09	(23.3%)	0.08
	-1 (Lowest)	(19.2%)	(37.9%)	0.42	(30.3%)	0.26
Rural	-Urban	87.5%	99.2%	0.48	99.0%	0.47
	-Rural	12.5%	0.8%		1.0%	
Cross-Section 4 - Followed: 2010-2015						
Variable		General Population n=8,677,084 (n,SD/%)	Recent Migrant n= 383,418 (n,SD/%)	Standardized Difference	Settled Migrant n=442,211 (n,SD/%)	Standardized Difference
Age	(mean, SD)	(40.32,13.74)	(35.58,11.33)	0.39	(37.25,11.32)	0.25
Sex	Female	(50.0%)	(53.7%)	0.07	(51.6%)	0.03
	Male	(50.0%)	(46.3%)		(48.4%)	
Income Quintile	-5 (Highest)	(21.0%)	(9.9%)	0.31	(10.9%)	0.28
	-4	(21.3%)	(14.7%)	0.17	(17.8%)	0.09
	-3	(20.1%)	(18.4%)	0.04	(20.2%)	0.00
	-2	(19.4%)	(22.9%)	0.08	(22.3%)	0.07
	-1 (Lowest)	(18.1%)	(34.1%)	0.37	(28.9%)	0.26
Rural	-Urban	88.0%	99.0%	0.46	99.1%	0.46
	-Rural	12.0%	1.0%		0.9%	

Appendix 5.4: Missing Data.

Missing Data	
Cross 1	Missing ethnicity: 2208 Rural cat missing: 89437 Rural binary: 10317 Income quint: 29238
Cross 2	Missing ethnicity: 3197 Rural cat missing: 94096 Rural binary: 4814 Income quint: 26726
Cross 3	Missing ethnicity: 4488 Rural cat missing: 96317 Rural binary: 3891 Income quint: 33243
Cross 4	Missing ethnicity: 5268 Rural cat missing: 94361 Rural binary: 340 Income quint: 35879

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Appendix 7: CV.

Mr. Jordan Edwards

Degrees

- 2016/9 (2020/8) Doctorate, Doctor of Philosophy, Epidemiology and Biostatistics, University of Western Ontario, Degree Status: In Progress
- 2014/9 - 2016/8 Master's Thesis, Master of Science, Community Health and Epidemiology, Dalhousie University, Degree Status: Completed
- 2010/9 - 2014/5 Bachelor's Honours, Bachelor of Science, Ecology and Psychology, Queen's University at Kingston Degree Status: Completed

Credentials

- 2017/7 International Summer Program - Introduction to Global Health, Western University Completion of the international summer program.
- 2010/6 DELF, Diplôme D'études en Langue Française-B2, CIEP

Recognitions

- 2020 Jane Murphy Poster Award – 200 (Canadian dollar) Canadian Academy of Psychiatric Epidemiology Prize / Award
- 2019/10 Student Travel Grant - 220 (Canadian dollar) Canadian Data Research Centre Prize / Award
- 2019/9 Student Travel Award - 200 (Canadian dollar) Canadian Academy of Psychiatric Epidemiology Prize / Award
- 2019/6 Best poster presentation by a student/trainee at the department of psychiatry academic research day - 300 (Canadian dollar) Western University Prize / Award
- 2019/5 Canadian Association for Health Services and Policy Research Travel Award – 100 (Canadian dollar) CAHSPR Prize / Award
- 2018/5 First Place Poster Presentation Award at the London Health Research Day (Canadian dollar) University of Western Ontario Prize / Award
- 2017/9 2017 Orientation Thesis Research Presentations and Competition. Top PhD Presentation University of Western Ontario Prize / Award
- 2017/7 Western University Psychiatry Academic Research Day. Best Poster Presentation by a Student/Trainee - 300 (Canadian dollar) Western University Prize / Award
- 2017/7 - 2017/7 Completion of the Schulich School of Medicine Summer School Global Health Program (Canadian dollar) Western University Honor
- 2017/6 National Travel Award for the CIHR Research Poster Presentation within the Canadian Student Health Research Forum - 1,000 (Canadian dollar) Canadian Institutes of Health Research Prize / Award
- 2017/3 Top 10 PhD Presentation at the London Health Sciences Research Day (Canadian dollar) Western University Honor
- 2016/4 Poster Presentation Award, People's Choice - Research in Medicine (RIM) Research Day- 150 (Canadian dollar) Dalhousie University Prize / Award
- 2015/5 Poster Presentation Award, First Prize Integrated Health Research Training Partnership (IHRTTP) Graduate Student Research Day - 100 (Canadian dollar) Dalhousie University Prize / Award

User Profile

- Research Specialization Keywords: Immigrant and Refugee Mental Health, Health Service Use, Mood and Anxiety Disorders
- Disciplines Trained In: Epidemiology and Biostatistics, Biology and Related Sciences
- Research Disciplines: Epidemiology and Biostatistics, Biology and Related Sciences
- Areas of Research: Mental Health and Society, Community Health / Public Health, Mood Disorders, Anxiety
- Fields of Application: Public Health, Health System Management, Pathogenesis and Treatment of Diseases, Education

Employment

- 2019/1 Research Assistant - Understanding the Role of the Family Physician in Early Psychosis Intervention Epidemiology and Biostatistics, Schulich School of Medicine / Western University, University of Western Ontario Part-time - Working on the qualitative portion of this CIHR funded project.
- 2020/7 - 2020/12 Research Assistant - Child and Youth Mental Health Research McMaster University Part-time - Working at the Offord Centre with Dr. Kathy Georgiades.
- 2019/1 - 2019/4 Teaching Assistant - Managing Health Services/ Community Health Assessments and Program Evaluation -Public Health, Schulich School of Medicine/ Western University, University of Western Ontario Part-time
- 2017/9 - 2018/12 Teaching Assistant - Foundations of Epidemiology Epidemiology & Biostatistics, Schulich School of Medicine / Western University, University of Western Ontario Part-time
- 2016/9 - 2018/9 Research Assistant - First Episode Psychosis Research Epidemiology and Biostatistics, Schulich School of Medicine / Western University, University of Western Ontario Part-time
- 2015/1 - 2017/12 Research Assistant - Service Learning Project Global Health, Medicine / Dalhousie University, Dalhousie University Part-time
- 2014/9 - 2016/8 Research Assistant- Scoping Review, Low Back Pain in the ED Community Health and Epidemiology, Medicine / Dalhousie University, Dalhousie University Part-time
- 2015/9 - 2016/5 Volunteer Patient Program Assistant - Dalhousie Medical School Dalhousie University
- 2010/6 - 2015/8 Patient Porter - QEII Health Science Centre Nova Scotia Health Authority
- 2013/6 - 2014/8 Research Assistant - Systematic Review Pilot Course Feasibility Study. Community Health and Epidemiology, medicine / Dalhousie University, Dalhousie University Part-time

Research Funding History

- 2019/9 - 2020/9 Principal Applicant Queen Elizabeth II Graduate Scholarship in Science and Technology (PhD) Funding, Scholarship Funding Sources: Total Funding - 15,000 (Canadian dollar)
- 2019/5 - 2020/5 Canadian Mental Health Association Ontario Doctoral Fellowship in Mental Health and Addictions Serv Total Funding - 5,000 (Canadian dollar) (Canadian dollar)

- 2018/7 - 2019/7 Lawson Health Research Institute Internal Funding Competition Total Funding - 15,000 (Canadian dollar) (Canadian dollar)
- 2017/5 - 2018/5 Ontario Graduate Scholarship Queen Elizabeth II Graduate Scholarship in Science and Technology (QEIGSST) Total Funding - 15,000 (Canadian dollar)
- 2014/9 - 2016/8 Maritime SPOR SUPPORT Unit MSc Studentship Total Funding - 17,000 (Canadian dollar)
- 2014/9 - 2015/8 Principal Investigator Nova Scotia Cochrane Resource Centre Student Scholarship, Scholarship Funding Sources: Dalhousie University Student Scholarship Total Funding - 6,000 (Canadian dollar)

Publications

- Kelly K. Anderson & Jordan Edwards. (2020). Age at Migration and the Risk of Psychotic Disorders: A Systematic Review and Meta-Analysis. *Acta Psychiatrica Scandinavica*. -: 1-11. Co-Author Published,
- Jordan Edwards, Amardeep Thind, Saverio Stranges, Maria Chiu, Kelly K. Anderson. (2020). Concordance Between Health Administrative Data and Survey Structured Interview Diagnoses for Mood and Anxiety Disorders . *Acta Psychiatrica Scandinavica*. 141: 385-395.
- Jordan Edwards, A. Demetri Pananos, Amardeep Thind, Saverio Stranges, Maria Chiu & Kelly K. Anderson. (2020). A Bayesian approach to estimating the prevalence of common mental disorders at the population level using multiple measures. *Epidemiology and Psychiatric Sciences*. - Submitted,
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- Jordan Edwards, Rebecca Rodrigues, Kelly K. Anderson. (2019). Framing the Incidence of Psychotic Disorders: The Case for Context. *Psychological Medicine*. 49: 2637-2638.
- Jordan Edwards, Kelly K Anderson, Saverio Stranges. (2019). Migrant mental health, Hickam's dictum, and the dangers of oversimplification, Published. *International Journal of Public Health*. -: 1-2.
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- Kelly K Anderson, Ross Norman, Arlene G MacDougall, Jordan Edwards, Lena Palaniyappan, Cindy Lau, Paul Kurdyak. (2018). Estimating the incidence of first-episode psychosis using population-based health administrative data to inform early psychosis intervention services. *Psychological medicine*. 49: 2091-2099.
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- Kelly K Anderson, Ross Norman, Arlene G MacDougall, Jordan Edwards, Lena Palaniyappan, Cindy Lau, Paul Kurdyak. (2018). Disparities in Access to Early Psychosis Intervention Services: Comparison of Service Users and Non-Users in Health Administrative Data. *Canadian Journal of Psychiatry*. 63: 395-403.
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- Intervention: Comparison of Service Users and Non-Users in Population-Based Health Administrative Data. *American Journal of Psychiatry*. 175(5):443-452.
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