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The Intersection of Gender/Sex and Food Insecurity on Mental Health Outcomes

Jessiman-Perreault, Geneviève

UNIVERSITY OF CALGARY

The Intersection of Gender/Sex and Food Insecurity on Mental Health Outcomes

by

Geneviève Jessiman-Perreault

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Abstract

Gender and food insecurity are important social determinants of health and are related to a wide spectrum of mental health conditions. Food insecurity typically contains four dimensions: qualitative, quantitative, social and psychological; each of which has its own unique stressors. Food insecurity is a chronically stressful experience, and chronic stress has been consistently associated with the development of mental health problems. This thesis examines, using a pooled sample from a national data set, how the sex gap in seven mental health outcomes is affected by consideration of food insecurity status. For the full sample, the sex gap in five of seven mental health outcomes was pronounced. When only the food insecure sub-sample was examined, there were no statistically significant sex differences in six of seven mental health outcomes. Therefore, food insecurity has a sex neutralizing effect on the sex gap in mental health outcomes, an indication of its powerful effect as a stressor.

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Table of Contents

List of Figures

List of Abbreviations

CAI= Computer-assisted Interviewing

CCHS= Canadian Community Health Survey

CI= Confidence Interval

CIDI-SF= Composite International Diagnostic Interview Short Form

CIHI= Canadian Institute for Health Information

CIHR= Canadian Institutes of Health Research

DSM= Diagnostics and Statistical Manual of Mental Disorder

HFSSM= Household Food Security Survey Module

HPA= Hypothalamic-pituitary-adrenal axis

IQR= Interquartile Range

LFS= Labour Force Survey

LICO= Low-income Cut-off

LIM= Low-income Measure

MDE= Major Depressive Episodes

OR= Odds ratio

PTSD= Post Traumatic Stress Disorder

PUMF= Public Use Microdata Files

RDC= Research Data Centres

SSHRC= Social Sciences and Humanities Research Council

WHO= World Health Organization

Chapter 1

Introduction

1.1 Mental Illness in Canada

It is estimated that 20% of Canadians will experience mental illness during their lifetime (Institute of Health Economics, 2008; Smetanin, Stiff, Briante, Adair, Ahmad, & Khan, 2011). Mental illness is a public health problem that impacts not only individual well-being, quality of life, and productivity but one that imposes a significant cost to the Canadian economy each year. The cost of mental illness has commonly been broken down into three main categories: direct costs, indirect costs, and human costs (Smetanin, et al., 2011; Deraspe, 2013). Direct costs refer to the cost of treating, supporting and rehabilitating individuals. This can include health care, community support, and income support. Indirect costs refer to costs associated with loss of productivity, such as absenteeism, presenteeism[1], and withdrawals from the labour market. Finally, the human costs cannot be quantified in a dollar amount but refer to the impact of mental illness on the individual's well-being such as pain, distress, anxiety and loss of enjoyment (Deraspe, 2013).

Smetanin and colleagues (2011) estimated mental illness in 2011 to have cost the Canadian economy $42.3 billion in direct costs and $6.3 billion in indirect costs. They also estimate that over the next 30 years there will be significant increases in the life and economic consequences of mental illness due to the aging and growth of the Canadian population. They suggest that within a generation 8.9 million Canadians will be living with mental illness;

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[1] Physical presence at work but with lowered productivity due to illness, extreme family or life pressures or stress. Due to this lack of mental presence an employee's work performance can deteriorate (Deraspe, 2013).

assuming constant prevalence rates, they estimate that the direct costs of mental illness will exceed $290.9 billion by 2041.

Using another metric, in 2011, mental health spending accounted for almost 3% of Canada's total gross domestic product (Statistics Canada, 2012). Short- and long-term productivity losses have serious consequences on public finances and translate to lower government tax revenues. In addition, governmental financial assistance and public spending on health care and community support can place a major strain on the resources of the government. Therefore, key spending on mental illness prevention and mental health promotion will promote public health, reduce the need for hospital admissions due to mental illness, and limit productivity declines, all of which would result in cost savings (Deraspe, 2011; Roberts & Grimes, 2011).

Proposed Causes of Mental Illness

Mental illness derives from a complex interplay among genetic, biological, individual and social factors (Public Health Agency of Canada, 2002). Given that the nervous system is the control centre of behaviour, cognition, mood and anxiety, it is often believed the cause of mental illness lies in the brain and central nervous system (Public Health Agency of Canada, 2002; McEwan, 2004).

Other researchers have emphasized the impact of socio-cultural factors. For example, Pickett and Wilkinson (2010) examined the rates of mental illness in high-income countries with varying levels of income inequality. They found that there was a three-fold difference in mental health problems between more or less equal countries (Pickett & Wilkinson, 2010). They attribute this difference to the impact of inequality on growing differences in social distance and

distinctions between social classes. Philosopher Alain de Botton calls this phenomenon "status anxiety" whereby individuals in lower social classes are "freighted by material deprivation, they now had added to their burden the implicit contempt of many above them in the social hierarchy" (de Botton, 2004, p.58-59). The most common theoretical pathway proposed to explain the relationship between social status and mental health is the social stress model (Dressler, Oths, & Gravlee, 2005; Horwitz, 1999). This model posits that prejudice, discrimination and related social problems exert an added burden on marginalized populations, when combined with the pre-existing burdens related to their lower social position, thereby generating mental health problems (Clark, 2004; Kessler, Mickelson, & Williams, 1999; Meyer, 2003; Taylor & Turner, 2002; Williams & Harris-Reid, 1999; Williams, Yu, Jackson, & Anderson, 1997). In Canada, it has been shown that those in the lowest income group are three to four times more likely to report their mental health as fair or poor compared with the highest income group (Statistics Canada, 2013). In addition, many cross-national and cross-sectional studies have shown that individuals with low income (e.g., defined as below $20,000) are at increased odds of depression (Lorant, Deliège, Eaton, Robert, Philippot, & Ansseau, 2003), mood disorders, anxiety disorder and substance abuse (Fryers, Melzer, & Jenkins, 2003). Moreover, authors have begun to assess the temporality of the relationship between low-income and mental illness; one such study found that a decrease in household income between two time points was associated with an increased risk of mood, anxiety or substance use disorders (Sareen, Afifi, McMillan, & Asmundson, 2011).

One sub-group of the lowest income group is food insecure Canadians. Food insecurity is operationally defined as "the uncertainty and insufficiency of food availability and access that are limited by resource constraints, and the worry or anxiety and hunger that may result from it" (Wunderlich & Norwood, 2006, p.49). Food insecurity is an important focus of this research and

will be discussed in detail in the next chapter, but for this introduction, it is helpful to note that as a result of low income alone, those who are food insecure are potentially three to four times more likely to report poor mental health compared to the highest income group (Statistics Canada, 2013). As will also be discussed, food insecurity presents other social, psychological and physiological barriers in relationship to mental well-being. Turning to these sociocultural and biological barriers now, the following section explains how fundamental to most causal theories of mental health is the role of stress.

1.2 Role of Stress in Development of Mental Illness

Current psychosocial research on the development of mental illness has emphasized the presence of stress in the pathway to mental illness regardless of whether the perspective is biological or sociocultural. Stress is defined as "the process in which environmental demands tax or exceed the adaptive capacity of an organism, resulting in psychological and biological changes that may place persons at risk for disease" (Cohen, Kessler, & Gordon, 1997, p.3). There are several items of note in this definition: first; that not all stress has a negative impact on the body; second, stress levels must exceed the capacity of an individual in order to cause a diseased state; and third, that prolonged heightened levels of stress can result in psychological or physiological harm.

1.2.1 Types of Stress: Chronic, Acute, Cumulative and Latent

Various terms are used in research to discuss stress; the most common iterations are chronic, acute, cumulative and latency stress. While all of these types of stress arise from a stressful situation, the temporality, severity and response determine whether it is characterized as

chronic, acute, cumulative or latent. Moreover, the hypothesized effects on mental illness vary according to the type of stress.

The following sections define each of these types of stresses and present evidence of their effect on mental well-being.

Acute Stress

Acute stress can be both adaptive and maladaptive. Acute stress refers to a single stressful event that can be stressful for a variety of reasons, for instance, daily demands, the unpredictability of situation, the novelty of the situation, or a sense of loss of control (Cohen, Kessler, & Gordon, 1997). The defining feature of acute stress is its short duration. After the original appraisal of the stressor the body either defines the event as a benign stressor or as a perceived stressor, resulting in a psychological or behavioural response (Cohen, Kessler, & Gordon, 1997).

If the acute stress is not mediated by a body response it can go on to become a chronic stressor. Acute stress will be discussed in this paper briefly but the primary stressor discussed in this research is chronic stress. Chronic stress not only has the most salient impact on the mental well-being of individuals, but food insecure Canadians are likely to experience ongoing chronic stress in addition to acutely stressful experiences.

Chronic Stress

The defining feature of chronic stress is that it persists, it can occur repeatedly, episodically, continuously, or it can persist simply because it is a difficult threat to overcome. According to Baum, Garofalo and Yali, chronic stress refers to "… background or ambient stress

due to more-or-less constant stressors embedded in living or working environments and to acute-incident stressors that have effects that persist well beyond the initiating event" (1999, p.132). Chronic stress may begin as an acute stressor but as the stressor is repeated or continues it becomes maladaptive and is then considered a chronic stressor (Selye, 1956). This persistent maladaptive stress can have lasting negative effects on the human body, in both the physical and psychological sense.

According to Hebert and Cohen (1993), prolonged coping with a chronic stressor can cause psychological fatigue, resulting in diminished productivity and performance deficiencies. The negative impact of chronic stressors can heighten the intensity of acute stressors as well. For example, Lepore, Evans and Schneider (1992) found that acute social stresses (e.g., fighting with housemates) were only associated with psychological distress in crowded houses, not in uncrowded houses. This suggests that the chronic stressor (i.e., living in a crowded house) may increase psychological vulnerability to acute stressors such as a one-off fight with housemates.

The distinguishing feature of chronic stress is the inability to change the situation and, therefore, the stressor will continue to affect the person's normal functioning. Chronic stress will be the main stressor discussed throughout this thesis as it best represents the experience of food insecure Canadians, who often feel the inability or impossibility to change their situation and, therefore, their stress continues, often throughout their life course (Hamelin, Beaudry, & Habicht, 2002). The specific stressful experiences typically facing food insecure Canadians will be discussed in subsequent sections.

Cumulative Stress

Another stress discussed in this section is cumulative stress. While chronic stress is the ongoing stressful situation that fails to change, cumulative stress encompasses all the various stressors felt in one's life course. A higher cumulative life course stress score is associated with greater life change and can theoretically put a person at greater risk for health problems (Cohen, Kessler, & Gordon, 1997). Cumulative stress is typically used to describe cumulative work stress or burnout.

Latency Stress

Finally, latency stress is commonly discussed in conjunction with toxic stressors in the lives of children. Toxic stress in children is described as "… severe, prolonged or repetitive adversity with a lack of the necessary nurturance or support of a caregiver to prevent an abnormal stress response" (Franke, 2014, p.391). Toxic stressors include neglect, physical, emotional and/or sexual abuse, parental substance abuse, and maternal depression (Shonkoff , Garner, Siegal, Dobbins, Earls, McGuinn, Pascoe, & Wood, 2011). Children exposed to such stressors are at risk of succumbing to long-term health effects such as maladaptive coping skills, poor stress management, unhealthy lifestyles, mental illness and physical disease (Franke, 2014). Toxic stress may have an immediate effect on observable behaviour but more troubling still is the potential permanent changes in the brain structure and function due to the frequent and prolonged activation of the body's stress response system (Franke, 2014; Shonkoff et al., 2011). Importantly, researchers examining the long-term impact of early childhood adversity have concluded that numerous adult diseases should, in fact, be considered developmental disorders due to the intense impact of toxic stress in childhood (Shonkoff et al. 2011); in other words

stressors demonstrate latency in adults whose childhood included exposure to toxic stress. Ongoing and intense chronic stressors experienced in childhood have been shown to exhibit long-lasting effects on the developing brain putting those children at high risk for anxiety and mood disorders, aggressive behavioural problems, hypo-immune dysfunction, medical morbidity and structural changes in the central nervous system (Shaw, 2003). Many researchers have studied the psychological effects of childhood abuse, including dysregulation of affect, provocative behaviours, avoidance of intimacy, attachment problems, and a negative view towards school and learning (Haviland, Sonne, & Wood, 1995; Lowenthal, 1998). Further, children exposed to high levels of toxic stressors have higher rates of risk-taking behaviours such as smoking, illicit drug use, and promiscuity (Shonkoff et al. 2011). Once young adults from high-risk circumstances become parents themselves, they may be less likely to provide a supportive nurturing environment that is required to protect their children from the impact of toxic stressors they themselves felt as children (Shonkoff et al. 2011). Latency stress, then, refers to the stress felt early in one's life that renders the individual vulnerable to adverse health conditions in future.

Toxic stressors may not only be associated with a permanent change in the brain structure and function when exposure is during childhood, but "…severe, prolonged, or repetitive adversity" without the appropriate supports exist at any stage of the life course (Franke, 2014, p.391). A reasonable hypothesis is that while food insecurity in adults may not change the latent brain, it may be adding an oppressive experience on a pre-existing vulnerability, such as stresses experienced throughout childhood or the stresses inherent to living in a lower social and economic position, and producing negative mental health outcomes based on this distinct combination of past and present stressors.

1.3 Overview of the Research Problem

The problem under investigation in this thesis is the relationship between sex/gender, household food insecurity and mental health outcomes. More specifically, this research focuses on how the sex gap in mental health outcomes may be diminished in strength amongst those experiencing household food insecurity, particularly as a chronic stressor.

1.3.1 Study Purpose

This study uses intersectionality theory to investigate how the relationship between gender/sex and mental health is altered by the consideration of food insecurity status.

1.3.2 Significance of the Study

Gender and food insecurity are two important social determinants of health and their impact on mental health have been studied individually. However, they have not been examined when they occur together, or when they "intersect", to possibly create different outcomes than would result individually. This can be tested by examining if sex/gender statistically interacts with the relationship between food insecurity and mental health and if these determinants together create a distinct social persona more at risk of mental illness.

The literature review, which follows, establishes that the relationship between food insecurity and mental health is distinctly bi-directional and that both food insecurity and mental health are extremely gendered (i.e., in terms of outcomes, experience, and reporting). Taking an intersectional approach to the identification of risk factors for poor mental health can illuminate areas (i.e., gender or food insecurity) of the causal pathway that may be modifiable and thus by modifying such conditions, the burden of mental illness may be reduced. In the complex

relationship between sex/gender, food insecurity and mental health; there is only one readily modifiable variable—household food insecurity.

1.3.3 Study Objectives

There are three main objectives of the present study:

1. Using Canadian Community Health Survey pooled data from 2005-2012, this study explores whether a *sex gap* exists in a variety of mental health outcome. Seven mental health outcomes are considered: a) physician diagnosed anxiety disorder, b) physician diagnosed mood disorder, c) depressive thoughts in the past month, d) major depressive episodes in the past 12 months, e) self-reported mental health, f) binge drinking, and g) thoughts of suicide in the past year.

2. The data will be analyzed to determine whether a household food insecurity *gradient* exists on a variety of mental health outcomes and persists despite controlling for income and other pertinent co-variates.

3. The data will also be analyzed to determine whether sex differences in mental health outcomes are neutralized (i.e., eliminated) by the consideration of household food insecurity status by assessing whether or not sex statistically interacts with the relationship between level of food insecurity and seven mental health outcomes of interest, amongst those experiencing food insecurity.

Chapter 2 presents a literature review on the complex relationship between mental health, household food insecurity, sex and gender. In the first sections of Chapter 2, mental illness and food insecurity in Canada will be introduced as public health problems of importance. In

subsequent sections, the relationship between: gender/sex and mental health; gender/sex and

food insecurity; and food insecurity and mental health will also be examined. Chapter 3 reviews

the study methods. The study results are presented in Chapter 4. Chapter 5 contains a discussion

of the key findings, strengths and limitations of the study, implications, and areas for future

research.

Chapter 2

Literature Review

As we saw in the introduction (Chapter 1), mental illness has a substantial impact on the well-being and productivity of individual Canadians and Canadian society as a whole. Around 20% of Canadians will experience mental illness during their lifetime (Institute of Health Economics, 2008; Smetanin, Stiff, Briante, Adair, Ahmad, & Khan 2011). While mental illness is due to complex relationships among genetic, biological, individual and social factors, the impact of socio-cultural factors such as low income is important. Basic human necessities such as food, clothing and housing are essential to a person's health and wellbeing. Being unable to meet one or more of those demands due to insufficient financial resources has been shown to have a profound impact on an individual's physical, social and mental health. Food insecurity additionally presents other social, psychological and physiological barriers to mental well-being. Fundamental to most causal theories of mental ill-health is the role of stress – chronic and otherwise.

2.1 Influence of Chronic Stress on Mental Health

According to the *Handbook of Stress Medicine and Health,* "…relatively constant stressful conditions over a long time can lead to serious outcomes. To the extent that resources are weakened, however, less and less [stress] will be needed to lead to symptoms, and eventually rather trivial events can trigger quite serious responses" (Cooper, 1996, p.14). While the relationship between environmental stress and psychiatric disorders is widely accepted, the specific causal pathway between the neurobiological mediators associated with stress response and the development of mental illness is not well understood (Agid, Kohn & Lerer, 2000).

In conditions such as Post Traumatic Stress Disorder (PTSD), a stressful event is required by the *Diagnostic and Statistical Manual of Mental Disorder* (DSM-IV) criteria prior to diagnosis of PTSD (American Psychiatric Association, 2000). In other conditions such as schizophrenia, the existence of stressful life events or chronic stress is shown to precede the diagnosis, what is known as a "triggering effect" (Norman & Malla, 1993a; Norman & Malla, 1993b; Day, 1981). Life adversity or chronic stress has widely been accepted to be associated with the depressive disorders, with some studies dating back more than 40 years (Llyod, 1980; Ravindran, Griffiths, Waddell, & Anisman, 1995; Cadoret, Winokur, Dorzab, & Baker, 1972). Stressful life experiences or adversities have been shown to have not only preceded the diagnosis of depression but have been shown to continue throughout the depressive episodes (Williamson, Birmaher, Anderson, Al-Shabbout, & Ryan, 1995; Goodyer, Herbert, Secher, & Pearson, 1997; Cui & Vaillant, 1997). Moreover, adverse life experiences (or ongoing chronic stress) were found to be more common amongst non-recovered psychiatric patients as well as patients who relapsed (Goodyer, et al., 1997; Paykel & Tanner, 1976).

The following section will present some theories on how chronic stress impacts the development of mental illness.

Theories on the Relationship between Stress and Mental Illness: General Adaptation Syndrome

The psychosocial stressor approach posits that stressful life events (that can be both cumulative and/or chronic stresses) combine with vulnerability factors such as personality and the presence of social support (which may act as buffers or mediators) to accelerate the development of mental illness in an individual (Kessler, Price, & Wortman, 1985).

Psychobiological stress response theories such as the General Adaptation Syndrome (Selye, 1956; Selye, 1976a) suggest three stages in stress response: alarm reaction, resistance stage, and exhaustion stage. This theory states that "stress" refers to anything that disrupts the homeostasis of the body (which is crucial to well-being). When a "stressor," defined as an actual or perceived threat to an individual, exceeds the adaptive capacity of the individual, the alarm reaction is initiated. The alarm reaction activates the hypothalamic-pituitary-adrenocortical (HPA) axis or the "flight or fight" response. This "flight or fight" response results in changes to the nervous, cardiovascular, endocrine, and immune systems. These changes are adaptive in the short-term as the alarm reaction stage involves releasing energy stores for the body's immediate use and energy is diverted to tissues that are more active during periods of stress, namely skeletal muscles and the brain (Selye, 1956). The next stage is resistance whereby the body attempts to survive the stressor by balancing the catatoxic[2] and syntoxic[3] defenses to allow the organism and stressor to coexist (Goldberger & Breznitz, 1982). If the body is unable to return to a normal level of resistance, the exhaustion stage sets in where the endocrine activity is heightened and cortisol exerts a negative effect on the body. The result of prolonged exposure to stress is that human resources are lowered and permanent damage to the body system is possible through wear and tear. Therefore, while acute stress in healthy individuals may be adaptive, if the threat or stress is ongoing, particularly in older or unhealthy individuals, the long-term effects of chronic stress can damage one's health (Schneiderman, Ironson, & Siegal, 2005).

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[2] Catatoxic defense refers to an active attack of pathogens through the induction of destructive enzymes. Therefore it used chemical changes in order to destroy the aggressor, in this case the stressor (Goldberger, & Breznitz,1982).
[3] Syntoxic defense refers to the passive tolerance that is created to allow for a peaceful coexistence with the aggressor (Goldberger, & Breznitz,1982).

Theories on the Relationship between Stress and Mental Illness: Allostatic Load

Another dominant theory on the impact of stress on the body is McEwan's theory of Allostasis and Allostatic Load (1998, 2000). This theory proposes that allostasis[4] maintains stability with normal deviations from homeostasis. Allostasis varies the physiological systems to match chronic demands; this involves mobilizing cortisol and epinephrine, which have both negative and positive effects on the body (McEwan, 2004). When allostasis continues for prolonged periods of time this leads to allostatic load which can accelerate disease processes and lead to chemical imbalances in the autonomic nervous system, central nervous system, neuroendocrine, and immune system activity (Rice, 2012). These theories will be discussed in the following section in the context of the stress of household food insecurity.

2.2 Food Insecurity in Canada

Household food insecurity is defined as "the uncertainty and insufficiency of food availability and access that are limited by resource constraints, and the worry or anxiety and hunger that may result from it" (Wunderlich & Norwood, 2006, p.49).

2.2.1 Extent of the Problem of Food Insecurity in Canada

According to the most recent statistics from the Canadian Community Health Survey (CCHS) (2011-2012), which monitors food insecurity every year through their Household Food Security Survey Module (HFSSM), approximately 8.3% of Canadian households (or about 1.1 million individuals) are experiencing food insecurity. From 2007-2012, food insecurity rates have remained relatively stable, with approximately 5% of Canadian children and 8% of Canadian adults living in a food insecure household (Roshanafshar & Hawkins, 2015).

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[4] Allostasis refers to the process of achieving stability (or homeostasis) through change (Sterling, & Eyer, 1988).

The prevalence of food insecurity estimate from Statistics Canada is likely an underestimation as the CCHS does not survey some groups who are particularly vulnerable to food insecurity, specifically First Nations people living on-reserve, homeless populations and those living in remote regions (Loopstra & Tarasuk, 2015). Researchers estimate that there could be as many as 470,000 additional food insecure people living in Canada that are not included in Statistics Canada's estimate (Holland, Kennedy, & Hwang, 2011; Rosol, Huet, Wood, Lennie, Osborne, & Egaland, 2011; Skinner, Hanning, & Tsuji, 2014). In addition, the CCHS subdivides food insecurity into 2 groups: moderate food insecurity and severe food insecurity. Typically, food insecurity researchers include a third group called marginal food insecurity, which has been shown to have predictive power on health outcomes (Cook, Black, Chilton, Cutts, de Cuba, Heeren, Rosen, Jacobs, Sandel, Casey, Coleman, Weiss, & Frank, 2013; Coleman-Jensen, 2009). With the inclusion of marginally food insecure individuals, the prevalence of food insecurity in Canada is approximately 13%, or 4 million Canadians (Tarasuk, Mitchell, & Dachner, 2014).

As mentioned above, food insecurity is typically divided into marginal food insecurity (4.1% of the Canadian population), moderate food insecurity (6.0% of the Canadian population) and severe food insecurity (2.6 % of the Canadian population) (estimates from Tarasuk et al., 2014). Households experiencing marginal food insecurity have reported one food insecure condition in the HFSSM and typically worry about running out of food or the limited selection of food available to them. Households experiencing moderate food insecurity report a compromise in quality and/or quantity of food amongst adults and/or children. Finally, households experiencing severe food insecurity have reported disrupted food patterns or a reduction in food intake amongst adults and/or children; this can include missing meals, reducing food intake, or, at its most extreme, going a full day without food (Tarasuk et al., 2014)**.**

16

Who is most affected?

Food insecurity disproportionately affects households with children under the age of 18 (15.6% food insecure vs. 11.4% food insecure for families without children under the age of 18), households whose main income source is social assistance (nearly 70% of families living on social assistance are food insecure), families headed by a lone mother (34.3% food insecure), families with an income below the low-income measure (29.0% food insecure), African Canadians (27.8% food insecure) or Aboriginal Canadians (28.2% food insecure), and families renting rather than owning their homes (26.1% food insecure) (Tarasuk et al., 2014). These family structures are also those most likely to be characterized as living in poverty.

Food insecurity and health

There is a strong association between food insecurity and physical health that is likely multifactorial. Household food insufficiency (perception of deficient quantity and quality of household food supply) has been linked with poorer self-rated health status amongst women (Cristofar & Basiotis, 1992), worse health status amongst caregivers of families reporting child hunger (McIntyre, Connor, & Warren, 2000), and an increased number of reported child health and behavioural problems (Wehler, Scott, & Anderson, 1992; Weinred, Wehler, Perloff, Scott, Hosmer, Sagor, & Gundersen, 2002; Kursmark & Weitzman, 2009; Slack & Yoo, 2005; Gundersen & Kreider, 2009; Whitaker, Phillips, & Orzol, 2006; Skalicky, Meyers, Adams, Yang, Cook, & Frank, 2006). Moreover, food insecurity is associated with the risk for and management of chronic disease, notably, diabetes and cardiovascular diseases (Seligman, Jacobs, Lopez, Tschann, & Fernandez, 2012; Kollannoor-Samuel, Vega-López, Chhabra, Segura-Pérez, Damio, & Perez-Escamilla, 2012; Bawadi, Ammari, Abu-Jamous, Khader, Bataineh, & Tayyem,

17

2012; Berkowitz, Baggett, Wexler, Huskey, & Wee, 2013; Silverman, Krieger, Kiefer, Hebert, Robinson, & Nelson, 2015; Vozoris & Tarasuk, 2003; Ford, 2013; Gucciardi, Vogt, DeMelo, & Stewart, 2009; Seligman, Laraia, & Kushel, 2010).

2.2.2 Four Dimensions of Food Insecurity

Food insecurity is a construct that recognizes that food has nutritional, psychological and social dimensions. Four dimensions of food insecurity are commonly described in the literature: quantitative, qualitative, social and psychological (Radimer, Olson, Campbell, 1990). As suggested from those groups disproportionately affected, food insecurity is strongly connected to other social problems such as poverty, homelessness, mental illness, addiction, and lack of workforce participation.

Quantitative Dimension

The quantitative dimension of food insecurity refers to the household situation where there is an insufficient amount of food to fill food need (Tarasuk, 2001a). This is associated with the physiological condition known as hunger. The quantitative dimension in food insecurity varies by severity, from less severe deprivation which equates with never quite getting enough food illustrated by a respondent from a study on food insecure Quebec families: "for sure we are not starving to death, but we cannot eat so we can fill up" (Hamelin, Beaudry, & Habicht, 2002, p.121) to extreme deprivation. Hamelin, Beaudry, and Habicht (2002) observed all 40 respondents in their study of the lived experience of food insecurity reporting hunger pangs, loss of appetite, fatigue, or illness associated with a shortage or loss of food. The direct impact of insufficient food includes fatigue, weakness, illness and a general diminishment of productivity

amongst food insecure individuals. The indirect impact of food insufficiency, notably the social and psychological components is discussed in the following sections.

Qualitative Dimension

The qualitative dimension of food insecurity refers to the quality of available food. This can refer to the nutritional adequacy, safety, variety, or cultural appropriateness (Engler-Stringer & Berenbaum, 2007; Tarasuk, 2001a). Results from a Canadian survey on reasons for not using food banks in Toronto show the qualitative insufficiencies many food insecure households face (Loopstra & Tarasuk, 2012). For example, one respondent spoke of the low quality of food bank food: "… There are no nutritious foods, and they give out only expired products. My neighbours got sick from eating expired tinned salmon." (Loopstra & Tarasuk, 2012, p.505).

A lack of variety of dishes and foods available is also a barrier to qualitative food security. One Quebecois respondent stated, "the same stuff always comes back: noodles with soya sauce (or cream of tomato), shepherd's pie, pancakes'' (Hamelin et al., 2002, p.122). A common barrier faced by food insecure Canadians is purchasing or receiving nutritious foods with their limited financial resources. For example, one Quebecois respondent stated, "we want to follow Canada's Food Guide, but it is impossible" (Hamelin et al., 2002, p.123).

In order to maintain enough food (quantitative dimension), the qualitative dimension is often compromised in terms of safety, nutritional quality or variety. This creates feelings of guilt, shame, and frustration at the main meal provider's (often the mother's) inability to provide adequate food for themselves or their family.

Social Dimension

Altered consumption patterns discussed in the previous section represent, according to Radimer, Olson and Campbell (1990), a deviation from social and cultural norms. At the household level, strategies are implemented to increase food resources, and can include: socially inappropriate actions to acquire money for food (for example, stealing or borrowing); seeking food from charitable food programs; buying food on credit; pawning belongings for food; or delaying bill payments for food (Tarasuk, 2001a). These strategies include any action that is not using money to purchase food. The examples above illustrate some socially unacceptable means of obtaining food, and food insecure families have documented feelings of social exclusion through statements such as, "organic foods (or fruits) are for the rich" (Hamelin et al., 2002, p.124), alienation, powerlessness, and guilt, illustrated by one respondent's statement, "we hide it, we don't know what others would think about us not having enough to eat" (Hamelin et al., 2002, p.124), associated with these means of obtaining food. *Psychological Dimension*

The final dimension of food insecurity is the psychological dimension; this is associated with food anxiety. Food anxiety is the uncertainty or insecurity about the adequacy and availability of food for oneself or for their family (Tarasuk, 2001a). This dimension further encompasses the preoccupation or obsession with food. This anxiety and obsession with food is portrayed by comments such as, "When you would get up in the morning, you would begin to worry if you were going to have enough food to make dinner, and if you did have enough food to get through today, what about tomorrow?" (Radimer, Olson, Greene, Campbell & Habicht, 1992, p.39). The psychological dimension of food insecurity emphasizes the constant feeling of worry and anxiety over not only the quantity of food but the quality and the means to obtain the food.

2.2.3 Individual vs. Household Food Insecurity

It is important to clarify the distinction between individual and household food insecurity. The variables used in this project use a combination of questions which measure variables such as household income, highest level of education in the household, and the number of individuals in the household. The metric used to measure food insecurity is at the household level. Therefore, food insecurity or food insecurity status must be treated as a household level variable. Although individuals in food insecure households are at a greater risk of the negative outcomes (e.g., poor mental health) associated with household food insecurity, an individual's outcomes are likely to differ from the household's outcomes. This is due to a number of factors such as personal coping skills, access to resources outside the household and allocation of resources within the household (Tarasuk, 2001a). A notable example of the distinction between individual and household food insecurity is the trend in existing research for mothers to forgo eating or reduce their portions of food in order to feed their children (Radimer et al, 1992; Hamelin et al., 2002; Tarasuk & Maclean, 1990). As a result, children experience less severe deprivation than their household food insecurity status might have us believe while mothers will experience more severe deprivation than their household food insecurity status would show.

2.2.4 Household Food Security Survey Module

Food insecurity status is not a binary measure divided into food insecurity or food security. Rather there are relative severities of food insecurity. In order to better measure household food insecurity the Household Food Security Survey Module (HFSSM), adapted from a similar measure used to monitor household food security in the United States since 1995

(Health Canada, 2007). The HFSSM was first included in national health surveys in Canada in 2004 with its inclusion in the Canadian Community Health Survey Cycle 2.2.

The HFSSM uses self-reports to determine "uncertain, insufficient or inadequate food access, availability and utilization due to limited financial resources, and the compromised eating patterns and food consumption that may result" (Health Canada, 2007). The HFSSM contains 18 questions about the food situation within the household over the past 12 months, 8 questions asked regarding the situation of children and 10 related to the household's adults. This module incorporates questions on three dimensions of food insecurity; psycho-emotional, dietary quality, and dietary quantity (Pérez-Escamilla & Segall-Corrêa, 2008). The module was not designed to capture other reasons for decreased food intake such as voluntary dieting or fasting. It is important to emphasize that every question is contextualized in terms of financial constraint, i.e., that lack of income is the reason for the answer, not lack of transportation, cooking skills, proximity to stores etc. which might affect food access. Questions on food insecurity range from least severe (worrying about running out of food) to most severe (not eating for a whole day) and are applied separately to determine the food insecurity status of children and adults. Typically using the HFSSM divides respondents into 3 groups; food secure, moderate food insecurity, and severe food insecurity. For the purpose of this thesis a fourth group "marginal food insecurity" was included as well. The HFSSM module will be discussed in detail in the methods section of this thesis.

2.3 Food Insecurity and Mental Health

Both mental ill health and food insecurity are persistent and problematic public health problems individually, but they have also been hypothesized to have a bi-directional effect on

each other. The following section will examine the mechanism by which being food insecure

increases one's risk of having poor mental health (and the indicators of poor mental health)

through applying the above-mentioned theories on the role of stress in mental health. The impact

of poor mental health on the risk of becoming food insecure will also be examined later. It must

be noted that the lack of critical micronutrients and macronutrients have been shown to be

associated with mental health symptoms and brain function (Davison & Kaplan, 2012; Kaplan,

Crawford, Field, & Simpson, 2007). This thesis posits that the experience of being food insecure

and the stresses associated with that experience have a substantial and important impact on

mental health. In future work, this alternative mechanism to adverse mental health outcomes

could be assessed by adjusting for self-reported food intake measures available in the CCHS

regular cycles (e.g., fruit and vegetable intake) or through examination of the only dietary intake

survey in Canada to concomitantly assess food insecurity, namely the CCHS 2.2.

2.3.1 Food Insecurity as a Chronically Stressful Condition

This thesis posits that the conditions experienced by food insecure Canadians are

chronically stressful, due mostly to the inability of food insecure Canadians to change or alter the

stress causing environment and the social and psychological impacts of not having enough to eat.

While not all food secure households remain so at all times, becoming food secure

largely has to do with a household's financial ability to manage the process of food provisioning

with resources available (Tarasuk, 2001a). Despite this, the presence of the threat of food

insecurity remains and could produce the state known as "food anxiety" where individuals have a

preoccupation or obsession with obtaining enough food (Radimer et al., 1992). In a historical

example on the psychological impact of severe food restriction, normal-weight men's food

intake was restricted for six months until they had lost 25% of their body weight (Keys, Brozek,

Henshchel, Mickelson, & Taylor, 1950). Participants became obsessed with food and even after

their weight returned to normal, previously normal healthy eaters began to binge eat whenever

appetizing food was presented. Even more striking, participants reported feeling out of control of

their eating habits and became obsessed with food (Keys et al., 1950). This anxiety can be

considered a chronic stressor despite not necessarily being associated with food insecure status,

as the risk of becoming food insecure once more causes undue stress and worry for the families

that fluctuate between the two states.

Chronically food insecure individuals or families may experience chronic stressors from

any or all dimensions of food insecurity: quantitative, qualitative, social and psychological. At

the quantitative dimension families or individuals might experience prolonged reduction in food

supply which not only creates the physiological condition of "hunger" but also the stress of

going without food for a day, reducing intake to feed children, or children not having enough to

eat (Tarasuk, 2001a). These conditions can cause chronic stress toward the uncertainty of having

enough food on a daily basis, and with the inability to change the circumstances of this

deprivation the chronically stressful conditions will continue.

At the qualitative level, stressors are related to the food being "deemed unsuitable or of

inferior quality" (Tarasuk, 2001a, p.8). These stressors are associated with the fear of

consumption of unsafe foods, lessened variety, and lack of freshness of available food. This state

of reduced quality of available food creates feelings of guilt (at feeding unhealthy food to the

family), frustration (lack of selection or monotony of purchases), and fear (at getting sick from

unsafe or spoiled food). Similarly, if food is obtained from a food bank, the food may be of

substandard selection, freshness and safety. Given that many families rely on the food bank, the chronically stressful situation of not having high quality food persists (Hamelin et al., 2002).

The psychological dimension largely encompasses the feeling of "food anxiety" discussed above; this food anxiety or preoccupation with food is inherent to the experience of deprivation. Food anxiety is often associated with such persistent feelings of deprivation or lack of choice.

The final dimension of food insecurity is the social dimension or the characteristics associated with the acquisition of food that may deviate from social norms. This can take the form of stigma at using the food banks or child feeding programs, shame of people finding out the family's food situation, fear of apprehension by authorities for stealing food, guilt and shame at their situation and what they must do in order to obtain food and alienation from the social and cultural norms (Tarasuk, 2001a; Hamelin et al., 2002).

The chronic stress of all these dimensions effectively reduces all thought to that of food. Where the next meal will come from becomes the dominant thought. In the absence of a comprehensive poverty reduction plan many Canadians families will fluctuate between food security and food insecurity or will remain food insecure for major segments of their life course. Both conditions are associated with prolonged chronic stress which impacts the brain, development, body, and overall health of the individual and the family.

It is clear that stress has a significant impact on the development of mental health and chronic exposure to stress is likely to increase one's susceptibility to mental disorder. Therefore, in order to decrease the burden of mental illness in Canada one must identify chronically stressful experiences and intervene to reduce the impact of those stressors on the lives of

Canadians. This thesis proposes food insecurity as a chronic stressor on the lives of Canadians by showing its profound effect on the mental health of affected Canadians.

Evidence on the Impact of Food Insecurity on Mental Health

The impacts of food insecurity on mental health are often difficult to disentangle from the negative impacts of poverty, homelessness, education, etc. which often go hand-in-hand with food insecurity. Numerous studies have examined the impact of food insecurity on mental disorder. Food insecurity has been associated with increased odds of depression (Casey, Goolsby, Berkowitz, Frank, Cook, Cutts, African, Zaldiyar, Levenson, Heeren, & Meyers, 2004; Heflin, Siefert, & Williams, 2005; Klesges, Pahor, Shorr, Wan, Williamson, & Guralnik, 2001; Laraia, Siega-Riz, Gundersen, & Dole, 2006; Temple, 2008; Vozoris & Tarasuk, 2003; Whitaker et al., 2006), distress (Vozoris & Tarasuk, 2003), anxiety (Siefert, Heflin, Corcoran, & Williams, 2004; Whitaker et al., 2006) and reduced scores on the Physical and Mental health (SF-12) index (Stuff, Casey, Szeto, Gossett, Robbins, Simpson, Connell, & Bogel, 2004).

This association between mental health and food insecurity has been observed repeatedly and the association has remained despite controlling for socioeconomic and other demographic variables (Lund, Breen, Flisher, Kakuma, Corrigall, Joska, Swartz, & Patel, 2010; Siefert, et al., 2004; Chilton & Booth, 2007; Anema, Wood, Weiser, Qi, Montaner, & Kerr, 2010). Thus, household food insecurity has been shown to be an independent risk factor for mental ill health. The theoretical pathway of this association begins with the idea that insecure access to food generates life stress because of the biological necessity of food as well as the social implication of being unable to afford enough food (Hadley & Crooks, 2012; Bhattacharya, Currie & Haider, 2004; Lynch, Smith, Kaplan, & House, 2000). This heightened and ongoing stress then results in

an increased likelihood of developing mental illnesses. Unfortunately, the majority of the studies discussed above are cross-sectional in nature and are, therefore, unable to support an argument for causation between food insecurity and mental health. Despite this limitation, notable longitudinal studies examining the relationship between food insecurity and mental health exist and will be discussed, in the context of Hill's criteria for causation, below.

2.3.2 An Argument for Causality

In order to make an argument for causality between food insecurity and mental health, Bradford Hill's five criteria for causation must be discussed. The first criterion is the temporal relationship.

Temporal relationship

Temporal relationship means that food insecurity must have occurred prior to the development or diagnosis of mental health problems, or in a bidirectional causality assessment, a mental health problem must have preceded the development of food insecurity. Many cross-sectional studies have been conducted on the relationship between mental health and food insecurity but this does not aid in the argument for a temporal relationship, in order to test this criterion we must turn to longitudinal studies, of which few have been completed.

Heflin, Siefert and Williams (2005) assessed whether a change in food insecurity status is associated with a change in the mental health of female welfare recipients in a three-year longitudinal study in Michigan in 1997. Heflin and associates found that a change in food insecurity status (from wave 1 to wave 3) was highly correlated with the self-reported mental health of women while controlling for common covariates (2005). In addition, Heflin and Ziliak (2008) reported that food insufficient individuals with higher amounts of food stamp benefits

(thus higher severity of food insecurity) have higher emotional distress than food insufficient individuals who received lower amounts of benefits.

Notable studies have also examined the temporality of the relationship between food insecurity and adverse mental health outcomes in children and youth. One study found that experiencing child or youth hunger was a risk factor for depression and suicidal thoughts in late adolescence or young adulthood (McIntyre, Williams, Lavorato, & Patten, 2015). Similarly, children in homes who were food secure at baseline and food insecure at follow-up were more likely to have externalizing problems at follow-up (Slopen, Fitzmaurice, Williams, & Gilman, 2010).

In contrast, one study was conducted on the effect of the mother's mental health on the development of household food insecurity (Melchior, Caspi, Howard, Ambler, Bolton, Mountain, & Moffitt, 2009). Using a cohort of British mothers with young children at home, the mothers' mental health conditions were assessed for their impact on food insecurity and the authors concluded that food insecurity is significantly more frequent when mothers are experiencing mental health problems (Melchoir, et al., 2009). Finally, and most convincingly of the bidirectional causality association, Garg, Toy, Tripodis, Cook and Cordella (2015) conducted a nationally representative study of low-income mothers with young children at home. At baseline, all mothers were food secure and 16% of mothers reported being depressed. Upon follow-up (15 months later), 11.8% of the mothers had become food insecure and the depression reported at baseline was significantly associated with becoming food insecure at follow-up. The authors conclude that maternal depression is an independent risk factor for becoming food insecure amongst low-income households with young children (Garg et al, 2015). Therefore, limited evidence suggests that there is a bidirectional temporal association between food

insecurity and mental health problems. To further examine the causal association between food insecurity and mental health problems, Bradford Hill's other criteria are considered.

Strength of the Association

The relationship between food insecurity and poor mental health has been shown to be highly correlated in a variety of cross-sectional studies that are discussed elsewhere, despite controlling for a variety of covariates including income (Whitaker, et al., 2006; Casey et al., 2004; Melchior et al., 2009; Lent et al., 2009; Huddleston-Casas, Charnigo, & Simmons, 2009; Vozoris & Tarasuk, 2003).

Dose response

Fulfilling this criterion for causation requires higher or more severe food insecurity to be associated with worse mental health problems. Few studies have examined dose-response for food insecurity and mental health, but one recent study attempted to disentangle the effect of moderate food insecurity (without hunger) and severe food insecurity (with hunger) (Muldoon, Duff, Fielden, & Anema, 2013). Muldoon et al. (2013), using a nationally representative Canadian health survey (CCHS 2007), examined 5588 food insecure families and discovered poor food quality or moderate food insecurity, was not a significant predictor of a mental health diagnosis but food insufficiency (hunger), or severe food insecurity, was significantly associated with mental health diagnosis (35% of families with food insufficiency reported a mental health diagnosis, compared to only 24% for families with poor food quality) (Muldoon et al., 2013). Whitaker and associates (2006) studied mothers with young children in 18 US cities and found that mothers had increased incidences of major depressive episodes and generalized anxiety disorders with increasing severity of food insecurity. In addition, Davison et al. (2015) showed

that household food insecurity had a causal influence on suicidal ideation, with increasing incidence of suicidal ideation associated with increasing severity of food insecurity. This association gives evidence of a dose-response relationship between severity of food insecurity and suicidal ideation and this association remains regardless of income (Davison, et al., 2015).

Consistency

Related to the strength criterion, the relationship between food insecurity and mental health has remained consistent across years of interest and study. It is of little doubt that food insecurity is consistently associated with the development of mental illness in many different contexts and among diverse socio-demographic groups.

Biological Plausibility

The final criterion for causation is plausibility. This criterion has been discussed in earlier sections of this thesis, but will be briefly summarized here. It is hypothesized and plausible that the condition of food insecurity creates distinctly stressful situations, one that households and individuals cannot readily change in order to ease the stress. Through a combination of genetic, environmental, and personal factors, ongoing stress plays an important role in the development of many mental health conditions including schizophrenia (Norman & Malla, 1993a; Norman & Malla, 1993b; Day, 1981), depressive disorder (Llyod, 1980; Ravindran, Griffiths, Waddell, & Anisman, 1995; Cadoret, Winokur, Dorzab, & Baker, 1972), and mood and anxiety disorders (Afifi, Boman, Fleisher, & Sareen, 2009).

Based on the full or partial fulfillment of all five of Hill's criteria for causation, this thesis argues that food insecurity has a causal relationship in the development of mental health problems, by way of the mechanism of chronic stress.

2.3.3 Bi-Directionality of Food Insecurity and Mental Health

As mentioned in the discussion of temporality, the effect of food insecurity on mental illness may not be one-dimensional. Food insecurity has detrimental effects on mental illness; increases in life stresses associated with ongoing nutritional deprivation, social and psychological stresses increases one's risk of mental illness or severity of mental illness (Kraines, 1964).

Mental illness can also increase one's risk of becoming food insecure (Murali & Oyebode, 2004, Tarasuk, Mitchell, McLaren, & McIntyre, 2013). This area of research is relatively new and few studies exist to be able to fulfill Hill's criteria of causation for bi-directionality, but several pertinent studies have been published in recent years that make a strong case for the correlation between mental illness and becoming food insecure. Tarasuk and associates (2013) studied households reporting chronic physical or mental health problems using a nationally representative Canadian dataset. The authors concluded that amongst food insecure households, adults reporting multiple chronic conditions (physical or mental health problems) were at increased risk of being severely food insecure, in particular, the diagnosis of mood or anxiety disorder was strongly related to severe household food insecurity compared to food secure households (Tarasuk et al., 2013). As mentioned, Heflin, Corcoran, and Siefert (2007) reported similar findings in a three-year longitudinal study on mothers in Michigan receiving cash assistance. They found that women with one or more mental health problems at baseline were more likely to report food insecurity upon follow-up compared to those without mental health problems (Heflin, et al., 2007). Similarly, another study examined food insecurity and material depression amongst rural low-income families in the United States and found that food insecurity predicted maternal depression over time at a three-year follow-up and vice versa

(Huddleston-Casas, Charnigo, Simmons, 2009). Huddleston-Casas et al.'s paper (2009) supports the bi-directionality of the relationship between maternal depression and food insecurity. A similar three-year longitudinal study examined low-income mothers in rural New York and found that depressive symptoms and poor mental health amongst mothers limited the likelihood that the family would leave food insecurity (Lent, Petrovic, Swanson, & Olson, 2009).

Lent, Petrovic, Swanson, and Olson (2009) conducted qualitative interviews with the mothers in their study to hypothesize mechanisms for this association; they found the most important mechanism by which mental illness impacted food insecurity was through limiting employment and, therefore, fewer financial resources to cope with food insecurity. Heflin and associates (2007) hypothesized three mechanisms by which mental health may impact food insecurity status: 1) chronic health problems limit the ability of families to maintain consistent income; 2) the financial demands of coping with a chronic illness may place strain on families' finances, and finally; 3) family members' ill health may create barriers to coping with their scarce household resources. All of these mechanisms seem plausible, but studies have attempted to disprove the first mechanism by controlling for income and this thesis will do the same (Tarasuk et al., 2013).

As was noted early in this thesis, mental illness is currently the second leading cause of disability and premature death in Canada. A significant portion of the 51 billion dollars a year that mental illness costs in Canada is a result of the loss of productivity (Institute of Health Economics, 2008). This loss of productivity can result in households being supported by disability payments if the family member is unable to work due to disability, or social assistance; both situations are associated with an increased risk for food insecurity (Tarasuk, et al., 2014). Moreover, a general loss of work due to mental illness reduces the available funds to a family,

making them more susceptible to food insecurity, particularly if their net income falls below the low-income measure (Tarasuk et al., 2014).

This hypothesized bi-directionality of effect gives one the unique opportunity to decrease the burden of both conditions (in this case food insecurity and mental health conditions) by reducing the prevalence of one of the stressors in the causal pathway, particularly, the greatest stressor--severe household food insecurity.

The next section extends this analysis to consider the role gender/sex plays in both differential rates of mental illness and food insecurity.

2.4 The Role of Gender/Sex in Health Inequalities

Gender (i.e., the socio-cultural expression of biological sex) is understood to be one of the most pervasive social determinants of health for a wide spectrum of health conditions. Sex (i.e., the biological division of a species into male or female) is not synonymous with gender and the biological differences between men and women alone cannot explain differences in health behaviours and outcomes (Vlassoff & Moreno, 2002). While it would be preferable to speak only in terms of gender, the CCHS only delineates by sex and, therefore, sex not gender will be used as a variable of interest in this thesis.

Health inequalities between men and women reflect biological sex differences, societal gender differences and the interplay between them. Gender differences in society can influence men's and women's exposure to risk factors (Vlassoff & Moreno, 2002), access to and literacy about information regarding disease management, prevention and control, subjective experience of illness, health service use, and perception of quality of care (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972; Callahan, Bertakis, Azari, Robbins, Helms, & Miller 1996;

Stoppe, Sandholzer, Huppertz, Duwe, & Staedt, 1999; Simoni-Wastila, 2000; Allen, Nelson, Rouhbakhsh, Scifres, Greene, Kordinak, Davis, & Morse, 1998; O'Malley, Forrest, & O'Malley, 2000).

2.4.1 Gender Differences in Mental Health

In a review of gender differences in health in Canada, Denton, Prus and Walters (2004) identified many examples of differential health effects felt by men and women. They studied the phenomenon that men and women are differentially exposed to determinants of health and the role these determinants play in health creates differences in health outcomes by gender. For example, while women experience poorer mental health when compared with men, such as higher levels of depression, psychiatric disorders, and distress (Arber & Cooper, 1999; MacIntyre, Hunt, & Sweeting, 1996) women still experience lower rates of mortality due to these conditions compared with men (Baum & Grunberg, 1991; McDonough & Walters, 2001; Verbrugge, 1985).

Many authors have written about the differences in mental health between genders and the data have remained relatively stable across time. According to Afifi (2007) these mental health differences occur first in adolescence when females have a higher prevalence of depression and eating disorders and experience more suicidal thoughts and suicide attempts compared with males (Afifi, 2007). Males, in contrast, are more likely to participate in high-risk behaviours and while their suicidal thoughts and attempts are much lower than females, males are more likely to complete suicide (Afifi, 2007). These differences do not cease at the onset of adulthood, rather women are more likely to experience affective disorders and psychosis while males are more likely to have higher rates of substance abuse and antisocial personality disorder

(Afifi, 2007). Moreover, women are three to four times more likely than men to develop phobias, more likely to suffer from panic disorders, and generalized anxiety disorder (rates for women are between 2.4-5% while rates for men are 1.0-2.4%) compared to men (Lunsky & Havercamp, 2002). Even amongst lone parents, who are more at risk for mental illness compared with their married counterparts, lone mothers have higher rates of anxiety disorder (10.7% compared to 4.9%) and mood disorders compared to lone fathers (19.9% versus 11.1%) (Wade, Veldhuizen & Cairney, 2011).

Differential gendered outcomes occur in mental health literacy as well. Cotton, Wright, Harris, Jorm, and McGorry (2006) studied young Australians aged 12-25 years and determined that females (60.7%) were far more likely to correctly identify depression in an online vignette, compared to males (34.5%). These findings could indicate that women may be more likely to identify potential mental illness in themselves and, therefore, be more likely to seek treatment for their self-diagnosis. Males, on the other hand, may be less likely to properly diagnose symptoms for certain mental illnesses, such as depression, and this could contribute to their lower rates of diagnosis for certain mental disorders.

Interestingly, while men are more likely to report post-traumatic experiences compared with women, women are much more likely to meet the criteria for post-traumatic stress disorder than men (Tolin & Foa, 2006). Simon (2002) showed that marriage transitions (a stressful event) are significantly associated with depressive symptoms in women and alcohol abuse in men. This finding implies a difference in the ways that males and females experience mental illness and that the same exposure to traumatic experience may not yield the same disorders. This difference in expression of mental illness does not indicate that women are more likely to experience mental illness; rather that men and women express their stress-invoked disorders in different

ways. This will be further discussed in the following sections in terms of externalizing and internalizing mental illnesses.

2.4.2 Reasons for Gender Differences in Mental Health

Several hypotheses have been offered to explain statistically significant sex/gender differences in mental health (referred to in this thesis as a sex/gender gap). Many theories focus on the disadvantaged position women hold in society compared with men as a source of the gender gap in mental health outcomes. Given that this thesis focuses specifically on a group of individuals who are socially disadvantaged as a whole, those with household food insecurity, such commonly-cited gender role theories will not be discussed in detail (Aneshensel, Rutter, & Lahenbruch, 1991; Artazcoz, Benach, Borrell, & Cortès, 2004; Bovier, Chamot, & Perneger, 2004). Other common explanations for this gender gap include reporting bias, biological susceptibility, or psychosocial factors such as social discrimination or female learned-helplessness (Weissman & Klerman, 1977; Clancy & Gove, 1974). These theories will not be discussed in this thesis, as there has been debate regarding the validity of their claims in the context of the progressive growth in the economic and social status of women in society today. An alternate theory on the differential rates of mental illness between men and women is discussed in detail below.

2.4.3 Externalizing vs. Internalizing Mental Illness

Theorists have begun to investigate whether there is, in fact, a real difference between genders in lifetime and current prevalence rates for mental disorders. Many theorists have concluded that the overall rates for mental disorders are comparable between men and women, but that men and women are more likely to suffer from different mental illnesses. For example,

depressive and some anxiety disorders are more common among women than among men but antisocial personality disorder and alcohol abuse dependence are more common among men compared with women (Robins, Helzer, Weissman, Orvaschel, Gruenberg, Burke, & Regier, 1984; Afifi, 2007; Aneshensel, Phelan, & Bierman, 2013). In fact, numerous studies have identified depressive symptoms and alcohol abuse as the most typical indicators of mental health problems among women and men respectively and, therefore, should be considered as outcomes in any study of gender and mental health (Kessler, McGonagle, Zhao, Nelson, Hughes, Eshleman, Wittchen, & Kendler, 1994; Dohrenwend & Dohrenwend, 1976; Mechanic, 1976; Simon, 2002). According to Mirowsky and Ross (1995), both depressive symptoms and alcohol abuse are derived from the same underlying feelings but responses to frustration and stress occur differently in men and women. Moreover, according to Rosenfield (1989), men are often socialized for combative and competitive roles that allow for outward expressions of feelings whereas women are socialized for nurturing and caring roles that discourage such outward expressions of feelings.

This reasoning could indicate that neither gender experiences worse mental health outcomes overall, instead that the outcome of life stresses might manifest as different types of mental health problems for men and women. For example, women are more likely to suffer from internalized[5] disorders such as depression, anxiety, self-blame, self-reproach, phobias, panic attacks, and a general anxious state (Aneshensel et al., 2013). In contrast, men are more likely to suffer from externalized[6] disorders, which in comparison with internalized disorders are problematic for others such as antisocial disorder, substance abuse and dependence, and

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[5] Internalizing disorders refer to the propensity to express distress inwards, this distress is typically expressed as mood disorders and anxiety disorder. (Cosgrove, et al., 2011)

[6] Externalizing disorders are the propensity to express distress outwards, typically this is expressed through substance abuse and antisocial personality disorder. (Cosgrove, et al., 2011)

aggressive personality traits (Aneshensel et al., 2013). Men's propensity for externalized disorders is supported by Cotton et al.'s (2006) study on young Australians which also found males were more likely to support the use of drugs and alcohol as treatment for psychological disorders compared with seeking professional help. This study highlights how women may be more likely to seek professional help for mental illness in contrast to males who may be more likely to self-treat with alcohol or illicit drug use. Therefore, given the phrasing of questions in surveys (often Canadian health surveys such as the Canadian Community Health Survey rely on self-report of physician diagnosis for anxiety and mood disorders) women might have higher rates of certain mental disorders while men's mental disorders might go underreported due to their lack of diagnosis or the stigma associated with disclosing seeking mental health services as a male. Therefore, this gender gap may not necessarily be a reporting bias rather a difference in expression (e.g., internalization or externalization of mental illness) of mental anguish according to gender.

Given the marked differences in rates of mental disorders as well as expressions of stress between men and women, the relationship between food insecurity and mental health should be examined for men and women separately. This thesis attempts to hypothesize a new perspective on the gender gap in mental health by investigating males and females in a particularly disadvantaged position (food insecurity), one where both males and females experience chronically stressful experiences, where this gender gap in mental health outcomes may not exist and posit reasons for the reduction in the otherwise persistent gender gap observed in the general population.

2.5 Gender/Sex and Food Insecurity

Denton, Prus, and Walters (2004) present three categories of psychosocial determinants of health to which men and women may be differentially exposed, thus creating gender differences in mental health outcomes. The first, critical life events suggest that those exposed to critical life events are at an increased risk of psychological distress, psychiatric disorders, and substance abuse (Kessler et al., 1985; Turner & Lloyd, 1995). The second, chronic stressors or ongoing and difficult conditions of daily life such as social life stress, financial stress, relationship stress, child stress, environmental stress, family health stress and job stress (Denton et al., 2004) have all been linked with increased levels of distress for the individual (McDonough & Walters, 2001). Finally, psychological resources, such as self-esteem, sense of coherence and mastery, act as a buffer against the effects of chronic stressors and stressful life events (Pearlin, Lieberman, Menaghan & Mullan, 1981). Mirowsky (1996) also examined the psychosocial determinants of mental health and concluded that gender differences in depression throughout the life course could be explained by the increasing social and economic differences between men and women.

Seifert et al.'s (2004) research support a dose-response relationship between food insecurity and mental health amongst women who were welfare recipients in 1997. They showed the correlation between a change in household food insecurity status over a one year time period and movements into states of poorer mental health for women in their sample (Seifert et al, 2004). Interestingly, Slopen, Fitzmaurice, Williams and Gilman (2010) found that, in a cohort of children aged 4-14 years, persistent food insecurity was associated with increased rates of internalizing and externalizing problems in children. Moreover, the authors found that upon follow-up, children who had moved from food security to food insecurity were 1.78 times more

likely to have externalizing problems (Slopen et al., 2010). Others have observed that a disproportionate number of food insecure households are led by mothers with a history of depression, psychosis spectrum disorder or domestic violence. As such, household food insecurity has been shown to be related to the mother's overall burden of mental illness and to domestic violence (Melchoir et al. 2009). Similarly, it has been argued that women with past mental health conditions are more likely to become food insecure, which could support the bi-directional effect of mental health on food insecurity (Garg et al., 2015; Melchoir et al., 2009).

According to Che and Chen (2001) female-led lone parent households are more likely to be food insecure compared with all other household structures. Mothers are also at increased risk of either a major depressive episode or a generalized anxiety disorder at every level of food insecurity (21% for moderate food insecure, 30.3% at severe food insecure) compared to food secure mothers (16.9%) (Whitaker, et al., 2006).

Melchoir et al. (2009) hypothesized how poor maternal health may affect the family's food situation. Data from interviews with food insecure mothers highlighted the fact that depressed mothers may lack energy and interest to shop for groceries or to prepare and cook family meals due to the symptomology of depression. Moreover for mothers with symptoms of psychotic disorders, it may be difficult to plan and execute family meals as well as manage the financial resources (Melchoir et al. 2009). Therefore, we can again see evidence of the bi-directionality of food insecurity and mental illness within gender groups.

It has been hypothesized that being a man or a woman is related to different vulnerabilities and/or buffering factors to stress. Food insecure women occupy a particular social position that may make them more susceptible to stress in an already stressful life circumstance.

For instance, women have been shown to protect other household members against food insecurity and will reduce their food intake in order to allow other household members to have more food (McIntyre, Officer, & Robinson, 2003; Olson, 2005; Parnell, Reid, Wilson, McKenzie, & Russell, 2001). Moreover, women predominantly hold the responsibility for providing food which, when food insecure, is a very stressful endeavour and may increase levels of stress felt by women (Olson, 2005; Parnell et al. 2001). Interestingly, when mothers are controlling the pooled household income children are far less likely to experience food insecurity compared to situations where the father controls family financial resources (Kenney, 2008). Finally, lone parents (who are more likely to be food insecure [Tarasuk et al., 2013]) are more likely to be women, therefore, lone-mother households hold a double vulnerability to food insecurity as well as the stresses associated with this insecurity.

Food insecurity adheres to two out of the three categories of psychosocial determinants of health to which men and women are theoretically differentially exposed (Denton et al., 2004)--critical life events and chronic stressor. Insecure access to food is a very stressful situation and many studies have linked this experience with increased rates of stress, irritability, social isolation, eating disorder, mood disorders, symptoms of anxiety and depression (Messer, 1989; Hadley & Crooks, 2012; Che & Chen, 2001; Hamelin et al., 2002; Kempson, Keenan, Sadani, & Adler, 2003; Olson, Rauschenbach, Frongillo Jr., & Kendall, 1996; McIntyre, Connor & Warren, 2000; McIntyre et al., 2003; Polivy, 1996; Tarasuk, 2001b; Wu &Schimmele, 2005). Food insecurity could be thought of as a chronic toxic stressor, characterized by near-constant worry, guilt, shame and exhaustion (Hamelin et al., 2002), which could buffer an individual's usual capacity to avoid succumbing to health problems. Given women's higher rates of anxiety and depressive disorders overall, there is a reason to consider the distinct problem of the mental

health of food insecure women. What then of the situation of food insecure men and their mental health?

2.5.1 Food Insecurity and Mental Health in Men

Little has been written about mental illness amongst food insecure men. More commonly food insecure men are used as referent group to be compared with food insecure women. According to Lykke (2010), being male does not uniformly provide the same privileges and burdens across all men and focusing on a single identity (gender) is ineffective in explaining the complexities and nuances of human lives.

Despite this relative silence on the issue, qualitative research studies have reported food insecure males feeling similar precursors to mental illness as women, such as a feeling as if they do not have a place in society, feelings of powerless, guilt, embarrassment, shame, inequity and frustration (Hamelin et al., 2002). These emotions are no doubt associated with heightened levels of stress and, therefore, should result in higher levels of mental illness. Men do experience high rates of mood or anxiety disorder at each level of food insecurity, but those figures still pale in comparison to the rates of mood and anxiety disorder for women (Tarasuk et al. 2013). Fichter and Quadflieg (2001) conducted a study on the prevalence of mental health conditions among homeless men (a group that often experiences food insecurity) in Germany and found high rates of alcohol dependence (72.7% compared to 15.2% in the general population), mood disorders (32.8% vs. 7.3%), anxiety disorder (15.9% vs. 6.2%), and psychiatric disorders (9.8% vs 0.6%).

While most research conducted on the topic of gender and mental health renders men invisible by confining them to act as the referent group, recent work done on intersectionality theory emphasizes moving beyond a single category or group characteristics. As such,

intersectionality authors argue that maleness does not confer the same advantages or disadvantages across the entire group of men. It is clear there is a distinctive gap in research on food insecure men and mental health. Food insecurity is a chronically stressful experience and men experience this stressor as well as women. This research aims to partially fill this gap by investigating the relationship between food insecurity and a wide variety of mental health outcomes, both internalizing and externalizing, for both men and women.

Figure 1 presents a visual summary of the theoretical pathway of the impact of food insecurity on mental health (red arrows), the impact of mental health on food insecurity (blue arrows) and the sex/gender context (dotted lines) in which these relationships are embedded.

Figure 1: Visualization of Theoretical Pathway of the Relationship between Food Insecurity, Sex and Health Outcomes
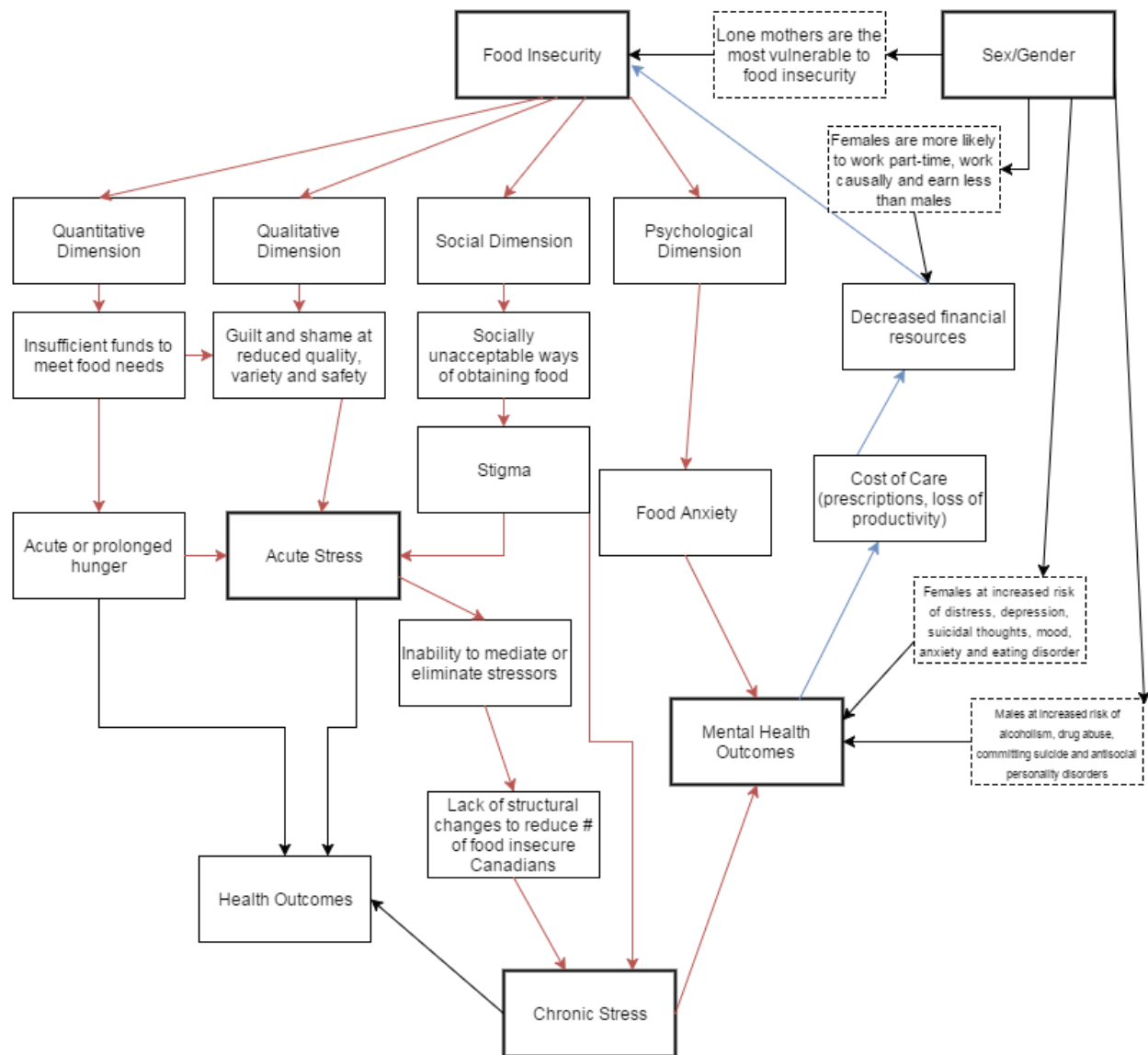
*Note: dotted lines represent the gender/sex context in which the casual bi-directional relationship between food insecurity and mental health is embedded

44

2.6 Conceptual Framework

The conceptual framework guiding this research is the social production of disease framework which posits that social characteristics such as gender, race, and social class determine individuals' exposure to health risks which in turn reflect a population's distribution of exposure and resultant distribution of disease. The development of the research project began with the discovery of an incidental finding that showed similar rates of mental illnesses (specifically, physician-diagnosed mood and anxiety disorders, which are normally differentially gendered) amongst severely food insecure individuals whether they were women or men (Tarasuk, et al., 2013, unpublished data). This thesis investigates the interaction and potential intersection of two important social characteristics: sex/gender and food insecurity, on the mental health burden of each sex at each level of food insecurity.

Within Canada, substantially health inequities have been shown to be related to variables such as income, education, gender, race, and sexuality. The common approaches used in quantitative research to address differences by demographic variables are the additive approach and the multiplicative approach (Dubrow, 2013). The additive approach assumes that the social or demographic categories are mutually exclusive and, therefore, have additive effects (Bauer, 2014; Dubrow, 2008; Weber & Parra-Medina, 2003). The multiplicative approach, in contrast, does not assume these categories to be mutually exclusive but rather accounts for the unique social identity created by the combination of variables and how that combination may have conditional effects based on their intersection (Rouhani, 2014). This multiplicative approach is represented statistically as an interaction between the exposure and another variable of interest, otherwise known as an effect modifier.

Theorists have argued that the additive approach does not properly address the complex relationship between variables related to social location and disadvantage, therefore, a multitude of variables and characteristics must be considered together and how they intersect or interact with one another must be examined. In response, researchers (Hankivisky & Christofferen, 2008; Weber & Parra-Medina, 2003) have called for a "multiplicative" approach inspired by intersectionality theory to be used to provide a more holistic model of the individual. Therefore, this study tests the interaction of two important determinants of health--gender and food insecurity, on mental health outcomes.

2.6.1 Intersectionality Theory

As shown in the preceding sections, substantial health inequalities[7] have been documented in relation to food insecurity and gender/sex but given the persistence of food insecurity rates, attempts to improve these health inequalities have largely failed. Many theorists have suggested that this failure could be due to the theoretical and methodological inadequacy of the research in addressing the complex nature of these social inequalities and their effects on health (Frankish, Veenstra, & Moulton, 1999; James, Este, Bernard, Benjamin, Llyod, & Turner, 2010; Weber, Parra-Medina, 2003). Warner and Brown (2011) argue that axes of inequities[8] must be assessed together, otherwise separate analysis may "potentially obscure important differences in how health is produced and maintained, undermining efforts to eliminate health disparities" (p.1236). In response to this growing dissatisfaction with current methods of analyzing health inequalities, many researchers have called for the application of

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[7] Health inequalities: the differences in health status that manifest as the differential distribution of health determinants between population groups. These differences are the result of genetic difference, different social and economic conditions or the consequence of personal lifestyle choices. (World Health Organization, 2016).
[8] Health inequities: the unjust distribution of health determinants among different population groups. This results in differences in opportunities for health services, nutritious food or housing. (World Health Organization, 2016).

intersectionality theory when studying the effects of health inequalities by income, education, gender, race and sexuality (Weber & Parra-Medina, 2003; Hankivsky & Christoffersen, 2008; Hankivsky, Reid, Cormier, Varcoe, Clark, Benoit, & Brotman, 2010; Lykke, 2010; Hancock, 2007).

Intersectionality refers to "… both a normative theoretical argument and an approach to conducting empirical research that emphasizes the interaction of categories of difference (including but not limited to race, gender, class, and sexual orientation)" (Hancock, 2007, p.64). While three categories of the study of intersectionality exist (intra-categorical complexity, anti-categorical complexity, and inter-categorical complexity), the category of focus in this study is intra-categorical complexity which in essence examines and recognizes the extreme variation and diversity within categories such as "manhood" or "womanhood" and "food insecure" (Hancock, 2007).

Critical legal theorist, Kimberlé Williams Crenshaw (1989), coined the term "intersectionality" to explain how race oppression and gender oppression interact in African-American women's lives. In her studies on why US-anti discrimination laws failed to protect African-American women in the workplace, she discovered it was because the law distinguished between two types of discrimination at play for these women--race discrimination and gender discrimination. Crenshaw determined that African-American women were being discriminated against on two fronts, on account of their gender and their race simultaneously. The law failed to understand their two discriminations together, thus, the dual discrimination being experienced was made invisible.

The theory of intersectionality has grown to encompass a number of axes of inequality including but not limited to class, gender, race, sexuality and ableism. Intersectionality employs three key assumptions, which refer to the mutually interacting and encompassing axes of inequality: (1) simultaneity, (2) multiplicatively, and (3) multiple jeopardy. The principle of simultaneity refers to examining the axes of inequality, and the distinct social identities they produce together because the distinct social identity is present in any given social interaction (Hanvisky, Cormier, & De Merich, 2009). The principle of multiplicatively means that axes of inequality intersect to create a unique social identity, for example, "severely food insecure females" vs "severely food insecure males", and this identity is uniquely its own and is not equal to merely the sum of its parts. This principle directs researchers towards the use of a multiplicative and interactional analysis (Hanvisky, et al., 2009). The final principle of intersectionality is multiple jeopardy; this principle is the idea that when disadvantaged or marginalized identities are experienced together they produce an increased degree of marginalization and discrimination.

The application of intersectionality, particularly in quantitative studies, is still in its infancy. In Canada, few quantitative research studies exist that examine health issues using an intersectional framework, and to my knowledge, none exist examining the intersection between gender/sex and food insecurity on mental health outcomes.

One recent Canadian study conducted by Veenstra (2011) employed intersectionality theory to investigate the impact of race, gender, class and sexual orientation on health inequities in Canada using quantitative research methods. This thesis will incorporate the methodology used by Veenstra (2011) in order to investigate the applicability of intersectionality theory in understanding mental health outcomes using Canadian data. Specifically, this thesis will explore

whether gender/sex and food insecurity interact in order to influence the odds of reporting self-reported and physician-diagnosed mental health problems using data from cycles (2005), 2007-2008, 2009-10 and 2011-12 of Statistics Canada's nationally representative Canadian Community Health Survey. Following the tenets of intersectionality theory, additive and multiplicative (or intersectional) models will be created to explain the rates of mental health problems in Canada for the target population of concern. This will be done by investigating the two-way interacting effects between gender/sex and food insecurity as predictors of mental health outcomes. More detailed explanations of the data source and data analysis are provided in Chapter 3.

Chapter 3

Methods

3.1 Introduction

This study is based on several cycles of data collected for the Canadian Community Health Survey from 2005-2012 (Cycle 3.1 [2005], 2007-2008, 2009-2010, and 2011-2012). This chapter presents the methods of the study in the following sections: background of the Canadian Community Health Survey, sampling, dataset, study variables, data management, and data analysis.

3.2 The Canadian Community Health Survey, Sampling and Target Population

In 1991, the National Task Force on Health Information identified numerous issues and problems with Canadian health information systems such as fragmented and incomplete data, data could not be easily shared, data were not being analyzed to the fullest extent, and the results of the research were not reaching Canadians. In order to partially rectify these issues, the Canadian Institute for Health Information (CIHI), Statistics Canada and Health Canada created the Health Information Roadmap. The Canadian Community Health Survey was one product based on the roadmap. The Canadian Community Health Survey (CCHS) is a series of cross-sectional surveys and is structured to collect information on a variety of issues relating to health including health status, health care utilization, and health determinants (Statistics Canada, 2007). These surveys are divided by health region and therefore reflect estimates according to health region and province as well as for the Canadian population as a whole.

The CCHS's target population, sampling procedure, and sample sizes are all determined by Statistics Canada, specifics of which are presented in the following sections (Statistics Canada, 2007).

The CCHS employs three sampling frames to select their sample of households. Forty-nine percent of households are selected from an area frame. Fifty percent of households are selected from a list of telephone numbers and 1% of households are selected from random digit dialing. The area sampling frame is modeled according to the sampling procedures of the Labour Force Survey (LFS) which employs a multistage stratified cluster design. Each province is divided into three types of regions: major urban centres, cities, and rural regions. Geographic and socioeconomic strata are created in the major urban centres. Cities and rural regions are first stratified geographically then socioeconomically. Independent samples of clusters are randomly drawn from each stratum. Dwelling lists are then prepared for each cluster and dwellings are selected randomly from each list. Telephone number sampling is used in all but five health regions. The Canada Phone Directory is linked to internal administrative files to obtain a postal code for each number. Those numbers are then mapped to health region to create a list frame. The telephone number sample has a "hit rate" (referring to the percentage of telephone numbers that are still operational) of 75 to 88%. Finally, in four health regions, random digit dialing is used to select a sample of households. Selection of individual respondents is designed to overrepresent youth, aged 12 to 19 years.

A three-step sample allocation procedure is followed to estimate the sample in each province. First, the sample size is allocated based on the population of the province. Second, sample size is allocated based on the number of health regions. Third, each province's sample is allocated among its health regions proportional to the square root of the estimated population in each health region. The three Territories are excluded from this protocol; instead, 850 respondents are sought from the Yukon, 900 respondents are sought from the Northwest Territories and 700 respondents are sought from Nunavut (Statistics Canada, 2007).

The CCHS surveys collect data from any person aged 12 or older residing in a dwelling in the ten provinces or three territories. Those living on Reserves or Crown land, institutions, living in remote regions, or members of the Armed Forces are not included in the sample. According to the guidebook, the CCHS data sample represents approximately 98% of the Canadian population who are 12 years or older (Statistics Canada, 2007).

CCHS Cycle 3.1 (collected from January to December 2005) was the last cycle to employ data collection over a 12-month period. Since 2007, data collection occurs on an ongoing basis. Twelve 2-month collection periods take place and approximately 65,000 respondents are sought in each 12-month period. Prior to 2008, data were released every two years with a sample size of approximately 130,000. Since 2008, the data are released annually with only 65,000 respondents. After two years, the data sets are combined and the pooled samples are released with 130,000 respondents (e.g., CCHS 2007-2008).

3.3 CCHS Response Rates and Sample Sizes

The CCHS response rates and sample sizes are shown in Table 1 below.

Table 1: CCHS Response Rate by Cycle

Cycle	Households Selected for Participation	Agreed to Participate	Household-Level Response Rate	Individual responses	Individual-Level Response Rate	Combined Canada-Level Response Rate
3.1	168 464	143 076	84.9%	132 947	92.9%	78.9%
2007-2008	172 709	144 502	83.7%	131 959	91.3%	76.4%
2009-2010	172 671	139 841	81.0%	124 870	89.3%	72.3%
2011-2012	183 721	144 000	78.4%	125 645	87.3%	68.4%

3.4 CCHS Survey Methodology

Survey questions in the CCHS are arranged in modules and further organized into core and optional components. The core questions are asked at the national level in all health regions. The optional questions are only asked in certain health regions based on specific interests of the provinces. In cycles collected after 2005, survey questions are further sub-divided into core, theme, optional and rapid response components. The core component is asked nationally while the other three components are optional and only asked in certain regions. The CCHS questions are designed for computer-assisted interviewing (CAI) with pre-programmed questions, content flow, and allowable responses (ranges or answers). CAI has many advantages including: employing a case management system; having a data transmission function in order to send the data to Statistics Canada; an automated call scheduler; encryption to ensure confidentiality in the transmission of data, and permitting the customization of interviews based on individual characteristics and responses. Half of the interviews take place by telephone while the other half take place in person. A knowledgeable household member is asked to answer basic questions on all residents of the dwelling and then one member is selected for a more in-depth interview (C2 Interview). In the case where the selected member is physically or mentally unable to complete the interview, another knowledgeable member of the household will supply information about the selected respondent. This is known as a proxy interview and the variable (ADME_PRX) is given to identify responses given by proxy (Statistics Canada, 2007, Statistics Canada, 2005).

3.5 CCHS Data Files

Statistics Canada produces two types of CCHS data files. The Public Use Microdata Files (PUMF) and the Master files. These files are developed in response to confidentiality guidelines

under the Statistics Act, to protect the confidentiality of survey respondents. A number of sensitive variables (e.g., age, detailed income, sexual orientation, gambling and alcohol consumption, and illicit drug use) in the Master file are collapsed, capped or completely deleted from the PUMF file. Access to the Master file can be gained through the Research Data Centres (RDC) program. The RDCs are facilities run by Statistics Canada employees and all results undergo a confidentiality screening process, known as vetting, before being made available to users. In contrast, the PUMF file is made widely available to the public, often through university-based libraries. For the purposes of this thesis, the Master File was accessed to obtain the Food Security Survey Module (HFSSM), more detailed information on chronic illness, and some sensitive information on mental health outcomes such as suicidal thoughts. In order to obtain the Master data file the primary investigator underwent screening through the RDC facilities, obtained permission to use the data through the Social Sciences and Humanities Research Council (SSHRC), and underwent an orientation at the Prairie RDC facility located at the University of Calgary.

3.6 Study Dataset and Exclusion Criteria

Four cycles of the CCHS (cycle 3.1 (2005), 2007-2008, 2009-2010 and 2011-2012) were pooled to create a larger dataset. Pooling is conducted in order to increase the precision of the estimates and to increase the sample size of the data to include more data on rare conditions (e.g., food insecure Canadians). In addition, pooling was conducted in order to create a dataset which could be generalized to the ten Canadian provinces. Given the food security module was optional in the CCHS 3.1, no respondents were obtained from Newfoundland and Labrador, New Brunswick, Manitoba or Saskatchewan because these provinces declined participation. For similar reasons, in the CCHS 2009 - 2010, no respondents were obtained from Prince Edward

Island or New Brunswick. In the CCHS 2007-2008 and CCHS 2011-2012, the module was core, therefore, respondents from all ten provinces were obtained.

Pooling CCHS data has become commonplace but several points must be considered prior to pooling. First, researchers must ensure that the same characteristics are being assessed from cycle to cycle. Second, the same population must be targeted across cycles; therefore, one must verify that geographic boundaries and target population have not changed between cycles. Finally, the "mode effect" must be considered. The mode effect means that the same method of data collection must occur across cycles (Thomas, 2007). All three of these assumptions were met in this analysis.

There are two established methods for combining cycles; the separate approach and the pooled approach. In simple terms, the separate approach calculates the estimates from each cycle separately then combines them. The pooled approach combines the data files and then estimates are calculated. Both methods require independence between samples for variance calculations. In order to account for the number of samples combined in the pooled approach, it is recommended that weights for the combined data file be adjusted by dividing by the number of cycles being combined, in this case, four cycles. While there are more complex methods available for combining cycles, all these methods require the assumption that the same values are being reported from cycle to cycle and given the changing nature of the CCHS this assumption is unlikely to be met. Therefore, the more basic approaches are recommended for pooling the CCHS provided that weights are used in the model and that cycle is controlled for in each model (Thomas, 2007). For this study, the pooled approach was used. Cycles were combined with the existing weights (survey weights), divided by four (the number of cycles pooled) and the pooled

dataset was treated as one sample from one population. Pooling created one dataset of 515 421 records prior to exclusions.

For this research project, the population of interest is Canadian adults over the age 19 to 64 years. Therefore, children aged 12 to 17 years were excluded from the dataset because youth mental health and child or youth food insecurity differ from adults (Roshanafshar & Hawkins, 2015; Davidson & Cappelli, 2011). The older age exclusion is because seniors have the lowest food insecurity rates of the adult demographic in Canada, likely related to seniors' pensions (Emery, Fleisch, & McIntyre, 2013). As well, seniors' mental health issues may include conditions associated with cognitive decline which may have unique effects on the gender-mental illness-food insecurity relationship. In addition, due to challenges of food supply related to isolated geographic areas, only respondents from the 10 provinces were included in the dataset. Therefore, respondents from Nunavut, the Northwest Territories and the Yukon were excluded. Finally, given its importance to the research question, only respondents with a response to the food security module were included in the dataset.

3.7 Study Variables

Three categories of variables were used in the study: mental health outcome variables, exposure variables, and covariates. Each of these categories of variables is discussed in the following sections. Detailed descriptions of the variables are available in Appendix A. Table 2 below shows the type of variable used in the present analysis.

Table 2: Level of Study Variables

Variable Name	Type of Variable
Suicidal Thoughts in the Past Year	Categorical (Binary)
Mental Health Status	Categorical (Binary)
Mood Disorder	Categorical (Binary)
Anxiety Disorder	Categorical (Binary)
Binge Drinking	Categorical (Binary)
Depressive Thoughts in the Past Month	Categorical (Binary)
Major Depressive Episode	Categorical (Binary)
Age	Continuous
Sex	Categorical (Binary)
Marital Status	Categorical
Sense of Belonging in the Local Community	Categorical (Binary)
Immigration Status	Categorical
Education	Categorical (Binary)
Household Composition	Categorical (Binary)
Main Source of Income	Categorical
Total Household Income	Categorical (Binary)
Race/Ethnicity	Categorical (Binary)
Food Insecurity Status	Categorical

3.7.1 Household Food Security Survey Module (HFSSM)

The exposure variable in this project is household food insecurity. Household food insecurity is quantified through the Household Food Security Survey Module (HFSSM), which is included in each year of the CCHS as an optional or mandatory component. This 18-item questionnaire is the most common metric used to measure household food insecurity in Canada and elsewhere (Bickel, Nord, Price, Hamilton, & Cook, 2000). The HFSSM was adapted from the food security measurement method developed in the United States which has been used annually to measure household food insecurity since 1995 (Bickel et al. 2000). The HFSSM is used to assess the food situation of adults as a group and children as a group. Therefore, it cannot be used to assess an individual's food situation and it cannot be assumed that all members of a household share the same food insecurity status (Statistics Canada, 2007; Matheson & McIntyre, 2013).

A four category household food insecurity variable was generated for this study in accordance with the literature on food insecurity in Canada (Tarasuk, Mitchell, & Dachner, 2014) from responses to the HFSSM. This variable indicates whether households, both with and without children, were able to afford the food they needed in the previous 12 months. The HFSSM captures four unique food situations:

1. Food Secure: Household members show no evidence of food insecurity.
2. Marginally Food Insecure: Household members feel anxious about running out of food or compromising the quality of food they eat by choosing less expensive options. Little or no reduction in household members' food intake is reported.

3.   Moderately Food Insecure: Household members have made compromises in quality

and/or quantity of food consumed by adults and/or children due to a lack of money for

food.

4.   Severely Food Insecure: At this level, all households with children have reduced the

children's food intake to an extent that the children have experienced hunger. Adults with

and without children will have experienced more extensive reductions in food intake.

This variable was created by dividing questions into those pertaining to children (aged 15

and under) and adults. This study has excluded all respondents who are under the age of 18 years

old, but given respondents are responding for their household the child food insecurity questions

were not excluded from this module. The "Food Secure" group included respondents who did

not answer affirmatively to any of the adult or child food situation questions. All respondents

answered affirmatively to the screening question in the HFSSM. The "Marginally Food

Insecure" group included respondents who answered affirmatively to one of the screening

question for the HFSSM. The "Moderately Food Insecure" group included respondents who

answered affirmatively to 2 to 5 adult food situation situations or 2 to 4 child food situation

questions. Finally, the "Severely Food Insecure" included respondents who answered

affirmatively to 6 or more adult food situation questions or 5 or more child food situation

questions.

3.7.2 Sex/Gender

The sex/gender variable is considered a key covariate and is central to the research

question. The sex/gender variable was tested as an interacting variable, meaning sex was

assessed as a potential effect modifier on the relationship between food insecurity and a variety

of mental health outcome variables. Given the established gender gap in both food insecurity and

mental illness, the analysis of the sex variable in this relationship is intended to illuminate whether there are sex differences in mental health outcomes when food insecurity is reported. This variable was coded as a dummy variable with men as the reference group.

Regarding the use of the word "gender", throughout the paper, gender refers to the sociocultural roles ascribed to men and women. We do not believe that there is a direct relationship between sex and gender (i.e. female=women, male=men) but given this project utilizes a national survey dataset we are unable at this time to extract other genders beyond those delineated by sex=female=women and sex=male=men. This limitation illuminates a gap in current gender/sex research that could be investigated in future research projects.

3.7.3 Mental Health Outcome Variables

Three categories of outcome variables are analyzed in this project: 1) self-reported physician-diagnosed mental health conditions; 2) self-reported mental health; and 3) binge drinking. In order to include both externalizing and internalizing mental health conditions, binge drinking was included as well as mood and anxiety disorders and self-reported mental health status. This project uses a broad number of mental health conditions in order to assess the influence of food insecurity on a wide range of mental health outcomes. Despite this intention, illicit drug use and problem gambling were unable to be included in the analysis due to a low sample size. In total, seven mental health outcomes were included in the analysis and are discussed in detail below.

3.7.3.1 Depressive Thoughts in the Past Month

The first of the seven self-reported mental health conditions variables is a measure of respondent's feelings of sadness or depression in the past month. The respondents were asked the

following question: "During the past month, about how often did you feel sad or depressed?"

Responses included: all of the time, most of the time, some of the time, a little of the time, or none of the time. This variable was recoded into a dichotomous variable. Those who responded all of the time, most of the time or some of the time were coded into the affirmative group. All other respondents were coded into the "no" group. This question was only asked of respondents from Prince Edward Island, Nova Scotia, Quebec, Ontario, Saskatchewan, Alberta, and British Columbia (Statistics Canada, 2005, 2007, 2009, 2011).

3.7.3.2 Major Depression Episodes in the Past Year

In the CCHS, the Composite International Diagnostic Interview Short Form (CIDI-SF) measures Major Depressive Episodes. The CIDI short form for Major Depressive Episodes was developed by Kessler, Andrews, Mroczek, Ustun and Wittchen (1998). This subset of questions assesses the depressive symptoms of respondents who felt depressed or lost interest in things for 2 weeks or more in the last 12 months. Respondents are screened into the CIDI-SF based on affirmative responses to the following 2 screening questions: respondents were asked whether they felt "sad, blue or depressed for two weeks or more in the past 12 months" or whether they had "lost interest in things they normally enjoy" for two or more weeks in the past 12 months. If a respondent answers affirmatively to the screening questions, their depression level is measured based on 7 additional questions (e.g., feeling tired or having low energy, weight gain or loss, trouble falling asleep, trouble concentrating, felt down on themselves, and thoughts of death). These questions include normal periods of sadness (e.g., grief over the death of a loved one), as well as "serious" depression. The classification of depression (respondents being coded as having depression) is based on an affirmative response to the original screening question and 5 out of 9 of the depression questions. This corresponds to a 90% predictive probability of case-

ness. This probability expresses the chance that the respondent would have been diagnosed as having experienced a Major Depressive Episode in the past 12 months had they completed the CIDI Long-Form (Statistics Canada, 2007). In this thesis, 0.90 probability was used because it closely follows the DSM-5 diagnostic guidelines for major depression in adults (American Psychiatric Association, 2013). Using the highest predictive probability possible lowers the number of false positives. Table 3 below is adapted from the CCHS-derived variable guidebook and shows how the short form was transformed into predicted probabilities of Major Depressive Episode.

Table 3: Transformation of Short Form Scores into Predictive Probability of Major Depressive Episodes

Short Form Score*	Predictive Probability of Major Depressive Episode
0	0
1	0.05
2	0.25
3	0.50
4	0.80
>4	0.90

*Based on scores from questions DPS_02, DPS_05, DPS_06, DPS_08A, DPS_08B, DPS_10, DPS_11, DPS_12, DPS_13, DPS_16, DPS_17, DPS_18, DPS_19, DPS_21A, DPS_21B, DPS_23, DPS_24, DPS_25, DPS_26

3.7.3.3 Anxiety Disorder

This variable was coded based on respondents' answers to the question "Do you have an anxiety disorder such as a phobia, obsessive-compulsive disorder or a panic disorder?" Respondents are reminded that the question is only referring to those conditions diagnosed by a

health professional. This variable is dichotomous and was coded into "yes" and "no" (1 and 0 respectively). This question was asked of respondents in all provinces. Given that the definition of all levels of food insecurity encompasses the concept of "food anxiety", defined as the uncertainty or insecurity about the adequacy and availability of food for one's self or for their family (Tarasuk, 2001a), this variable acts as a notional validity test rather than a true outcome variable. Therefore, we would expect those with food insecurity to have high rates of anxiety disorder as food anxiety is encompassed in the measurement of food insecurity, albeit not as a physician-diagnosis.

3.7.3.4 Mood Disorder

Similar to the anxiety variable, this variable was coded based on respondent's answers to the question "Do you have a mood disorder such as depression, bipolar disorder, mania or dysthymia?" Respondents are reminded that the question was only referring to those conditions diagnosed by a health professional. This variable is dichotomous and was coded into "yes" and "no" (1 and 0 respectively). This question was asked of respondents in all provinces.

3.7.3.5 Suicidal Thoughts in the Past Year

This variable codes respondents' answers to the question "Have you ever seriously considered committing suicide or taking your own life? Has this happened in the past 12 months?" This variable was recoded into a dichotomous variable with yes coded as 1 and no coded as 0. In addition, those who answered "not applicable" were coded into the no group, given they answered negatively to this question in an earlier prompt question. This question was only asked of respondents in Newfoundland and Labrador, Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

3.7.3.6 Self-Reported Mental Health

This variable assessed the respondent's self-rated mental health. Respondents are asked to answer the question "In general, would you say your mental health is: excellent, very good, good, fair or poor?" Those who responded "fair" or "poor" were collapsed into one group labeled "fair/poor" while all other respondents were coded into a group labeled "good/very good/excellent". This question was asked of respondents in all provinces.

3.7.3.7 Binge Drinking in the Past Month

The final outcome variable assesses the frequency of a respondent's binge drinking. Binge drinking is defined in the CCHS as having more than 5 or more alcoholic drinks on one occasion (Statistics Canada, 2007). Respondents are asked, "How often in the past 12 months have you had 5 or more drinks on one occasion?" Responses could be: never, less than once a month, once a month, 2-3 times a month, once a week and more than once a week. This variable was recoded into a dichotomous variable. The new groups were labeled "once a month or less" among those who answered never, less than once a month or once a month and all other respondents were coded into a group labeled "more than once a month". This question was asked of respondents in all provinces.

3.7.4 Covariates

Covariates for the study were selected based on the literature review conducted on the relationship between food insecurity and gender, gender and mental health, and food insecurity and mental health (Heflin & Ziliak, 2008; Muldoon, Duff, Fielden & Anema, 2013; Carter, Kruse, Blakely & Collings, 2011; Alaimo, Olson, Frongillo Jr., & Briefel, 2001; Siefert, Heflin, Corcoran & Williams, 2004; Tarasuk, Mitchell, McLaren & McIntyre, 2013; Heflin, Siefert &

Williams, 2005; Radloff, 1975; Artazcoz, Benach, Borrell & Cortès, 2004; Olabiyi & McIntyre, 2014). The covariates were subdivided into two groups: demographic variables and socioeconomic variables.

3.7.4.1 Demographic Variables

The CCHS collects information on respondents' age, sex [the appropriate term for the variable which will be used henceforth when discussing CCHS data and results], marital status, household composition, and education. The age variable is continuous and this dataset was restricted to only include data from respondents aged 18 to 64 years. Each respondent is classified as either male or female. Marital status was grouped into three categories: 1) married or common-law, 2) single and 3) widowed, divorced or separated. In order to gain information on respondent's type of household unit, a "household composition" variable was created, which was derived by the CCHS to incorporate a respondent's marital status, sex, and household size. This variable originally had 16 categories and was recoded into five groups: 1) single, 2) couple with no children, 3) couple with children, 4) female lone parent, and 5) male lone parent.

Education level was created as a derived variable by the CCHS. Respondents are asked the highest level of education for all members of the household. Originally, all responses were coded into one of four groups: 1) less than secondary school graduation, 2) secondary school graduation, 3) some post-secondary and 4) post-secondary graduate. This variable was recoded into a binary variable. All respondents whose highest household education level was, at least, post-secondary graduate were collapsed into one category. All other responses were coded into "less than post-secondary graduation". This question was asked of respondents in all provinces.

3.7.4.2 Socioeconomic and Psychosocial Variables

Socioeconomic and psychosocial information is also collected from respondents. The CCHS measures respondents' race/ethnicity, immigration status, income source, total income, and sense of belonging in the community.

The first socioeconomic variable used in this study is a race/ethnicity variable. The CCHS provides comprehensive information on respondents' race or ethnicity. The race/ethnicity variable was created from two derived variables (sdcdcgt and sdcabt). These two variables were derived, by the CCHS, based on the responses from questions sdc_42A to sdc_4V. These questions asked respondents whether they identify with a wide number of ethnic or cultural origins. Responses were compiled to create two variables; one identifying the race or ethnicity of non-Aboriginal respondents from 13 cultural or ethnic groups (sdcdcgt) and the other, categorical variable includes only those who had self-reported themselves as Aboriginal in a previous question (sdcabt) and categorizing them as North American Indian, Métis or Inuit. A new binary racial variable was created by combining these two variables. This variable has been recoded into either "visible minority" which includes all categories except "white" and non-visible minority including only those who reported themselves as "white". This question was asked of respondents in all provinces.

The immigration status variable was created by compiling information from two variables. The first question asks respondents whether the respondent is Canadian born. Those who responded that they were Canadian born were coded as one group. Those who were not Canadian born were further subdivided according to information on the following question which asks "In what year did you first come to Canada to live?" Given that this data set was

pooled from 4 different datasets across 7 years according to the year of the cycle in which the respondent comes from, 10 years from the year of the survey data collection was used as a threshold. Immigrant respondents were divided into less than 10 years ago or more than 10 years ago. This 10-year threshold has been consistently used in Canadian literature examining the healthy immigrant effect (Chen, Wilkins, & Ng, 1996; Newbold & Danford, 2003; Perez, 2002; Dunn & Dyke, 2000; Laroche, 2000). This question was asked of respondents in all provinces.

Income source is utilized in this project as a socioeconomic covariate. Respondents are asked, "What was your household's main source of income?" Originally, respondents answers were represented in 13 categories: 1) wages and salaries, 2) income from self-employment, 3) dividends and interest, 4) Employment Insurance, 5) Worker's Compensation, 6) benefits from Canada or Quebec pension, 7) retirement pension, 8) old age security, 9) Guaranteed Income Supplement, 10) child tax benefit, provincial, municipal social assistance or welfare, 11) child support, 12) alimony, and 13) other. These 13 categories were collapsed into three categories: 1) wages, 2) government assistance, or 3) other. The group "wages" includes those who responded their main source of income was from wages and salaries, or income from self-employment. Those who responded their main source of income was Employment Insurance, Worker's Compensation, benefits from Canada or Québec pension, old age security and Guaranteed Income Supplement (note that widow(ers) may be eligible before age 65 for seniors benefits), child tax credit or provincial, municipal social assistance or welfare were collapsed into the group called "Government assistance". Those who responded that their main source of income was from retirement pensions, child support, alimony or other were collapsed into one group called "other source". This question was asked of respondents in all provinces.

In addition to income source, the total household income variable was utilized for this study. This variable was originally a continuous variable but was recoded in this study as a binary variable. Respondents are asked, "What is your best estimate of the total income, before taxes and deductions, of all household members from all sources in the past 12 months?" Those with household incomes above $80,000 before taxes were collapsed into one group. Those with household incomes of $80,000 before taxes or less were collapsed into one group. No consensus exists in the academic community regarding how to determine a "low-income cut-off". A variety of methods are used and examples include: the Statistics Canada after-tax low-income measure (LIM), the after-tax low-income cut-off (LICO), and the Market Basket Measure (Giles, 2004). Depending on which method is used, the low-income population of Canada has varied from 9 to 16% (Giles, 2004). Rather than utilizing one of the above methods, the income cut-off in this study was determined based on its relationship to the proportion of individuals who are food secure in that income bracket. This study utilized an $80,000 before tax cut-off in order to divide the sample into respondents who are unlikely to not have enough money to be able to feed their family and those who may have difficulty feeding their family. After examining the cross-tabulations of food insecurity and total household income, $80,000 before taxes was identified as an appropriate cutoff as 97% of respondents whose household income before taxes was $80,000 or above were food secure. In contrast, approximately 81% of those with a total household income of below $80,000 were food secure (see Table 4). Total household income was asked of respondents in all provinces.

Table 4: Weighted and Bootstrapped Estimates of Food Insecurity and Total Household Income

	Above $80 000 Proportions % (95% CI)	$80 000 or below Proportions % (95% CI)
Food Secure	96.96 (96.79 – 97.13)	80.93 (80.61 – 81.25)
Marginally Food Insecure	1.52 (1.39 – 1.63)	5.50 (5.31 – 5.68)
Moderate Food Insecurity	1.42 (1.29 – 1.54)	11.08 (10.79 – 11.36)
Severe Food Insecurity	0.11 (0.080 – 0.14)	2.50 (2.38 – 2.61)

The "sense of belonging in the community" variable is the only social support variable included in this analysis. Respondents are asked, "How would you describe your sense of belonging to your local community? Would you say it is: very strong, somewhat strong, somewhat weak, or very weak?" This variable was recoded as a binary variable; very strong and somewhat strong were collapsed into one group titled "strong". Somewhat weak and very weak were collapsed into one group titled "weak". This variable was collected in all provinces.

3.8 Data Analysis

All data analysis was conducted on site at the Prairie RDC located in the University of Calgary using the newest version of STATA (STATA 14). Graphs and tables were produced using Microsoft Office Suite.

The data analysis phase of a study is commonly divided into three stages: initial, primary and secondary (Matthews & Farewell, 1996). Weighting and bootstrapping was conducted on all models; details are provided below.

3.8.1 Initial Data Management

The aim of initial data management was to check the quality of the data. Prior to any formal statistical analysis, the accuracy of the data as well as questions of interest was examined. Some examples of this include: checking for data entry errors, missing data, outliers, and out of range values. The initial phases of the analysis should began by creating simple tabulations and graphical presentations of the data to determine if there is any evidence of the above issues. The majority of the data cleaning for the CCHS is conducted by Statistics Canada employees at the time of interviewing and by analysts prior to releasing the data files to the RDCs. Computer-assisted interviews ensure that no out of range values can be entered and flow errors are effectively controlled through the skip pattern. Any inconsistencies in response categorization are usually set as "not stated" or "other-specify". When responses are coded as "other-specify" Statistics Canada employees may either assign the response a code or leave it as "other". These additional answers may aid in refining future cycles.

I also conducted data cleaning, notably; any "out of range values" were discarded from the age variable by setting the allowable age range from 18 to 64. Consistency checks were conducted by examining the cross-tabulations of marital status and household composition to ensure that respondents who answered "single" in marital status also answered "single" in household composition. In addition, consistency checks were run on the household composition variable and the sex variable to ensure all those who responded that they were "female lone parents" also responded "female" in the sex variable and vice versa for male lone parents.

3.8.2 Primary Data Analysis

The primary data analysis examined pre-defined questions of primary interest (Matthews & Farewell, 1997). In this study, the primary objectives were to investigate the sex gap and food insecurity gradient in seven mental health outcomes: suicidal thoughts in the past year, major depressive episodes in the past year, depressive thoughts in the past month, anxiety disorder, mood disorder, binge drinking, and self-reported mental health status. Moreover, this study aimed to determine whether sex differences in mental health outcomes were neutralized (i.e., eliminated) by the consideration of food insecurity status by assessing whether sex statistically interacts with food insecurity on seven mental health outcomes.

All of the primary analyses were conducted on weighted data (see details on weighting below). In addition, 500 bootstraps (see below) were performed on all analyses. The primary analysis was subdivided into univariate, bivariate and stratified analyses.

3.8.2.1 Univariate Analysis

The univariate analysis consisted of initial descriptive analyses. Descriptive statistics on the demographic, socioeconomic, and psychosocial variables are presented in Section 4.1. Proportions and 95% confidence intervals (95% CI) are presented for all univariate analyses. All estimates were weighted and bootstrapped with 500 replicates. This section includes data on the burden of the seven mental health outcomes (suicidal thoughts in the past year, major depressive episodes in the past year, depressive thoughts in the past month, anxiety disorder, mood disorder, binge drinking, and self-reported mental health status) in the Canadian population and the burden of food insecurity in the Canadian population.

3.8.2.2 Bivariate Analysis

The bivariate analysis is presented in Section 4.2.1 and addresses Objective 1 of this study. Objective 1 aims to determine whether a sex gap in mental health outcomes existed in the Canadian population and to determine whether a food insecurity gradient existed on the seven mental health outcomes. In this thesis, a sex/gender gap refers to any statistically significant difference (proportions or odds ratios) in health outcomes. A food insecurity gradient refers to statistically significant increases in proportions or odds ratio of mental health problems at each level of increasing severity of food insecurity. Moreover, this thesis classified food insecurity gradients as either steep or shallow; a gradient is considered steep when there is a two-fold or greater difference between levels of food insecurity severity. In addition, the relationship between food insecurity and potential confounders and the relationship between mental health outcomes and potential confounders were assessed. Effect modifiers[9] were identified if interactions between the covariate and the exposure (food insecurity status) were significant risk factors (at alpha level 0.05) for the seven mental health outcomes. No statistical test exists to test for confounding, rather the analyst must assess whether the association between exposure and outcome in the adjusted model (adjusted by the potential confounding variable) vary substantially from the crude model. If the association varies substantially (at the discretion of the analyst) then the variable being tested may be a confounder. All demographic, socioeconomic and psychosocial covariates were assessed as potential confounders and effect modifiers. No potential confounders[10] were identified for the relationship between food insecurity status and the seven mental health outcomes (Appendix B). Proportions and 95% confidence intervals (95%

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[9] Effect modification: "A real effect that occurs in a study when a third factor (the effect modifier) influences the magnitude or direction of a causal association between a study exposure and outcome" (Oleckno, 2008, p.580).
[10] Confounding: "A distortion in the magnitude of a true effect of a study exposure on a study outcome due to a mixing of effects between the exposure and an extraneous factor" (Oleckno, 2008, p.575).

CI) are presented for all bivariate analyses. All estimates were weighted and bootstrapped with 500 replicates.

3.8.2.3 Stratified Analysis

The stratified analysis, presented in Section 4.2.2, aims to address Objective 3 of this study. Objective 3 aims to determine whether sex differences in mental health were neutralized (or eliminated) by the consideration of food insecurity status, amongst those experiencing household food insecurity. In essence, this section of the analysis examined whether crude associations between food insecurity and mental health were altered by sex adjustment. This analysis is presented in Section 4.2.2 and Objective 3 was addressed by examining crude and adjusted analyses. Comparing the adjusted analyses to the crude analysis assesses each covariate (including sex) as a potential effect modifier (whether the interaction terms are significant) and as a potential confounder. Once this was determined, the analysis was stratified by sex and presented graphically. Sex was assessed to determine whether it acted as an effect modifier in the relationship between food insecurity and mental health outcomes, amongst those experiencing household food insecurity. Odds Ratios (OR) and 95% confidence intervals (CI) are presented. All estimates have been weighted and bootstrapped with 500 replicates.

3.8.3 Secondary Analysis

Secondary analyses aimed to address any questions that were not pre-defined at the outset of the study. The secondary analysis in this thesis is the multivariable analysis.

3.8.3.1 Multivariable Analysis

The multivariable analysis aimed to identify other potential interacting variables with the relationship between food insecurity and mental health outcomes. These interacting terms were analyzed using the intersectionality framework in Chapter 5. Note that interactions outside of the relationship in question (e.g., sex and education; immigration status and income) are not part of this set of multivariable analyses. After identifying potential confounders and effect modifiers in the relationship between food insecurity and mental health outcomes, forward step-wise logistic regression models were created. Once all pertinent covariates were included in the model, their statistical significance (p-value <0.05) was assessed. Non-significant covariates were removed from the model, unless their interaction terms remained significant. This analysis is presented in Section 4.3.2. Reasons for the interactions are hypothesized and suggestions are made for further research in Chapter 5.

3.9 Weighting and Bootstrapping

The purpose of weighting is to adjust the parameters of estimates calculated from the dataset to provide accurate estimates of the population in which the samples were drawn (Patten, Williams, Lavorato, Fiest, Bulloch, & Wang, 2015). These parameters must be adjusted to account for non-response and self-selection bias and to correct for over- or under-representation of certain groups or characteristics. Weighting procedures are determined by Statistics Canada (2007). When producing estimates that are representative of the population (e.g., the Canadian population living in the provinces that are between the ages of 18-64) the survey weights must be incorporated into the analysis. Each respondent included in the final sample is given a survey

weight. This survey weight corresponds to the number of people in the entire population that are represented by the individual in the sample.

For the CCHS, each cycle has its own survey weight which must be pooled together with the cycle data itself. The four survey weights were pooled and included in every model. As stated in above sections, all four cycles use a three-stage sampling frame for its sample selection: first an area frame which is the primary sampling frame, and two frames that are composed of telephone number lists and random digit dialing. Given that only minor differences exist between the two telephone frames, they are treated together in terms of weighting. The weighting strategy treats the area frame and the telephone frame independently. Weights resulting from the two frames are combined together through a process called "integration". With some adjustments, the integrated weights become the final weights (Statistics Canada, 2007). All estimates in this study have been weighted. Thomas and Wannell (2009) recommend rescaling the pooled sampling weights by a constant factor of 1/k where k represents the total number of samples combined, in this case 4.

Bootstrapping can be defined and explained as follows:

> "…the bootstrap takes the sample (the values of the independent and dependent variables) as the population and the estimates of the sample as true values. Instead of drawing from a specified distribution (such as the normal) by a random number generator, the bootstrap draws with replacement from the sample. It therefore takes the empirical distribution function (the step-function) as true distribution function." (Schmidheiny, & Basel, 2012, p.1).

Bootstrap weights, in addition to survey weights, must also be pooled and merged to the dataset (Statistics Canada, 2007). As per recommendations from Statistics Canada, this study used 500 replicate bootstrap weights on all univariate, bivariate and full model analyses to account for clustering in survey sampling approach. Bootstrapping is a statistical technique that randomly re-samples, with replacement, to approximate the sample size of the empirical distribution. Bootstrapping has several advantages including: improving the precision of the estimates and narrowing the confidence intervals (this helps to avoid Type I error) and reducing the necessity of meeting the heteroscedasticity assumption (Deng, Allison, Fang, Ash, & Ware, 2013).

Having discussed the CCHS survey in detail and the study which pooled CCHS cycles for this thesis, Chapter 4 presents the results in terms of the aims of the study.

Chapter 4

Results

This chapter presents empirical findings related to the three objectives of this research study, which are to determine whether: 1) there is a sex gap in mental health outcomes; 2) a household food insecurity status gradient exists on various mental health outcomes, namely whether respondents with increasing severity of food insecurity experience higher odds of reporting adverse mental health outcomes; and 3) the sex differences in mental health outcomes are eliminated when household food insecurity status is considered. The organization of this chapter includes: 1) descriptive findings on the pooled sample from the Canadian Community Health Survey (CCHS); 2) bivariate results, examining proportions of mental health outcomes for each sex and at each level of food insecurity (Objective 1 and 2); 3) sex-stratified analyses of food insecurity status and seven mental health outcomes, where sex is assessed as a potential effect modifier in each outcome prior to stratification (Objective 3); and 4) a multivariable analysis to identify other intersecting covariates that may be candidates for intersectionality theory.

4.1 Description of the Canadian Community Health Survey Sample

From a pooled sample of 515 421, 206 490 respondents were excluded by employing listwise deletion from the combined data set for all who fit the exclusion criteria: under the age of 18, over the age of 64, those residing in the northern territories, or who had missing data on the Household Food Security Survey Module (HFSSM). Those who had missing data on the HFSSM (i.e., those for whom the HFSSM was administered but who did not respond) did not differ from those who responded in terms of age, sex or marital status. Those who did not respond to the HFSSM were more likely to reside in Manitoba, Saskatchewan or New Brunswick

compare with those who did answer, this is due to the fact that the HFSSM was only an option component in those provinces in Cycle 3.1 and Cycle 2009-2010. Figure 2 below provides a detailed description of the exclusion process. The total sample size of the study dataset was 308 931, including approximately 37 500 food insecure respondents.

Figure 2: Description of Exclusions Leading to Final Sample Size

```
┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐
│ CCHS 3.1 (2005)  │  │ CCHS 2007-08     │  │ CCHS 2009-10     │  │ CCHS 2011-12     │
│ N=132 947        │  │ N=131 959        │  │ N=124 870        │  │ N=125 645        │
└──────────────────┘  └──────────────────┘  └──────────────────┘  └──────────────────┘
                          ┌──────────────────┐
                          │ Total Sample     │
                          │ N=515 421        │
                          └──────────────────┘
┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐
│ Age <18,>/=65    │  │ Northern         │  │ Missing          │
│ N=167 005        │  │ Territories      │  │ HFSSM            │
│                  │  │ N=9 793          │  │ N=29 692         │
└──────────────────┘  └──────────────────┘  └──────────────────┘
                          ┌──────────────────┐
                          │ Final Sample Size│
                          │ N=308 931        │
                          └──────────────────┘
```
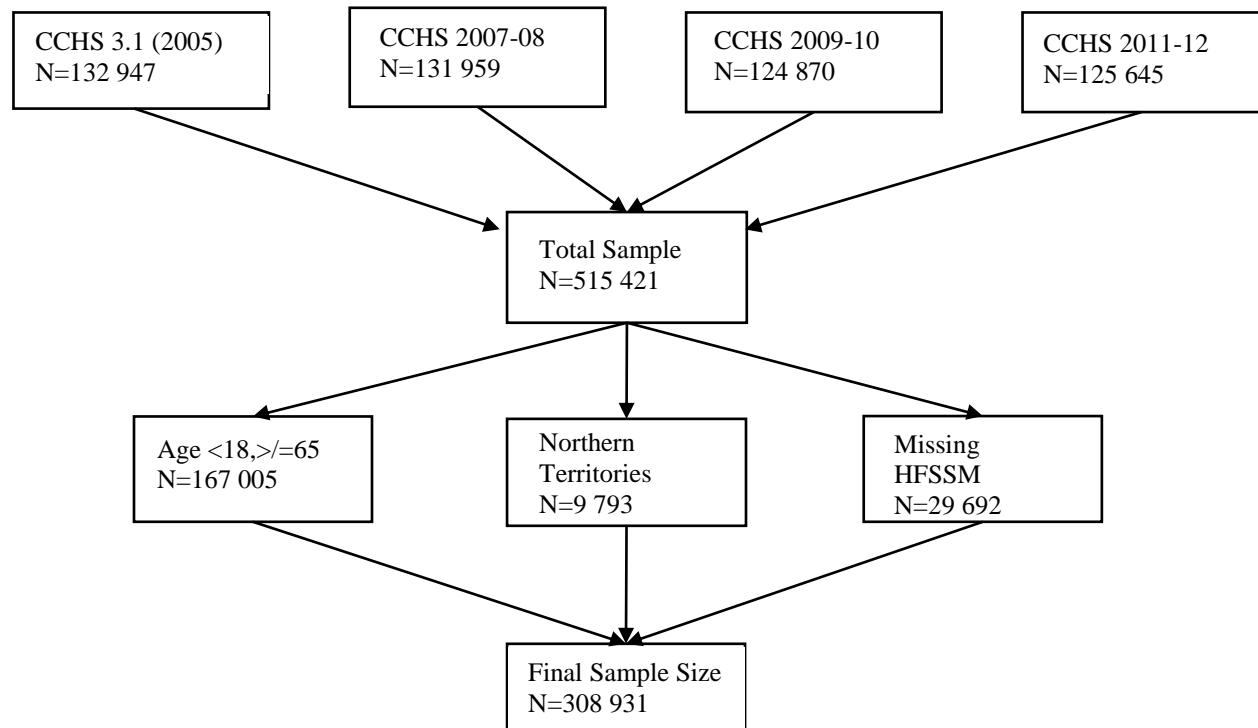
Table 5 summarizes the descriptive statistics for the pertinent covariates included in the study. All data were bootstrapped and weighted to approximate the target population and only weighted and bootstrapped estimates are presented.

Table 5: Univariate Statistics of Covariates in the Canadian Population (Bootstrapped)

Variable	Proportion (%)	95% Confidence Interval
Sex		
Male	49.9	49.8 – 50.0
Female	50.1	50.1 – 50.2
Marital Status		
Married or Common-Law	63.8	63.6 – 64.1
Divorced, widowed or separated	9.2	9.0 – 9.3
Single	27.0	26.8 – 27.2
Household Composition		
Single	17.4	17.1 – 17.6
Couple with no children	25.0	24.7 – 25.2
Couple with children	48.5	48.2 – 48.8
Female lone-parent	7.4	7.2 – 7.6
Male lone parent	1.7	1.7 – 1.8
Education		
Post-secondary diploma or higher	80.3	80.1 – 80.6
Less than post-secondary	19.7	19.4 – 19.9
Race/Ethnicity		
Non-visible minority	78.8	78.5 – 79.1
Visible minority	21.2	20.9 – 21.5
Immigration Status		
10 or more years ago	15.7	15.4 – 15.9
Less than 10 years ago	7.5	7.3 – 7.7
Canadian Born	76.8	76.5 – 77.1
Income Source		

Wages	87.9	87.7 – 88.1
Government Assistance	9.4	9.2 – 9.6
Other Sources	2.7	2.6 – 2.8
Total Household Income		
$80,000 or above	43.2	42.9 – 43.6
Less than $80,000	56.8	56.4 – 57.1
Sense of Belonging in Local Community		
Strong	61.7	61.4 – 62.0
Weak	38.3	38.0 – 38.6

Given the bootstrapping and weighting procedures conducted on the analysis and the random sampling procedures used to collect each cycle of the CCHS, the findings presented here are generalizable to 98% of the Canadian population aged 18-65 years living in the provinces who have completed the HFSSM. Results are therefore written as applicable to the 'Canadian population' recognizing that this population only includes those who have fulfilled the exclusion criteria. Proportions are presented as percentages with 95% confidence intervals (95% CI) in brackets. Covariates and explanatory variables are presented first followed by the outcome variables.

In line with the random selection of CCHS participants within households, the Canadian population comprised of approximately equal proportions of male and female respondents. In this population, almost two-thirds of individuals were married or living common-law. Almost half were coupled with children, another quarter were coupled without children. Lone parenthood in this dataset was low (7.4% for female-headed households and 1.7% for male lone parents). Eighty percent of households' highest education level was, at least, post-secondary

graduate. Approximately 79% of this population identified as non-visible minorities and a similar proportion of the population was born in Canada. The vast majority of households' main source of income was wages (87.9%) and 56% of the households had a total household income before tax above $80,000 per year. The majority (61.7%) of the Canadian population had a strong sense of belonging in their local community.

The study population was restricted to include respondents aged 18 to 64 years of age. Figure 3 below shows the distribution of the continuous variable of age.

Figure 3: Distribution of Age for the Canadian Population
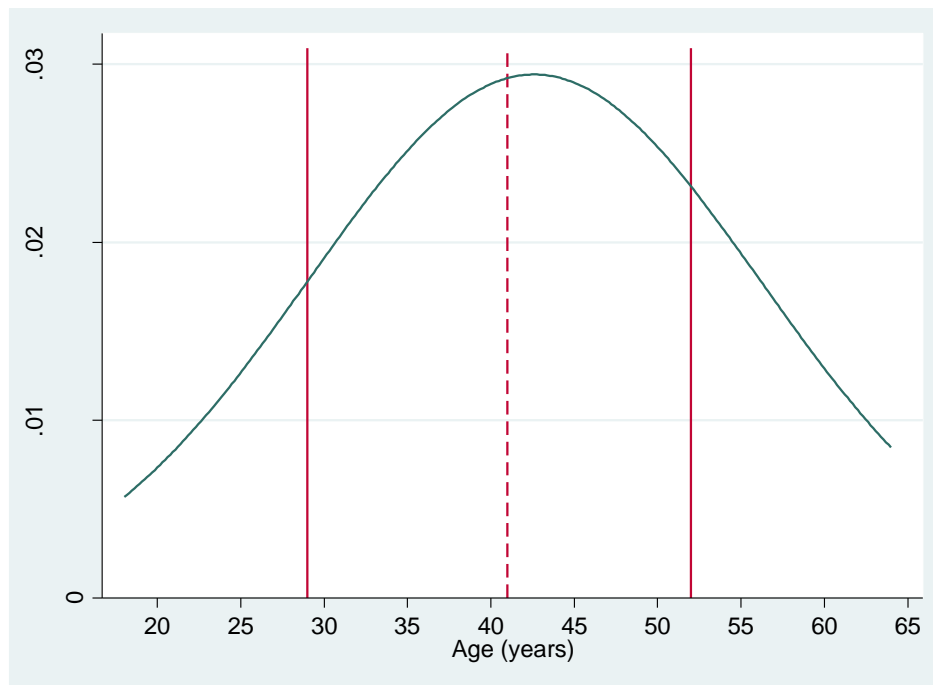
The two solid lines represent the interquartile range (IQR), which totals 23 years. The dotted line represents the median of 41 years. The mean and the standard deviation for age were 40.8 years and 13.1 respectively. The distribution of age (of those aged 18-64) is approximately normal in this population.

Table 6: Food Insecurity Status of Canadian Population (Bootstrapped)

Food Security Status	Proportion (%)	95% Confidence Interval
Food Secure	88.1	87.9 – 88.3
Marginally Food Insecure	3.7	3.6 – 3.8
Moderately Food Insecure	6.8	6.6 – 6.9
Severely Food Insecure	1.4	1.4 – 1.5

Table 6 displays the distribution of household food insecurity status amongst the Canadian population. Approximately 12% of the population were food insecure: 3.7%, 6.8% and 1.4% fulfilling the criteria for marginal, moderate and severe food insecurity respectively.

Seven mental health outcomes were examined in this study. The distribution of these variables across the Canadian population is shown in Table 7. The prevalence of these mental health outcomes ranged from a high of 20% of Canadians reporting having felt sad or depressed in the past month and the same percentage reporting suicidal thoughts in the past year to 5.4% of respondents saying that their self-reported mental health was fair/poor.

Table 7: Univariate Statistics of Seven Mental Health Outcomes in the Canadian Population (Bootstrapped)

Variable	Proportion (%)	95% Confidence Interval
Depressive Thoughts (month)		
No	80.0	79.6 – 80.4
Yes	20.0	19.6 – 20.4
Major Depressive Episodes (year)		
No	93.6	93.3 – 93.8
Yes	6.4	6.2 – 6.7
Anxiety Disorder		
No	94.1	94.0 – 94.3
Yes	5.9	5.8 – 6.0
Mood Disorder		
No	92.8	92.7 – 92.9
Yes	7.2	7.1 – 7.3
Suicidal Thoughts (year)		
No	80.0	79.1 – 81.0
Yes	20.0	19.0 – 20.9
Mental Health Status		
Good/Very Good/Excellent	94.6	94.5 – 94.8
Fair/Poor	5.4	5.2 – 5.5
Binge Drinking (month)		
Once a month or more	17.1	16.8 – 17.3
Less than once a month	82.9	82.7 – 83.2

4.2 Bivariate Association of Food Insecurity Status and Mental Health Outcomes with Effect Modifiers

Objectives 1 and 2 aimed to determine whether a sex gap in mental health outcomes exists in the Canadian population and to determine whether a household food insecurity level gradient exists on selected mental health outcomes. This was accomplished through bivariate statistics that examined the prevalence of the seven mental health outcomes according to household food insecurity status and potential confounders or effect modifiers.

4.2.1 Sex Differences in Mental Health Outcomes

Table 8 presents the prevalence of seven mental health outcomes among Canadian women and men (Objective 1). In addition, Table 8 presents the mean absolute differences in proportions between males and female, and their respective confidence intervals; a positive difference denotes males having a higher proportion while a negative difference denotes females have a higher proportion. A pervasive sex gap was apparent with women reporting higher rates of depressive thoughts in the past month, major depressive episodes, anxiety disorder, mood disorder and fair or poor mental health status, and men reporting higher prevalence of suicidal thoughts in the past year and binge drinking.

Table 8: Proportion of Seven Mental Health Outcomes in the Canadian Population Stratified by Sex, Bootstrapped and Weighted

Variable	Males % (95% CI)	Females % (95% CI)	Difference (%) (95% CI)
Depressive Thoughts (month)			±9.4 (9.3 - 9.5)
No	84.7 (84.2 – 85.2)	75.3 (74.7 – 75.9)	
Yes	15.3 (14.8 – 15.8)	24.7 (24.1 – 25.3)	
Major Depressive Episodes (year)			±3.7 (3.6 - 3.8)
No	92.6 (92.3 – 92.9)	88.9 (88.5 – 89.3)	
Yes	7.4 (7.1 – 7.7)	11.1 (10.7 – 11.5)	
Anxiety Disorder			±3.3 (3.2 – 3.3)
No	95.8 (95.6 – 95.9)	92.5 (92.3 – 92.7)	
Yes	4.2 (4.1 – 4.4)	7.5 (7.3 – 7.7)	
Mood Disorder			±4.2 (4.2 – 4.2)
No	94.9 (94.7 – 95.1)	90.7 (90.5 – 90.9)	
Yes	5.1 (4.9 – 5.3)	9.3 (9.1 – 9.8)	
Suicidal Thoughts (year)			±2.5 (2.3 - 2.7)
No	78.6 (77.1 – 80.1)	81.1 (79.8 – 82.4)	
Yes	21.4 (19.9 – 22.9)	18.9 (17.6 – 20.2)	
Mental Health Status			±0.9 (0.9 – 0.9)
Fair/Poor	95.1 (94.9 – 95.3)	94.2 (94.0 – 94.4)	
Good/Very Good/Excellent	4.9 (4.7 – 5.1)	5.8 (5.6 – 6.0)	
Binge Drinking (month)			±15.3 (15.1 - 15.4)
Once a month or less	75.6 (75.2 – 76.0)	90.9 (90.6 – 91.1)	
More than once a month	24.4 (24.0 – 24.8)	9.1 (8.9 – 9.4)	

4.2.2 Household Food Insecurity Status Gradient in Mental Health Outcomes

Table 9 presents findings on the proportion of seven mental health outcomes in the Canadian population according to level of household food insecurity (Objective 2). A steep food insecurity status gradient existed on five of seven mental health outcome variables (depressive thoughts in the past month, major depressive episodes, anxiety disorder, mood disorder and self-reported mental health status). In addition, a shallow food insecurity status gradient existed on the remaining two mental health outcomes (suicidal thoughts in the past year and binge drinking).

Table 9: Proportion of Seven Mental Health Outcomes in the Canadian Population by Food Insecurity Status, Bootstrapped and Weighted

Variable	Food Secure % (95% CI)	Marginal Food Insecurity % (95% CI)	Moderate Food Insecurity % (95% CI)	Severe Food Insecurity % (95% CI)
Depressive Thoughts (month)				
No	82.4	69.2	60.2	40.3
	(82.0 – 82.8)	(66.8 – 71.5)	(58.2 – 62.1)	(36.3 – 44.2)
Yes	17.6	30.8	39.8	59.7
	(17.2 – 18.0)	(28.5 – 33.2)	(37.9 – 41.8)	(55.8 – 63.7)
Major Depressive Episodes (year)				
No	92.3	84.2	78.7	59.1
	(92.0 – 92.6)	(82.4 – 86.0)	(77.3 – 80.1)	(55.7 – 62.5)
Yes	7.7	15.8	21.3	40.9
	(7.4 – 7.9)	(14.0 – 17.6)	(19.9 – 22.7)	(37.5 – 44.3)
Anxiety Disorder				
No	95.2	90.0	86.5	74.5
	(95.1 – 95.3)	(89.2 – 90.8)	(85.8 – 87.2)	(72.6 – 76.4)
Yes	4.8	10.0	13.5	25.5
	(4.7 – 4.9)	(9.2 – 10.8)	(12.8 – 14.2)	(23.6 – 27.4)
Mood Disorder				
No	94.2	88.6	82.6	65.6
	(94.1 – 94.3)	(87.8 – 89.5)	(81.8 – 83.4)	(63.4 – 67.7)
Yes	5.8	11.4	17.4	34.4
	(5.7 – 5.9)	(10.5 – 12.2)	(16.6 – 18.2)	(32.3 – 36.6)
Suicidal Thoughts (year)				
No	82.9	74.5	75.0	58.9
	(81.8 – 83.9)	(70.2 – 78.9)	(72.2 – 77.7)	(54.0 – 63.7)
Yes	17.1	25.5	25.0	41.1
	(16.1 – 18.2)	(21.1 – 29.8)	(22.3 – 27.8)	(36.3 – 46.0)

Mental Health Status				
Fair/Poor	4.0	9.3	15.0	31.1
	(3.9 – 4.2)	(8.4 – 10.2)	(14.2 – 15.8)	(28.9 – 33.4)
Good/Very Good/ Excellent	96.0	90.7	85.0	68.9
	(95.8 – 96.1)	(89.8 – 91.6)	(84.2 – 85.8)	(66.6 – 71.1)
Binge Drinking (month)				
Once a month or less	83.2	82.7	80.5	74.7
	(83.0 – 83.5)	(81.5 – 84.0)	(79.4 – 81.5)	(72.4 – 77.1)
More than once a month	16.8	17.3	19.5	25.3
	(16.5 –17.0)	(16.0 – 18.5)	(18.5 – 20.6)	(22.9 – 27.6)

By way of illustration, the gradient for a common mental health problem—depressive thoughts in the past month, was 17.6% for food secure respondents, 30.8% for the marginally food insecure, 39.8% for moderately food insecure, and 59.7% for severely food insecure persons. For a rarer condition, 7.7% of food secure Canadians fulfill the criteria for experiencing major depressive episodes in the past year. The corresponding proportions for marginal, moderately and severely food insecure respondents are 15.8%, 21.3%, and 40.9% respectively.

Therefore, in reference to Objective 1 and 2, a prominent sex gap in mental health outcomes does exist in the Canadian population, as does a steep food insecurity status gradient on selected mental health outcomes.

Background work to this section is available in Appendix B, which presents the results of the adjusted analyses of the effect modifiers.

As can be seen in Appendix B, the number and types of covariates identified as effect modifiers on the relationship between household food insecurity status and specific mental health outcomes varied. For example, three covariates were identified as effect modifiers on the

relationship between food insecurity status and major depressive episodes: age, education and household composition. Six covariates were identified as effect modifiers on the relationship between food insecurity status and self-reported mental health status: age, education, total household income, household composition, ethnicity, and immigration status. Five covariates were identified as effect modifiers on the relationship between food insecurity status and binge drinking more than once a month: sex (which will be discussed in detail in the following sections), marital status, total family income, household composition, and immigration status. Hypotheses on the relationship of these effect modifiers on the mental health outcome in relation to the theory of intersectionality and evidence from past literature will be discussed in Chapter 5.Significant interactions (or effect modifiers) are included, along with all independently significant covariates, in the final multivariable analyses presented in Section 4.3.2.

4.2.3 Sex Stratified Analysis of Food Insecurity Status and Mental Health Outcomes

The extension of the previous analysis addresses Objective 3 which aimed to determine whether sex differences in mental health were neutralized (or eliminated) by the consideration of level of household food insecurity status in the analysis, amongst those experiencing household food insecurity.

The mental health outcome, depressive thoughts in the past month, is used to illustrate the method leading to results for the seven mental health outcomes.

4.2.3.1 Depressive Thoughts in the Past Month

Table 10 shows the crude and sex-adjusted odds ratios of food insecurity status on depressive thoughts in the past month. Food secure respondents act as the reference group in this analysis. Those who are marginally food insecure were 2.06 (1.86 – 2.34) times more likely to

report having depressive thoughts in the past month compared to food secure respondents. Moderately food insecure respondents were 3.10 (2.84 – 3.39) times more likely to report having depressive thoughts in the past month compared to food secure respondents. Severely food insecure respondents were 6.95 (5.90 – 8.19) times more likely to report depressive thoughts in the past month compared to food secure Canadians.

To assess for effect modification the covariate of interest, sex, was included in the model along with interaction terms between each level of food insecurity and sex (derived from Appendix B). The interaction terms were then assessed for significance; if the interaction terms were not significant at p<0.05 (data not shown) then the covariate of interest (sex) is not an effect modifier or is not interacting with the relationship between food insecurity status and depressive thoughts in the past month. For this outcome, sex was not a statistically significant effect modifier. Therefore, the odds of each level of food insecurity reporting having depressive thoughts in the past month did not statistically significantly differ between males and females; this is presented graphically below in Figure 4.

Table 10 also presents the relationship between food insecurity status and depressive thoughts in the past month, adjusted by sex. Sex was significant at p<0.001 and will therefore be included in the multivariable model in Section 4.3.2. Female respondents were 1.79 (1.70 – 1.88) times more likely to report having depressive thoughts in the past month compared to male respondents, holding food insecurity status constant.

This analysis also assessed sex as a potential confounder; there is no statistical test to assess confounding. Instead, to look for confounding, the odds ratios for each level of food insecurity in the sex-adjusted model are assessed. If the association has changed in a substantial (at the discretion of the analyst) way, sex may be considered a confounder.

90

Table 10: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Depressive Thoughts in the Past Month

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.09	1.86 – 2.34	<0.001	
Moderately FI	3.10	2.84 – 3.39	<0.001	
Severely FI	6.95	5.90 – 8.19	<0.001	
ADJUSTED by SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.05	1.82 – 2.30	<0.001	
Moderately FI	3.00	2.74 – 3.28	<0.001	
Severely FI	7.13	6.06 – 8.39	<0.001	
Sex				
Male (ref.)				
Female	1.79	1.70 – 1.88	<0.001	Not Sig.

Table 10 shows that the sex-adjusted odds ratios have not altered much from the crude model and, therefore, sex is not considered a confounder. If sex had proven to be a statistically significant effect modifier, then sex would be deemed to have an intersecting effect on the relationship between food insecurity status and the mental health outcome. Therefore, holding sex constant, marginally food insecure respondents were 2.05 (1.82 – 2.30) times more likely than food secure respondents to report having depressive thoughts in the past month. Moderately food insecure respondents were 3.00 (2.74 – 3.28) times more likely to report having depressive thoughts in the past month compared to food secure respondents. Finally, severely food insecure respondents were 7.13 (6.06 – 8.39) times more likely to report having depressive thoughts in the past month compared to food secure respondents. All of the odds ratios mentioned above were significant at p<0.001.

Figure 4 presents the sex-stratified model of food insecurity status on depressive thoughts in the past month. Food secure respondents act as the reference group (odds ratio of 1) in this analysis and were therefore excluded from this graph.

Figure 4: Sex-Stratified Model of Food Insecurity Status and Depressive Thoughts in the Past Month, amongst those Experiencing Household Food Insecurity

Depressive Thoughts in the Past Month

	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	2.25	3.268	8.321
Women	1.921	2.834	6.103
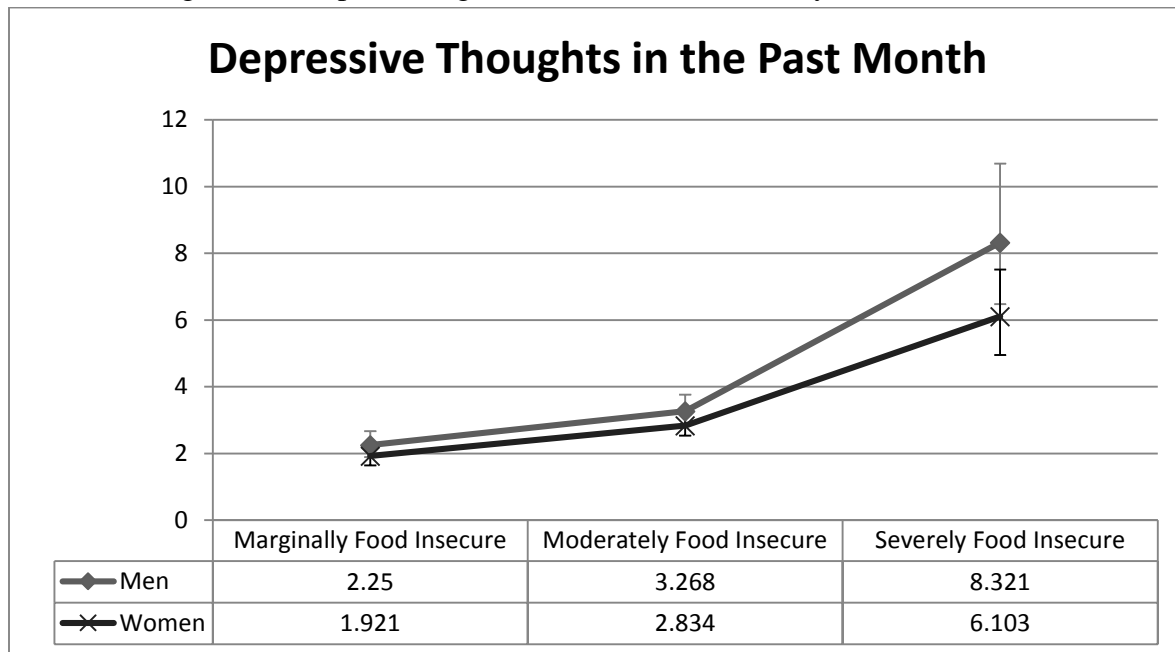
Figure 4 reiterates what has been presented in the above analysis, namely that sex did not act as an effect modifier on the relationship between food insecurity status and depressive thoughts in the past month. This can be shown by the overlapping confidence intervals between males and females at each level of food insecurity. Therefore, at each level of food insecurity, females and males reported the same odds of having depressive thoughts in the past month, at alpha level 0.05. Figure 4 further shows a steep food insecurity status gradient for depressive thoughts in the past month.

Tables 11-16 present similar data for the other six mental health outcomes and Figures 5-10 present the sex-stratified data graphically for these mental health outcomes.

4.2.3.2 Major Depressive Episodes in the Past Year

In Table 11, the sex and food insecurity interaction terms were not significant at p<0.05 (data not shown) therefore the covariate of interest (sex) was not an effect modifier or was not

interacting with the relationship between food insecurity status and major depressive episodes. Therefore, the odds of each level of food insecurity having fulfilled the criteria for major depressive episodes in the past year did not statistically significantly differ between males and females; this is presented graphically below in Figure 5.

Table 11: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Major Depressive Episodes in the Past Year

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.22	1.89 – 2.59	<0.001	
Moderately FI	3.75	3.39 – 4.15	<0.001	
Severely FI	10.06	8.63 – 11.71	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.16	1.84 – 2.53	<0.001	
Moderately FI	3.60	3.25 – 3.99	<0.001	
Severely FI	10.22	8.78 – 11.90	<0.001	
Sex				
Male (ref.)				
Female	1.71	1.58 – 1.84	<0.001	Not Sig.

This table also presents the relationship between food insecurity status and depressive thoughts in the past month, adjusted by sex. Sex was significant at p<0.001 and will therefore be included in the multivariable model in Section 4.3.2. Female respondents were 1.71 times more likely to fulfill the criteria for major depressive episodes compared to males, holding food insecurity status constant. Table 11 also shows that the sex-adjusted odds ratios have changed little from the crude model and therefore sex was not considered a confounder. Holding sex constant, there was a gradient in food insecurity status and all odd ratios in Table 11 for this analysis significant at p<0.001.

Figure 5: Sex-Stratified Model of Food Insecurity Status and Major Depressive Episodes in the Past Year, amongst those Experiencing Household Food Insecurity

Major Depressive Episodes

	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	2.464	3.793	11.454
Women	1.999	3.499	9.299

Of note in Figure 5 is the steep food insecurity status gradient for major depressive episodes and the substantial increase in odds of fulfilling the criteria for major depressive episodes for those who report severe food insecurity.

4.2.3.3 Anxiety Disorder

Table 12 shows the crude and sex-adjusted odds ratios of food insecurity status on anxiety disorders. The sex and food insecurity interaction terms were not significant at $p<0.05$ (data not shown) therefore the covariate of interest (sex) was not an effect modifier or was not interacting with the relationship between food insecurity status and anxiety disorders. The odds of individuals at each level of food insecurity having an anxiety disorder did not statistically significantly differ between males and females; this is presented graphically below in Figure 6. Sex was again significant at $p<0.001$ and will therefore be included in the multivariable model in Section 4.3.2. Female respondents were 1.79 times more likely to report having an anxiety

disorder compared to males, holding food insecurity status constant. Sex was not considered a confounder because of the similarly between crude and sex-adjusted odds ratios. The significant gradient in anxiety disorder according to food insecurity status is apparent in Figure 6.

Table 12: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Anxiety Disorder

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.20	1.98 – 2.45	<0.001	
Moderately FI	3.10	2.88 – 3.33	<0.001	
Severely FI	6.78	6.10 – 7.53	<0.001	
ADJUSTED by SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.16	1.95 – 2.40	<0.001	
Moderately FI	2.95	2.74 – 3.17	<0.001	
Severely FI	6.83	6.15 – 7.58	<0.001	
Sex				
Male (ref.)				
Female	1.79	1.70 – 1.88	<0.001	Not Sig.

Figure 6: Sex-Stratified Model of Food Insecurity Status and Anxiety Disorder, amongst those Experiencing Household Food Insecurity

Anxiety Disorders	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	2.275	2.795	6.183
Women	2.099	3.027	7.308

4.2.3.4 Mood Disorder

Table 13 shows the crude and sex-adjusted odds ratios of food insecurity status on mood disorders. The sex and food insecurity interaction terms were not significant at $p<0.05$ (data not shown) therefore the covariate of interest (sex) was not an effect modifier or was not interacting with the relationship between food insecurity status and mood disorders. The odds of each level of food insecurity having a mood disorder did not statistically significantly differ between males and females; this is graphically presented below in Figure 7. Table 13 presents the relationship between food insecurity status and mood disorders, adjusted by sex. Sex was significant at $p<0.001$ and was therefore included in the multivariable model in Section 4.3.2. Females were 1.86 (1.78 – 1.95) times more likely to report having a mood disorder compared to males, holding food insecurity status constant. Table 13 shows that the sex-adjusted odds ratios have not altered much from the crude model and therefore sex was not considered a confounder.

Table 13: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Mood Disorder

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.08	1.89 – 2.28	<0.001	
Moderately FI	3.41	3.20 – 3.64	<0.001	
Severely FI	8.51	7.72 – 9.38	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.04	1.86 – 2.24	<0.001	
Moderately FI	3.25	3.04 – 3.47	<0.001	
Severely FI	8.66	7.86 – 9.53	<0.001	
Sex				
Male (ref.)				
Female	1.86	1.78 – 1.95	<0.001	Not Sig.

Holding sex constant, marginally, moderately and severely food insecure Canadians were, respectively, 2.04 (1.86 – 2.24), 3.25 (3.04 – 3.47) and 8.66 (7.86 – 9.53) times more likely

than food secure Canadians to report having a mood disorder. All of the odds ratios mentioned above were significant at $p<0.001$.

Figure 7: Sex-Stratified Model of Food Insecurity Status and Mood Disorder, amongst those Experiencing Household Food Insecurity

Mood Disorder

	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	2.266	3.235	8.506
Women	1.918	3.253	8.783
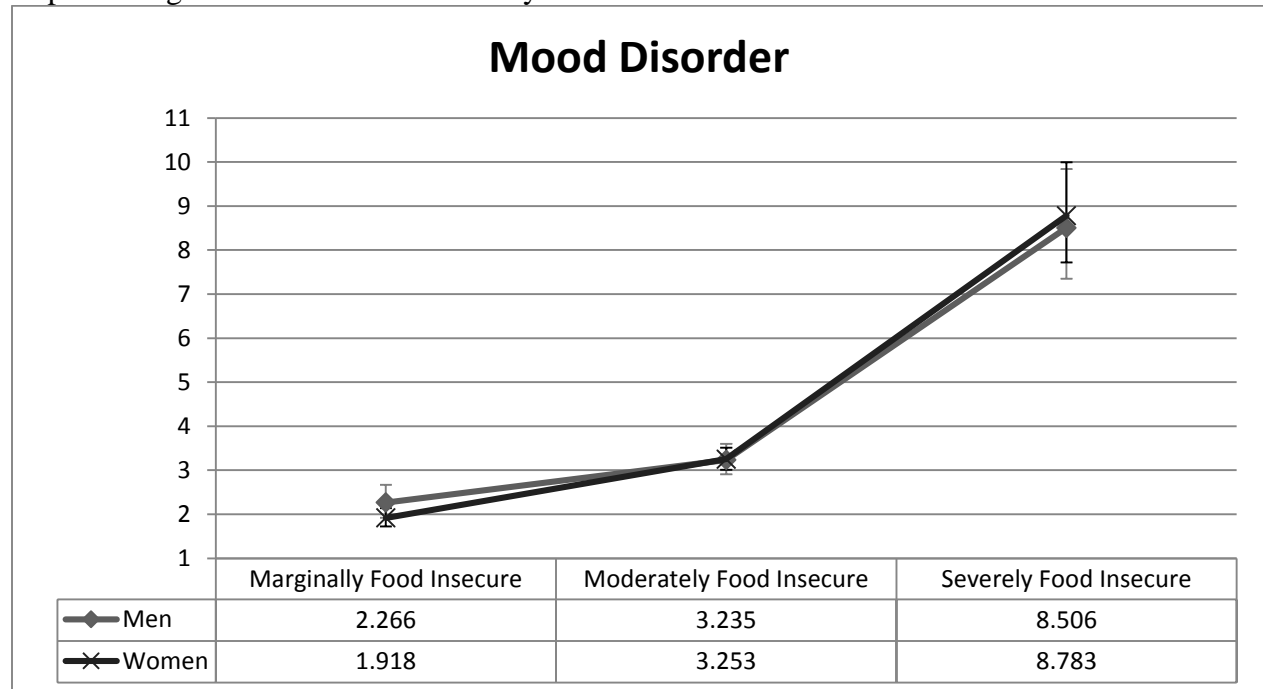
Figure 7 presents the sex-stratified model of food insecurity status on mood disorders. This graph reemphasizes the above analysis, namely that sex did not act as an effect modifier on the relationship between food insecurity status and anxiety disorders. Moreover, Figure 7 shows a steep food insecurity gradient on mood disorders with a substantial increase in the odds of reporting having a mood disorder at the severely food insecure level.

4.2.3.5 Suicidal Thoughts in the Past Year

Table 14 shows the crude and sex-adjusted odds ratios of food insecurity status on thoughts of suicide in the past year. The sex and food insecurity interaction terms were not significant at $p<0.05$ (data not shown) therefore the covariate of interest (sex) was not an effect modifier or was not interacting with the relationship between food insecurity status and thoughts

97

of suicide in the past year. Therefore, the odds of each level of food insecurity having thoughts of suicide in the past year did not statistically significantly differ between males and females; this is graphically presented below in Figure 8.

Table 14: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Thoughts of Suicide in the Past Year

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	1.65	1.30 – 2.11	<0.001	
Moderately FI	1.61	1.36 – 1.92	<0.001	
Severely FI	3.38	2.74 – 4.19	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	1.67	1.31 – 2.13	<0.001	
Moderately FI	1.64	1.38 – 1.96	<0.001	
Severely FI	3.39	2.73 – 4.20	<0.001	
Sex				
Male (ref.)				
Female	0.84	0.74 – 0.95	0.006	Not Sig.

Table 14 presents the relationship between food insecurity status and thoughts of suicide in the past year, adjusted by sex. Sex was significant at p=0.006 and was therefore included in the multivariable model in Section 4.3.2. Female Canadians were 0.84 (0.74 – 0.95) times less likely to report having thoughts of suicide in the past year compared to male Canadians, holding food insecurity status constant. Table 14 shows that the sex-adjusted odds ratios have not altered much from the crude model and therefore sex was not considered a confounder. Holding sex constant, marginally food insecure Canadians were 1.67 (1.31 – 2.13) times more likely than food secure Canadians to report having thoughts of suicide in the past year. Given the overlapping confidence intervals for marginal and moderately food insecure Canadians, moderately food insecure Canadians were not statistically significantly more likely to report having thoughts of suicide in the past years compared to marginally food insecure Canadians.

Finally, severely food insecure Canadians were 3.38 (2.74 – 4.19) times more likely to report

having suicidal thoughts in the past year compared to food secure Canadians. Unless otherwise

stated, all of the odds ratios mentioned above were significant at p<0.001.

Figure 8: Sex-Stratified Model of Food Insecurity Status and Suicidal Thoughts in the Past Year,
amongst those Experiencing Household Food Insecurity

Suicidal Thoughts in the Past Year

	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	1.715	1.774	2.88
Women	1.635	1.565	3.876
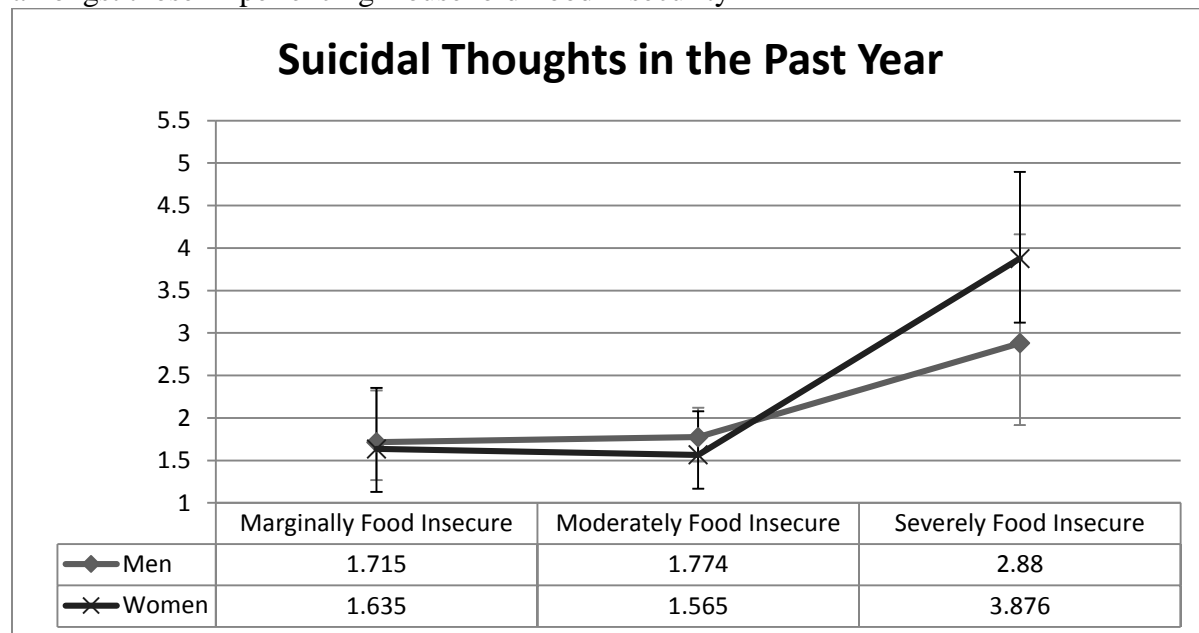
Figure 8 graphically presents the relationship between food insecurity status and suicidal

thoughts in the past year, stratified by sex. Figure 8 presents evidence that sex does not act as an

effect modifier in the relationship between food insecurity status and suicidal thoughts in the past

year. This can be shown by the overlapping confidence intervals for each level of food insecurity

between sexes. Therefore, at each level of food insecurity males and females experienced

statistically the same odds of reporting having had suicidal thoughts in the past year, at alpha

level 0.05. Figure 8 shows a relatively flat gradient for marginal and moderate food insecure

Canadians (no statistically significant difference between marginal and moderate in terms of

odds of reporting having had suicidal thoughts in the past year), with a steep increase in odds of

suicidal thoughts at the severely food insecure level.

4.2.3.6 Mental Health Status

Table 15: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Self-Reported Mental Health Status

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.25	2.19 – 2.73	<0.001	
Moderately FI	4.20	3.89 – 4.53	<0.001	
Severely FI	10.75	9.62 – 12.00	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	2.44	2.18 – 2.72	<0.001	
Moderately FI	4.15	3.84 – 4.48	<0.001	
Severely FI	10.74	9.61 – 12.00	<0.001	
Sex				
Male (ref.)				
Female	1.13	1.07 – 1.19	<0.001	Not Sig.

Table 15 shows the crude and sex-adjusted odds ratios of food insecurity status on self-reported mental health. The sex and food insecurity interaction terms were not significant at $p<0.05$ (data not shown) therefore the covar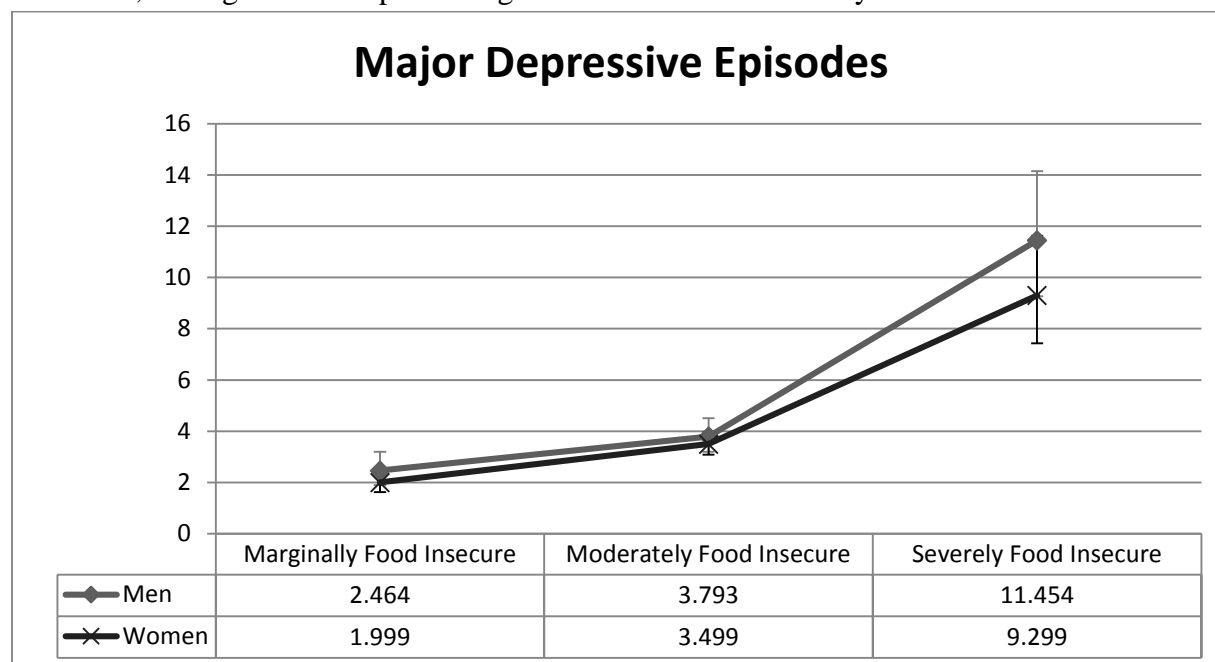iate of interest (sex) was not an effect modifier or was not interacting with the relationship between food insecurity status and thoughts of suicide in the past year. Therefore, the odds of each level of food insecurity reporting their mental health status as poor or fair did not statistically significantly differ between males and females; this is graphically presented below in Figure 9. Table 15 presents results on the relationship between food insecurity status and reporting one's mental health status as poor or fair, adjusted by sex. Sex is significant at $p<0.001$ and was therefore included in the multivariable model in Section 4.3.2. Female Canadians were 1.13 (1.07 – 1.19) times more likely to report their mental health status as poor or fair compared to male Canadians, holding food insecurity status constant. Table 15 shows that the sex-adjusted odds ratios have not altered much from the crude model and therefore sex was not considered a confounder. Holding sex constant, marginally, moderately and severely food insecure Canadians were, respectively, 2.44 (2.18 – 2.72), 4.15 (3.84 – 4.48)

and 10.74 (9.61 – 12.00) times more likely than food secure Canadians to report their mental health status as poor or fair. All of the odds ratios mentioned above were significant at p<0.001.

Figure 9: Sex-Stratified Model of Food Insecurity Status and Self-Reported Mental Health Status, amongst those Experiencing Household Food Insecurity

Self-Reported Mental Health Status

	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	2.475	4.222	10.767
Women	2.402	4.099	10.709
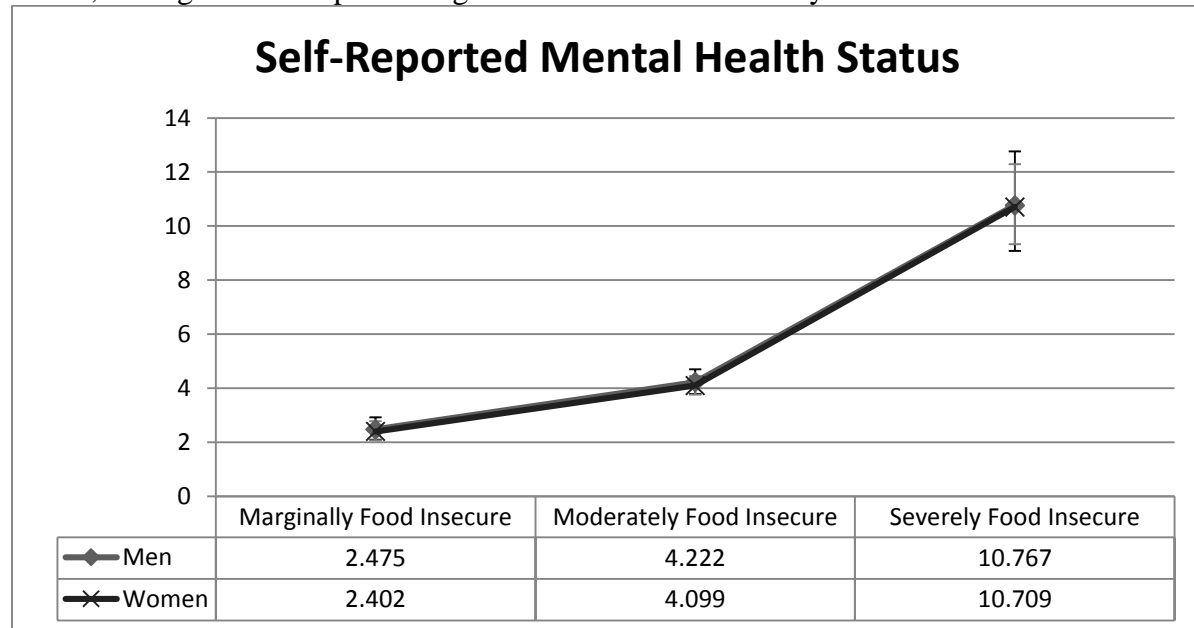
Figure 9 graphically presents the relationship between food insecurity status and self-reported mental health status, stratified by sex. Figure 8 presents evidence that sex did not act as an effect modifier in the relationship between food insecurity status and self-reported mental health status. Moreover, Figure 9 shows a steep food insecurity gradient for each sex on self-reported mental health with a substantial increase in odds of reporting fair or poor mental health status at the severe food insecure level.
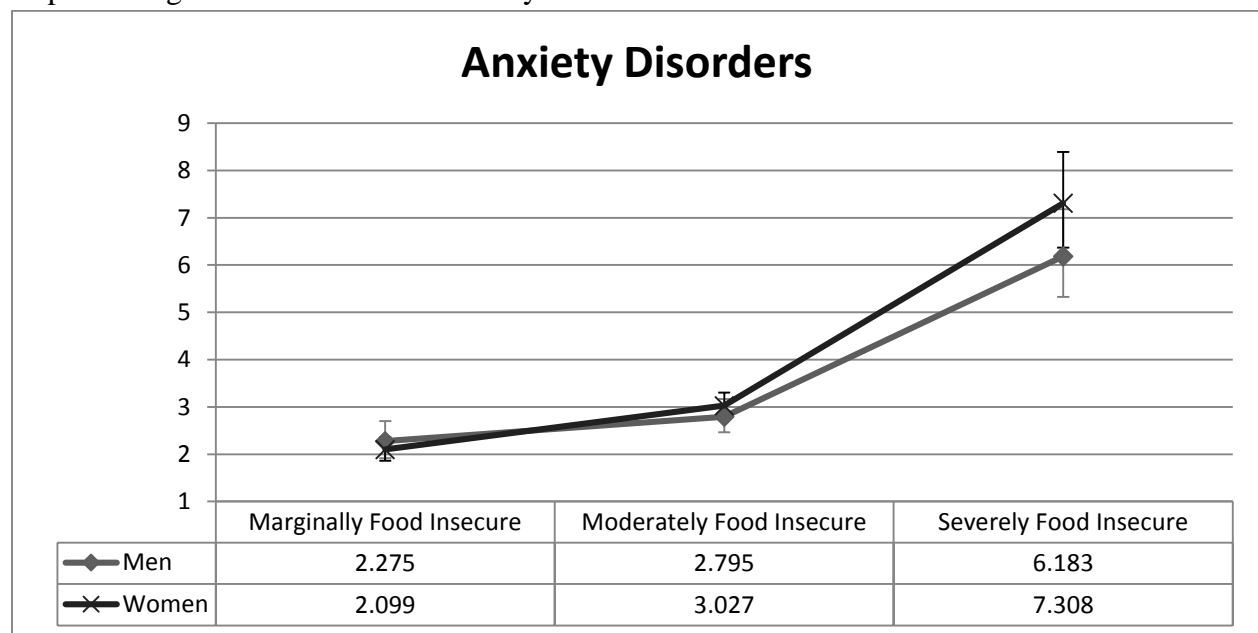
4.2.3.7 Binge Drinking

Table 16 shows the crude and adjusted by sex odds ratios of food insecurity status on binge drinking. The sex and food insecurity interaction terms were significant at p<0.05 at the moderately food insecure level. Therefore, the covariate of interest (sex) was an effect modifier and sex was interacting with moderate food insecurity.

Table 16: Crude and Sex-Adjusted Analysis of Food Insecurity Status and Binge Drinking

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure(ref.)				
Marginally FI	1.04	0.95 – 1.14	0.429	
Moderately FI	1.20	1.12 – 1.30	<0.001	
Severely FI	1.68	1.48 – 1.90	<0.001	
ADJUSTED by SEX				
Food Security Status				
Food Secure(ref.)				
Marginally FI	1.07	0.98 – 1.18	0.131	
Moderately FI	1.36	1.26 – 1.47	<0.001	
Severely FI	1.72	1.51 – 1.96	<0.001	
Sex				
Male (ref.)				
Female	0.31	0.30 – 0.32	<0.001	
Interaction				
MarginalFI * Sex			0.148	
ModerateFI * Sex	1.26	1.08 – 1.47	0.003	
SevereFI * Sex			0.274	Significant
Backwards Elimination				
ModerateFI * Sex	1.25	1.07 – 1.46	0.004	

Moderately food insecure women were 1.25 (1.07 – 1.46) times more likely to report binge drinking more than once a month compared to food secure women and moderately food insecure men. At the marginally food insecure and severely food insecure level there was no evidence of effect modification by sex; this is shown in Figure 10 below. Marginally food insecure individuals were not statistically significantly (p=0.429) more likely to binge drink more than once a month compared to food secure individuals; this was indicated by the odds of marginally food insecure Canadians binge drinking crossing the over the odds ratio of 1. Severely food insecure individuals were, on average, 1.72 times more likely to report binge drinking more than once a month compared to food secure individuals; this was statistically significant at alpha level 0.05.

Figure 10: Sex-Stratified Model of Food Insecurity Status and Binge Drinking, amongst those Experiencing Household Food Insecurity

Binge Drinking

	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Men	1.028	1.241	1.643
Women	1.182	1.563	1.904
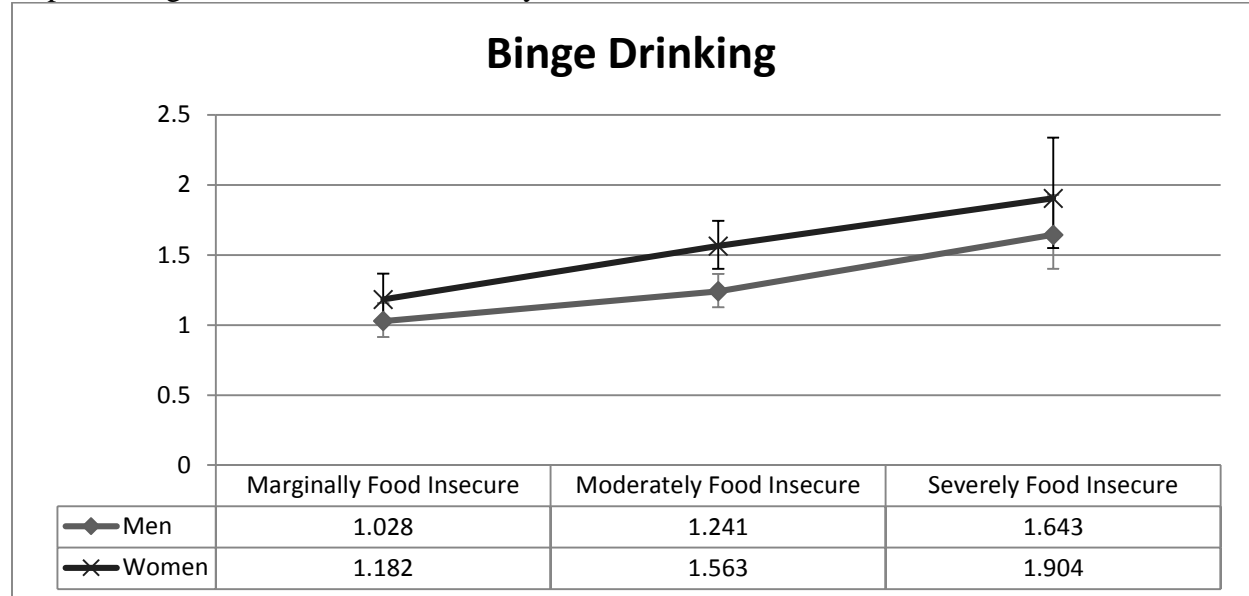
Figure 10 graphically represents the odds of binge drinking (more than 5 drinks on one occasion) for each level of food insecurity for males and females. Females had slightly higher odds of binge drinking at the marginal and severe food insecurity level but given the overlapping confidence intervals between males and females, females were not statistically significantly more likely to report binge drinking compared to males at the marginal and severe food insecurity levels. At the moderate level, as shown in the graphical representation, sex was acting as an effect modifier on the relationship between food insecurity status and binge drinking. Figure 10 shows that at the moderate food insecurity level, females were 1.56 times more likely to report binge drinking more than once a month compared to food secure females. Moreover, marginally food insecure males were not statistically significantly more likely to report binge drinking more than once a month compared to food secure; this can be shown by the lower error bar crossing the odds ratio of 1.

The preceding sex-stratified analyses have presented results aimed at addressing Objective 2 which was a consideration of whether sex differences in mental health are

neutralized by the addition of food insecurity status. The results in Section 4.2.3 confirm that the previously shown sex difference in six out of seven mental health outcomes was neutralized by the consideration of level of food insecurity, amongst those experiencing household food insecurity. Therefore, at each level of food insecurity (marginal, moderate and severe) there were no statistically significant sex differences in depressive thoughts in the past month, major depressive episodes, anxiety disorders, mood disorder, suicidal thoughts in the past year and mental health status. Sex differences were neutralized, with the addition of food insecurity status, for marginally and severely food insecure individuals for six out of seven mental health outcomes.

4.3 Secondary Analysis

Secondary analyses aim to address questions that arose after the study was underway. Objective 1 results confirmed the substantial impact of sex on the mental health outcomes of individuals, and Objectives 2 and 3 presented the powerful effect that food insecurity status has on not only mental health outcomes but also on the relationship between sex and mental health outcomes, within the group of food insecure Canadians. While the potential intersectionality of sex, food insecurity status and mental health outcomes was the focus of this study, the multivariable analysis identified other covariates that acted as an effect modifier on the relationship between food insecurity status and mental health outcomes. These covariates could be studied using the intersectionality framework in future research to explain the risk and reporting of mental health problems in Canada, this will be discussed in Chapter 5.

4.3.1 Multivariable Analysis

As mentioned, the multivariable analysis aimed to identify potential interacting variables

in the relationship between food insecurity status and mental health outcomes. All significant

variables, effect modifiers, and potential confounders from the adjusted analysis were included in

an all-inclusive model, through forward step-wise inclusion that was then reduced through

backwards elimination at p=0.05.

Interactions arising from these models will be discussed, using the intersectionality

framework, in Chapter 5. After identifying potential confounders and effect modifiers, forward

step-wise logistic regression models were created, which involved including all significant

interactions and the (significant or non-significant) effect-modifying covariates. No confounding

variables were identified in the relationship between food insecurity and seven mental health

outcomes (Appendix B). Once all pertinent covariates were included in the model, their

statistical significance (p-value <0.05) was assessed. Non-significant covariates were removed

from the model, unless their interactions remained significant. If variables contained multiple

groups that were significant, a Bonferroni significance level was used to assess for significance.

This analysis is presented in the following sequence: depressive thoughts in the past month,

major depressive episodes in the past year, anxiety disorder, mood disorder, suicidal thoughts in

the past year, self-reported mental health status and binge drinking. All interpreted odds ratios

were significant at alpha level 0.05. In Chapter 5, reasons for the interactions are hypothesized

and suggestions are made for further research.

4.3.1.1 Depressive Thoughts in the Past Month

Table 17 presents results from a reduced model including all significant variables on the

relationship between food insecurity status and depressive thoughts in the past month. For

depressive thoughts in the past month, no variables included had an interacting effect on the

relationship between food insecurity status and depressive thoughts in the past month. Sex, age, marital status, total household income, source of income, ethnicity, sense of belonging and cycle of CCHS all had a statistically significant independent impact on depressive thoughts in the past month at alpha level 0.05. Immigration status, household composition and education were removed from this model as they did not have a statistically significant impact on depressive thoughts in the past month. Controlling for sex, age, marital status, total household income, source of income, ethnicity, sense of belonging, and cycle of CCHS, marginally, moderately and severely food insecure respondents had, respectively, 1.72 (1.52 – 1.96), 2.51 (2.29 – 2.75) and 5.02 (4.19 – 6.01) times the odds of reporting having depressive thoughts in the past month compared to food secure respondents. Controlling for food insecurity status, age, marital status, total household income, source of income, ethnicity, sense of belonging, and cycle of CCHS, female Canadians had 1.79 (1.70 – 1.89) times the odds of reporting having depressive thoughts in the past month compared to male Canadians. Controlling for food insecurity status, sex, age, total household income, source of income, ethnicity, sense of belonging, and cycle of CCHS, those who are divorced widowed or separated had 1.51 (1.39 – 1.65) times the odds, and single Canadians have 1.35 (1.27 – 1.43) the odds, of reporting having depressive thoughts in the past month compared to married or common-law Canadians. Controlling for food insecurity status, sex, age, marital status, source of income, ethnicity, sense of belonging, and cycle of the CCHS, Canadian families earning less than $80,000 in the past year have 1.23 (1.16 – 1.31) the odds of reporting having had depressive thoughts in the past month. Controlling for food insecurity status, sex, age, marital status, total household income, ethnicity, sense of belonging, and cycle of the CCHS, those whose primary source of income is government assistance had 1.29 (1.16 – 1.31) the odds of reporting having had depressive thoughts in the past month compared to those

whose primary source of income is wages. Interestingly, controlling for food insecurity status, sex, age, marital status, total household income, source of income, sense of belonging and cycle of CCHS, visible minorities had 0.87 (0.81 – 0.95) times the odds of reporting having depressive thoughts in the past month compared to non-visible minorities. Finally, controlling for food insecurity status, sex, age, marital status, total household income, source of income, ethnicity and cycle of CCHS, Canadians who have a weak sense of belonging in their local community had 1.54 (1.46 – 1.62) times the odds of reporting having depressive thoughts in the past month compared to those with a strong sense of belonging.

Table 17: Multivariable Logistic Reduced Regression Model of Food Insecurity Status and Depressive Thoughts in the Past Month

	OR	95% CI	P-value
Food Insecurity Status			
Secure (Ref.)			
Marginal	1.72	1.52 – 1.96	<0.001
Moderate	2.51	2.29 – 2.75	<0.001
Severe	5.02	4.19 – 6.01	<0.001
Sex			
Male (Ref.)			
Female	1.79	1.70 – 1.89	<0.001
Age	0.995	0.993 – 0.997	<0.001
Marital Status			
Married or Common-law (Ref.)			
Divorced, widowed or separated	1.51	1.39 – 1.65	<0.001
Single	1.35	1.27 – 1.43	<0.001
Total Income			
$80,000 or more (Ref.)			
Less than $80,000	1.23	1.16 – 1.31	<0.001
Source of Income			
Wages (Ref.)			
Gov. Assistance	1.29	1.16 – 1.31	<0.001
Other	1.26	1.18 – 1.40	0.001
Ethnicity			
Non-visible minority (Ref.)			
Visible minority	0.87	0.81 – 0.95	0.001
Sense of Belonging			
Strong (Ref.)			
Weak	1.54	1.46 – 1.62	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.13	1.05 – 1.21	0.001
2009 – 2010	1.00	0.94 – 1.07	0.903
2011 – 2012	1.81	0.75 – 0.87	<0.001

Finally, because four cycles of the CCHS were combined to create the dataset used in this analysis the year of the cycle is also included in the analysis and assessed for significance. Controlling for food insecurity status, sex, age, marital status, total household income, source of income, sense of belonging and ethnicity, those who were part of the 2007-2008 cycle had 1.13 (1.05 – 1.21) the odds of reporting having depressive thoughts in the past year compared to those included in the 3.1 (2007) cycle. Controlling for food insecurity status, sex, age, marital status, total household income, source of income, sense of belonging and ethnicity, those who were part

of the 2011-2012 cycle had 1.81 (1.75 – 1.87) the odds of reporting having depressive thoughts in the past year compared to those included in the 3.1 (2007) cycle.

The remaining mental health outcomes' multivariable results are more succinctly presented with remarkable findings highlighted.

4.3.1.2 Major Depressive Episodes in the Past Year

Table 18 presents results from a reduced model including all significant variables on the relationship between food insecurity status and fulfilling the criteria for major depressive episodes in the past year. Only ethnicity was excluded from this model, due to non-significance. Controlling for covariates, marginally food insecure respondents had 1.82 times the odds of fulfilling the criteria for major depressive episodes in the past year compared to those who were food secure. Given, the interaction terms at the moderate and severe food insecurity levels, it is inappropriate to interpret the moderate and severe food insecurity odds ratios independent of the modifying covariate. Controlling for all other covariates, females had 1.72 times the odds of fulfilling the criteria for major depressive episodes compared to males.

Table 18: Multivariable Logistic Reduced Regression Model of Food Insecurity Status and Major Depressive Episodes

	OR	95% CI	P-value
Food Insecurity Status			
Secure (Ref.)			
Marginal	1.82	1.52 – 2.16	<0.001
Moderate	3.11	2.70 – 3.58	<0.001
Severe	5.90	4.83 – 7.21	<0.001
Sex			
Male (Ref.)			
Female	1.72	1.58 – 1.88	<0.001
Age	0.992	0.988 – 0.995	<0.001
Education			
Post-secondary graduate or higher (Ref.)			
Less than post-secondary graduate	0.95	0.86 – 1.04	0.261
Marital Status			
Married or common-law (Ref.)			
Divorced, widowed or separated	1.95	1.63 – 2.33	<0.001
Single	1.48	1.26 – 1.74	<0.001
Income Source			
Wages (Ref.)			
Government Assistance	1.22	1.09 – 1.36	<0.001
Other	1.33	1.10 – 1.60	0.003
Total Income			
$80,000 or higher (Ref.)			
Less than $80,000	1.17	1.06 – 1.29	0.002
Household Composition			
Single with no kids (Ref.)			
Couple with no kids	0.96	0.80 – 1.16	0.702
Couple with kids	0.89	0.76 – 1.05	0.181
Female lone parent	0.93	0.79 – 1.09	0.357
Male lone parent	0.98	0.73 – 1.32	0.893
Immigration Status			
Canadian Born (Ref.)			
10 or more years ago	0.83	0.71 – 0.98	0.032
Less than 10 years ago	0.51	0.41 – 0.65	<0.001
Sense of Belonging			
Strong (Ref.)			
Weak	1.48	1.38 – 1.60	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.10	1.00 – 1.21	0.054
2009 – 2010	0.99	0.89 – 1.09	0.833
2011 – 2012	1.39	1.23 – 1.57	<0.001
ModerateFI*Education	0.73	0.58 – 0.91	0.005
SevereFI*Couple with no kids	1.94	1.27 – 2.96	0.002

Two interaction terms were statistically significant at alpha level 0.05 in this model;

education and household composition. Controlling for sex, age, marital status, income source, total household income, household composition, immigration status, sense of belonging and cycle of CCHS, those who are moderately food insecure and have not graduated with a post-secondary degree were 27% (9% - 42%) less likely to fulfill the criteria for major depressive episodes compared to both moderately food insecure respondents with a post-secondary degree and food secure Canadians without a post-secondary degree. Finally, controlling for sex, age, marital status, income source, total household income, education, immigration status, sense of belonging and cycle of CCHS, severely food insecure Canadians who are coupled without children were 94% (27% - 196%) more likely to fulfill the criteria for major depressive episodes compared to food secure Canadians who are coupled without kids and severely food insecure Canadians who are single.

4.3.1.3 Anxiety Disorder

Table 19 presents results from a reduced model including all significant variables on the relationship between food insecurity status and having an anxiety disorder. Only marital status was excluded from this model, due to non-significance. Given there are significant interaction terms at all levels of food insecurity, it is inappropriate to interpret them as independent risk factors for anxiety disorders.

Controlling for covariates, female respondents were 1.85 (1.75 – 1.95) times more likely to report having an anxiety disorder compared to males.

111

Table 19: Multivariable Logistic Reduced Regression Model of Food Insecurity Status and Anxiety Disorder

	OR	95% CI	P-value
Food Insecurity Status			
Secure (Ref.)			
Marginal	2.24	1.87 – 2.70	<0.001
Moderate	1.50	1.19 – 1.89	0.001
Severe	3.50	2.92 – 4.21	<0.001
Sex			
Male (Ref.)			
Female	1.85	1.75 – 1.95	<0.001
Age	0.996	0.993 – 0.998	0.002
Education			
Post-secondary graduate or higher (Ref.)	1.05	0.99 – 1.12	0.098
Less than post-secondary graduate			
Total Income			
$80,000 or more (Ref.)			
Less than $80,000	1.24	1.16 – 1.33	<0.001
Source of Income			
Wages (Ref.)			
Gov. Assistance	1.70	1.58 – 1.84	<0.001
Other	1.74	1.54 – 1.96	<0.001
Household Composition			
Single no kids (Ref.)			
Couple with no kids	0.83	0.77 – 0.89	<0.001
Couple with kids	0.87	0.80 – 0.94	<0.001
Female lone parent	0.92	0.82 – 1.03	0.135
Male lone parent	0.85	0.69 – 1.04	0.116
Ethnicity			
Non-visible minority (Ref.)			
Visible Minority	0.74	0.67 – 0.81	<0.001
Immigration Status			
Canadian Born (Ref.)			
10 or more years ago	0.72	0.65 – 0.80	<0.001
Less than 10 years ago	0.28	0.22 – 0.36	<0.001
Sense of Belonging in the community			
Strong (Ref.)			
Weak	1.45	1.38 – 1.54	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.31	1.22 – 1.41	<0.001
2009 – 2010	1.17	1.09 – 1.27	<0.001
2011 – 2012	1.49	1.38 – 1.60	<0.001
ModerateFI*Age	1.012	1.006 – 1.018	<0.001
MarginalFI* Education	0.67	0.53 – 0.86	0.001
MarginalFI*Couple without children	0.69	0.53 – 0.89	0.004
SevereFI* Less than 10 years	0.29	0.10 – 0.90	0.033
MarginalFI* Gov.Assistance	1.37	1.05 – 1.80	0.021
SevereFI* Gov.Assistance	1.69	1.34 – 2.15	<0.001

There are six statistically significant interaction terms in this model. The first interaction term is for age and moderate food insecurity. Controlling for all other covariates moderately food insecure Canadians had 1.01 (1.01 – 1.02) times the odds of reporting having an anxiety disorder as they age, compared to food secure Canadians. Education also proved to be an effect modifier; marginally food insecure Canadians who do not have a post-secondary degree were 33% (14% - 47%) less likely to report having an anxiety disorder compared to food secure Canadians who do not have a post-secondary degree and marginally food insecure Canadians who do have a post-secondary degree, controlling for all other covariates. Marginally food insecure Canadians who are coupled with children were 31% (11% - 47%) less likely to report having an anxiety disorder compared to marginally food insecure Canadians who are single without children and food secure Canadians who are coupled with children, net of all other covariates. Finally, two interaction terms existed for source of income. Controlling for all other covariates, marginally food insecure Canadians whose primary source of income is government assistance had 1.37 times the odds of reporting having an anxiety disorder compared to food secure Canadians whose primary source of income was government assistance and marginally food insecure Canadians whose primary source of income was wages. Controlling for all other covariates, severely food insecure Canadians whose primary source of income is government assistance had 1.69 times the odds of reporting having an anxiety disorder compared to food secure Canadians whose primary source of income was government assistance and severely food insecure Canadians whose primary source of income was wages.

4.3.1.4 Mood Disorder

Table 20 presents results from a reduced model including all significant variables on the relationship between food insecurity status and having a mood disorder. Marital status and

education were excluded from this model. Given there were significant interaction terms at the moderate level of food insecurity, it is inappropriate to interpret moderate food insecurity as an independent risk factor for mood disorder. Controlling for covariates, marginally food insecure respondents were 1.84 times more likely to reporting having a mood disorder compared to food secure respondents.

Table 20: Multivariable Logistic Reduced Regression Model of Food Insecurity Status and Mood Disorder

	OR	95% CI	P-value
Food Insecurity Status			
Secure (Ref.)			
Marginal	1.84	1.66 – 2.03	<0.001
Moderate	2.59	2.36 – 2.84	<0.001
Severe	5.36	4.81 – 5.96	<0.001
Sex			
Male (Ref.)			
Female	1.91	1.82 – 2.02	<0.001
Age	1.010	1.008 – 1.012	<0.001
Total Income			
$80,000 or higher (Ref.)			
Less than $80,000	1.20	1.12 – 1.27	<0.001
Source of Income			
Wages (Ref.)			
Gov. Assistance	1.75	1.63 – 1.87	<0.001
Other	1.76	1.58 – 1.96	<0.001
Household Composition			
Single no kids (Ref.)			
Couple with no kids	0.66	0.62 – 0.71	<0.001
Couple with kids	0.69	0.65 – 0.74	<0.001
Female lone parent	0.86	0.79 – 0.95	0.002
Male lone parent	0.90	0.73 – 1.09	0.274
Ethnicity			
Non-visible minority (Ref.)			
Visible minority	0.78	0.70 – 0.86	<0.001
Immigration Status			
Canadian Born (Ref.)			
10 or more years ago	0.81	0.74 – 0.90	<0.001
Less than 10 years ago	0.38	0.32 – 0.45	<0.001
Sense of Belonging			
Strong (Ref.)			
Weak	1.53	1.46 – 1.60	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.20	1.13 – 1.27	<0.001
2009 – 2010	1.17	1.09 – 1.25	<0.001
2011 – 2012	1.25	1.17 – 1.34	<0.001
ModerateFI*Gov.Assistance	1.20	1.05 – 1.38	0.009
ModerateFI*Couple with no kids	1.29	1.08 – 1.53	0.004
ModerateFI*Ethnicity	0.79	0.64 – 0.97	0.026

Net of the above variables, severely food insecure Canadians had 5.36 times the odds of reporting having a mood disorder compared to food secure Canadians. Controlling for covariates,

female Canadians were 1.91 times more likely to report having a mood disorder compared to male Canadians.

In this model, three interaction terms were statistically significant at the moderate food insecurity level. Net of all other covariates, moderately food insecure Canadians whose primary source of income was government assistance had 1.20 (1.13 – 1.27) times the odds of reporting having a mood disorder, compared to moderately food insecure Canadians whose primary source of income were wages and compared to food secure Canadians whose primary source of income is government assistance. Controlling for all other covariates, moderately food insecure Canadians who are coupled without children had 1.29 (1.08 – 1.53) times the odds of reporting having a mood disorder, compared to moderately food insecure Canadians who are single without children and compared to food secure Canadians who are coupled without children. Finally, net of all other covariates, moderately food insecure Canadians who are visible minorities were 21% (3% - 36%) less likely to report having a mood disorder compared to food secure Canadians who are visible minorities and compared to moderately food insecure Canadians who are not visible minorities.

4.3.1.5 Suicidal Thoughts in the Past Year

Table 21 presents results from a reduced model including all significant variables on the relationship between food insecurity status and suicidal thoughts in the past year. Education, ethnicity and total household income were excluded from this model, due to non-significance. Given there were significant interaction terms at the severe level of food insecurity, it is inappropriate to interpret severe food insecurity as an independent risk factor for having suicidal thoughts in the past year. Controlling for sex, age, marital status, source of income, household composition, immigration status, sense of belonging and cycle of CCHS, marginally food

116

insecure Canadians were 1.50 times more likely to report having suicidal thoughts in the past

year, compared to food secure Canadians.

Table 21: Multivariable Logistic Reduced Regression Model of Food Insecurity Status
and Suicidal Thoughts in the Past Year

	OR	95% CI	P-value
Food Insecurity Status			
Secure (Ref.)			
Marginal	1.50	1.17 – 1.92	0.001
Moderate	1.40	1.17 – 1.67	<0.001
Severe	1.37	0.67 - 2.80	0.386
Sex			
Male (Ref.)			
Female	0.84	0.74 – 0.96	0.012
Age	0.994	0.987 – 1.001	0.122
Marital Status			
Married or common-law (Ref.)			
Divorced, widowed or separated	1.97	1.44 – 2.69	<0.001
Single	1.71	1.31 – 2.22	<0.001
Source of Income			
Wages (Ref.)			
Gov.Assistance	1.39	1.19 – 1.62	<0.001
Other	1.62	1.25 – 2.10	<0.001
Household Composition			
Single with no kids (Ref.)			
Couple with no kids	1.44	1.06 – 1.95	0.020
Couple with kids	1.51	1.16 – 1.96	0.002
Female lone parent	1.14	0.91 – 1.44	0.259
Male lone parent	1.18	0.76 – 1.83	0.452
Immigration Status			
Canadian Born (Ref.)			
10 or more years ago	1.34	1.06 – 1.68	0.012
Less than 10 years ago	1.56	0.99 – 2.45	0.054
Sense of Belonging			
Strong (Ref.)			
Weak	1.43	1.25 – 1.63	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.01	0.87 – 1.18	0.884
2009 – 2010	1.03	0.85 – 1.25	0.752
2011 – 2012	0.89	0.68 – 1.15	0.370
SevereFI*Age	1.018	1.002 – 1.035	0.032

Controlling for covariates, moderately food insecure Canadians were 1.40 times more

likely to report having had suicidal thoughts in the past year compared to food secure Canadians.

Controlling for food insecurity status, age, marital status, source of income, household composition, immigration status, sense of belonging and cycle of CCHS, female Canadians were 16% (4% - 26%) less likely to report having had suicidal thoughts in the past year compared to male Canadians. There was one interaction term for the relationship between food insecurity status and suicidal thoughts. Net of all the above covariates, severely food insecure respondents had 1.02 times the odds of reporting having had suicidal thoughts in the past year as they age, compared to food secure respondents.

4.3.1.6 Mental Health Status

Table 22 presents results from a reduced model including all significant variables on the relationship between food insecurity status and self-reported mental health status. No covariates were excluded from this model. Given there were significant interaction terms at all levels of food insecurity, it is inappropriate to interpret food insecurity as an independent risk factor for having reported fair or poor mental health. Controlling for covariates, female respondents were 1.14 times more likely to report having fair or poor mental health compared to males.

Five interaction terms were statistically significant in this model. Controlling for other covariates, marginally food insecure Canadians had 1.02 times the odds of reporting their mental health status as fair or poor as they age compared to food secure Canadians. Moderately food insecure Canadians without a post-secondary degree were 12% (4% - 30%) less likely to report their mental health status as fair or poor compared to food secure Canadians without a post-secondary degree and with moderately food insecure Canadians with a post-secondary degree, controlling for all other covariates.

Table 22: Multivariable Logistic Reduced Regression Model of Food Insecurity Status and Self-Reported Mental Health Status

	OR	95% CI	P-value
Food Insecurity Status			
Severe (Ref.)			
Marginal	1.09	0.74 – 1.62	0.652
Moderate	3.67	3.32 – 4.06	<0.001
Severe	5.64	4.84 – 6.57	<0.001
Sex			
Male (Ref.)			
Female	1.14	1.08 – 1.21	<0.001
Age	1.010	1.007 – 1.013	<0.001
Education			
Post-secondary graduate or higher (Ref.)	1.15	1.07 – 1.23	<0.001
Less than post-secondary graduate			
Marital Status			
Married or Common-law (Ref.)			
Divorced, widowed or separated	1.54	1.33 – 1.79	<0.001
Single	1.46	1.29 – 1.66	<0.001
Total Income			
80K or higher (Ref.)			
Less than 80K	1.38	1.28 – 1.50	<0.001
Source of Income			
Wages (Ref.)			
Gov. Assistance	1.77	1.64 – 1.92	<0.001
Other	1.80	1.60 – 2.03	<0.001
Household Composition			
Single no kids (Ref.)			
Couple with no kids	0.94	0.81 – 1.08	0.378
Couple with kids	1.07	0.94 – 1.23	0.317
Female lone parent	0.84	0.75 – 0.94	0.002
Male lone parent	0.99	0.79 – 1.24	0.923
Ethnicity			
Non-visible minority (Ref.)			
Visible Minority	1.12	1.01 – 1.24	0.039
Immigration Status			
Canadian Born (Ref.)			
10 or more years ago	1.04	0.94 – 1.16	0.437
Less than 10 years ago	0.48	0.39 – 0.59	<0.001
Sense of belonging in the community			
Strong (Ref.)			
Weak	2.15	2.03 – 2.29	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.03	0.95 – 1.12	0.470
2009 – 2010	1.07	0.98 – 1.16	0.130
2011 – 2012	1.17	1.08 – 1.27	<0.001
MarginalFI*Age	1.015	1.006 – 1.024	0.001
ModerateFI*Education	0.82	0.70 – 0.96	0.011

SevereFI*Couple with no kids	1.53	1.14 – 2.06	0.005
ModerateFI* More than 10 years	0.63	0.47 – 0.84	0.001
MarginalFI* Less than 10 years	1.90	1.09 – 3.32	0.024

Severely food insecure Canadians who are coupled without children had 1.53 times the odds of reporting their mental health status as fair or poor, compared to food secure Canadians who are coupled without children and compared to severely food insecure Canadians who are single without children, controlling for all other covariates. Moderately food insecure Canadians who immigrated more than 10 years ago were 37% (16% - 53%) less likely to report their mental health status as fair or poor compared to moderately food insecure individuals who were born in Canada and compared to food secure individuals who immigrated to Canada more than 10 years ago, controlling for all other covariates. Finally, marginally food insecure individuals who immigrated to Canada less than 10 years ago had 1.90 times the odds of reporting their mental health status as fair or poor compared to marginally food insecure individuals who were Canadian born and compared to food secure individuals who immigrated to Canada less than 10 years ago, controlling for all other covariates.

4.3.1.7 Binge Drinking

Table 23 presents results from a reduced model including all significant variables on the relationship between food insecurity status and binge drinking (5 or more drinks on one occasion). No covariates were excluded from this model. Given there were significant interaction terms at the moderate and severe levels of food insecurity, it is inappropriate to interpret moderate or severe food insecurity as independent risk factors for binge drinking.

Table 23: Multivariable Logistic Reduced Regression Model of Food Insecurity Status and Binge Drinking

	OR	95% CI	P-value
Food Insecurity Status			
Secure (ref.)			
Marginal	0.96	0.86 – 1.06	0.395
Moderate	1.16	1.02 – 1.31	0.020
Severe	3.05	1.32 – 7.07	0.009
Sex			
Male (Ref.)			
Female	0.29	0.28 – 0.30	<0.001
Age	0.971	0.969 – 0.973	<0.001
Education			
Post-secondary graduate or higher (Ref.) Less than post-secondary graduate	1.29	1.23 – 1.35	<0.001
Marital Status			
Married or common-law (Ref.)			
Divorced, widowed or separated	1.36	1.25 – 1.50	<0.001
Single	1.65	1.53 – 1.77	<0.001
Total Income			
80K or higher (Ref.)			
Less than 80K	0.88	0.84 – 0.92	<0.001
Source of Income			
Wages (Ref.)			
Gov. Assistance	0.93	0.87 – 0.99	0.048
Other	0.89	0.78 – 1.02	0.082
Household Composition			
Single no kids (Ref.)			
Couple with no kids	1.06	0.97 – 1.16	0.204
Couple with kids	0.76	0.70 – 0.82	<0.001
Female lone parent	0.74	0.68 – 0.82	<0.001
Male lone parent	0.82	0.71 – 0.93	0.002
Ethnicity			
Non-visible minority (Ref.)			
Visible minority	0.68	0.63 – 0.74	<0.001
Immigration Status			
Canadian Born (Ref.)			
10 or more years ago	0.61	0.56 – 0.66	<0.001
Less than 10 years ago	0.38	0.33 – 0.44	<0.001
Cycle of CCHS			
3.1 (Ref.)			
2007 – 2008	1.02	0.97 – 1.07	0.521
2009 – 2010	1.03	0.97 – 1.09	0.369
2011 – 2012	1.09	1.03 – 1.15	0.002
ModerateFI*Sex	1.32	1.11 – 1.57	0.001
SevereFI* Total Income	0.39	0.16 – 0.90	0.028
ModerateFI*Couple with kids	0.79	0.65 – 0.95	0.014

Controlling for sex, age, education, marital status, total household income, source of income, household composition, ethnicity, immigration status and cycle of CCHS, marginally food insecure Canadians were not statistically significantly different in terms of odds of binge drinking compared to food secure Canadians. Three interaction terms were statistically significant in this model. Moderately food insecure females had 1.32 times the odds of reporting binge drinking more than once a month compared to moderately food insecure males and compared to food secure females, controlling for all other covariates. Severely food insecure Canadians whose yearly household income was less than $80,000 were 61% (10% - 84%) less likely to report having binge drank more than once a month compared to food secure Canadians whose income was less than $80,000 and compared to severely food insecure Canadians whose income is more than $80,000, controlling for all other covariates. Finally, moderately food insecure Canadians who were coupled with children are 21% (5% - 35%) less likely to report having binge drank more than once a month compared to moderately food insecure Canadians who are single without children and compared to food secure Canadians who were couple with children, controlling for all other covariates.

4.4 Summary of Results

The preceding sections presented the bivariate, adjusted, stratified and multivariable analysis results aimed at addressing the three research objectives. A summary of the results as they relate to these research objectives is presented in Table 24 below.

Table 24: Summary of Results for Objectives 1, 2 and 3

Objective	Results
1: Determine whether a sex gap exists in seven mental health outcomes	There was a persistent sex gap in all seven mental health outcomes. Females reported higher rates of depressive thoughts in the past month, major depressive episodes in the past year, fair/poor mental health, and anxiety and mood disorders. Males reported higher rates of suicidal thoughts in the past year and binge drinking in the past month.
2: Determine whether a household food insecurity gradient exists in seven mental health outcome	Household food insecurity was an independent risk factor for all seven mental health outcomes, with the exception of binge drinking. A steep household food insecurity gradient was present in five of seven mental health outcomes. A shallow household food insecurity gradient was present on the remaining two mental health outcomes.
3: Determine whether sex differences in seven mental health outcomes are neutralized by the consideration of level of food insecurity, amongst those experiencing household food insecurity.	Sex did not statistically modify the relationship between food insecurity status and 6 of 7 mental health outcomes. Therefore, amongst those experiencing household food insecurity, there was no difference between males and females in the prevalence of six mental health outcomes when household food insecurity status was considered. Sex was an effect modifier on the relationship between household food insecurity and binge drinking in the past month.

In the following chapter, the primary analysis results will be discussed in relation to past studies, presented in Chapter 2, and in terms of public health importance. The interactions from the multivariable regression will be discussed in the context of intersectionality theory. Bias and confounding will also be discussed and compared with previous studies on potential confounding variables. Finally, the strengths and limitations of the research and areas for future research will be discussed.

Chapter 5

Discussion

5.1 Introduction: A Reorientation to the Literature

Mental health is a public health issue of importance that affects individuals' well-being, quality of life and productivity. In Canada in 2011, the estimated combined direct and indirect costs of mental illness was approximately $50 million (Deraspe, 2013). The Government of Canada has consistently recognized that mental illness is a public health issue of importance. In 2013-2014, the Canadian Institutes for Health Research (CIHR), one of three major national grant-giving bodies, awarded $55 million in funding for mental health and behavioural conditions. In addition, Health Canada provided $110 million in one-time funding to the Canadian Mental Health Commission, a non-profit organization that supports improvements in the mental health care system (Government of Canada, 2015).

The causes of mental illness are generally thought to be related to sociocultural factors, biological factors and genetic predisposition, all of which can be exacerbated by stress. This thesis focuses on the social stress pathway to mental ill health (Dressler, Oths, & Gravlee, 2005; Horwitz, 1999). Social stresses include prejudice, stigma, discrimination and related social problems inherent to the experience of living in situations of social disadvantage (Clark, 2004; Kessler, Mickelson, & Williams, 1999; Meyer, 2003; Taylor & Turner, 2002; Williams & Harris-Reid, 1999; Williams, Yu, Jackson, & Anderson, 1997).

Individuals with low income have an increased risk of many mental health outcomes such as depression, mood disorder, anxiety disorder and substance abuse (Fryers, Melzer, & Jenkins, 2003; Lorant, Deliège, Eaton, Robert, Philippot, & Ansseau, 2003; Sareen, Afifi, McMillan, &

Asmundson, 2011). Households experiencing food insecurity are one sub-group of low-income Canadians. Food insecurity is operationally defined as "the uncertainty and insufficiency of food availability and access that are limited by resource constraints, and the worry or anxiety and hunger that may result from it" (Wunderlich &Norwood, 2006, p. 49). Food is a basic human right and food insecurity is considered one of Canada's 14 social determinants of health (Mikkonen & Raphael, 2010). In Canada from 2011-2012, there were approximately 1.1 million food insecure individuals which amount to approximately 8% of the Canadians population (Roshanafshar & Hawkins, 2015). Food insecurity disproportionately affects lone mothers, Aboriginal and African Canadians, households which rely primarily on social assistance, households with children under the age of 18, families renting rather than owning their homes, and families with low income (Tarasuk, Mitchell, & Dachner, 2014; Roshanafshar & Hawkins, 2015).

Food insecurity is a chronically stressful experience and chronic stress has been consistently linked to mental ill health in studies dating back 40 years (Llyod, 1980; Ravindran, Griffiths, Waddell, Anisman, 1995; Cadoret, Winokur, Dorzab, & Baker, 1972). The distinguishing feature of chronic stress is the inability to change the situation and therefore, the stressor will continue to affect the person's normal functioning. The experience of being food insecure typically encompasses four dimensions: quantitative, qualitative, social, and psychological (Tarasuk, 2001a). Each of these dimensions relates to specific stressors that place food insecure individuals at a higher risk of adverse mental health outcomes. In the absence of structural societal changes, food insecure individuals are unlikely to be able to change their income situation and, therefore, the chronic stressor—food insecurity-- will continue, possibly for some, throughout much of their life course.

125

Evidence on the association between food insecurity and mental health, by way of chronic stress, is compelling and fulfills all five of Hill's criteria for causation. Moreover, there is a growing body of evidence that suggests the relationship between food insecurity and mental health may be bidirectional (Melchior, Caspi, Howard, Ambler, Bolton, Mountain, & Moffitt, 2009; Garg, Toy, Tripodis, Cook, & Cordella, 2015; Murali & Oyebode, 2004; Tarasuk, Mitchell, McLaren, & McIntyre, 2013). These studies suggest that mental ill health results in lower productivity which leads to reduced financial resources to buffer a household against food insecurity.

The relationship between food insecurity and mental health is embedded within a gender/sex context, whereby gender/sex impact food insecurity and mental health separately as well as together. The relationship between gender and food insecurity and between gender and mental health has been studied extensively. There is well-established literature on the gender gap in mental health outcomes and this gap has remained stable across time. Males typically experience higher rates of externalizing illnesses such as alcoholism, drug abuse and antisocial disorders. In contrast, females are more likely to suffer from internalizing disorders such as depression, anxiety and mood disorders (Afifi, 2007; Aneshensel, Phelan, & Bierman, 2013). It has been argued that both depressive symptoms and alcohol abuse are derived from the same underlying feelings but responses to frustration and stress occur differently in men and women (Mirowsky & Ross, 1995). In addition, females and males have different rates of diagnosis and identification of symptoms of mental health (World Health Organization, nd) and males are less likely to seek treatment for their perceived mental health problems and are more likely to self-medicate with drugs and alcohol (Cotton, Wright, Harris, Jorm, & McGorry, 2006).

Gender and sex also play an important role in a discussion of household food insecurity. Female lone parent-led households are more likely to be food insecure compared with any other household structure (Che & Chen, 2001, Tarasuk et al., 2014). In addition, females are more likely to be employed part-time, employed in lower paying sectors or receive lower pay compared with males (Morissette & Lu, 2013; Cool, 2010); this lowered financial position puts women at increased risk of food insecurity due to insufficient household resources. In addition, women predominantly hold the responsibility for providing food in the household (DeVault, 1991; Kenney, 2008) and in a food insecure household this can be an extremely stressful experience and may increase the level of stress felt by women (Olson, 2005; Parnell, Reid, Wilson, McKenzie, & Russell, 2001). Finally, there is large body of literature stating that mothers in the household will reduce their food intake in order to feed their children; this results in more severe food insecurity for women within a food insecure household (Radimer, Olson, Greene, Campbell, & Habitch, 1992, Hamelin, Beaudry, & Habicht, 2002, Tarasuk, Maclean, 1990). Much less has been written about male food insecure individuals; food insecure males do experience higher rates of mood and anxiety disorder compare with food secure males (Tarasuk et al., 2013) but these rates still pale in comparison to female rates of the same disorders. One study conducted on a group of homeless men found high rates of alcoholism, mood disorder, anxiety disorder and psychiatric disorders (Fichter & Quadflief, 2001). This thesis examined whether the established sex gap in mental health outcomes was neutralized by the consideration of food insecurity status. Put plainly, do food insecure males and females experience the same odds of reporting adverse mental health outcomes at each level of food insecurity severity? Specifically, this thesis addressed three research questions:

1) Are there sex differences in seven mental health outcomes: a) anxiety disorder, b) mood disorder, c) depressive thoughts in the past month, d) major depressive episodes in the past ear, e) self-reported mental health status, f) binge drinking, and g) thoughts of suicide in the past year?

2) Is there a household food insecurity gradient on these seven mental health outcomes?

3) Are the sex differences in mental health outcomes neutralized (or eliminated) by the consideration of household food insecurity status, amongst those experiencing food insecurity?

These three research questions were addressed through bivariate and sex-adjusted analyses of the relationship between food insecurity and mental health, controlling for a variety of covariates. In addition, a multivariable analysis was conducted on the relationship between food insecurity and the mental health outcomes to determine other covariates that might intersect with the relationship. The analysis was conducted on a dataset containing pooled data from cycles 3.1 (2005), 2007-2008, 2009-10 and 2011-12 of Statistics Canada's nationally representative Canadian Community Health Survey (CCHS). The study dataset was restricted to respondents aged 18-64 years residing in the ten provinces who had responded to the Household Food Security Survey Module (HFSSM).

The following sections will summarize and discuss: key findings from the primary and secondary analysis; applicability of intersectionality theory; implications of this thesis' results; propose areas for future study; and discuss the limitation and strengths of this study.

5.2 Summary of Key Findings

Using a pooled sample of the Canadian Community Health Survey Cycle 3.1, 2007-2008,

2009-2010, and 2011-2012 this thesis used STATA statistical software to test three research

questions. The results of the three research questions are summarized in the Tables 25-27 below.

Table 25: Summary of Results Addressing Sex Gap in Seven Mental Health Outcomes

Mental Health Outcome*	Prevalence % (95% CI)		Odds Ratio (95% CI)
	Males	**Females**	**Ref: Males**
Depressive Thoughts in the Past Month			
Yes	15.3 (14.8-15.8)	24.7 (24.1 – 25.3)	1.79 (1.70 – 1.88)
Major Depressive Episodes in the Past Year			
Yes	7.4 (7.1 – 7.7)	11.1 (10.7 – 11.5)	1.71 (1.58 – 1.84)
Anxiety Disorder			
Yes	4.2 (4.1 – 4.4)	7.5 (7.3 – 7.7)	1.79 (1.70 – 1.88)
Mood Disorder			
Yes	5.1 (4.9 – 5.3)	9.3 (9.1 – 9.8)	1.86 (1.78 – 1.95)
Suicidal Thoughts in the Past Year			
Yes	21.4 (19.9 – 22.9)	18.9 (17.6 – 20.2)	0.84 (0.74 – 0.95)
Mental Health Status			
Fair/Poor	4.9 (4.7 – 5.1)	5.8 (5.6 – 6.0)	1.13 (1.07 – 1.19)
Binge Drinking			Moderately Food Insecure Females
More than once a month	24.4 (24.0 – 24.8)	9.1 (8.9 – 9.4)	1.25 (1.07 – 1.46)

*controlling for food insecurity status

Table 25 presents results on the prevalence of mental health outcomes for each sex and

the odds of females experiencing each of the mental health outcomes compared with males,

controlling for food insecurity status. Females have a higher prevalence of depressive thoughts in

the past month, major depressive episodes in the past year, anxiety disorders, mood disorders,

and poor/fair mental health. Males and females have a similar prevalence of suicidal thoughts in

the past year (females have slightly high odds of reporting suicidal thoughts in the past year) and males have a higher prevalence on binge drinking. Interestingly, moderately food insecure females have 1.25 greater odds of reporting binge drinking more than once a month compared to food secure females and moderately food insecure males. This interaction will be discussed in detail in later sections.

Table 26: Summary of Bivariate Results Addressing Food Insecurity Gradient in Seven Mental Health Outcomes

Mental Health Outcome*	Odds Ratio			
	Food Secure (Reference)	Marginally Food Insecure	Moderately Food Insecure	Severely Food Insecure
Depressive Thoughts in the Past Month Yes	---	2.05 (1.82 – 2.30)	3.00 (2.74 – 3.28)	7.13 (6.06 – 8.39)
Prevalence % (95% CI)	17.6 (17.2 – 18.0)	30.8 (28.5 – 33.2)	39.8 (37.9 – 41.8)	59.7 (55.8 – 63.7)
Major Depressive Episodes in the Past Year Yes	---	2.16 (1.84 – 2.53)	3.60 (3.25 – 3.99)	10.22 (8.78 – 11.90)
Prevalence % (95% CI)	7.7 (7.4 – 7.9)	15.8 (14.0 – 17.6)	21.3 (19.9 – 22.7)	40.9 (37.5 – 44.3)
Anxiety Disorder Yes	---	2.16 (1.95 – 2.40)	2.95 (2.74 – 3.17)	6.83 (6.15 – 7.58)
Prevalence % (95% CI)	4.8 (4.7 – 4.9)	10.0 (9.2 – 10.8)	13.5 (12.8 – 14.2)	25.5 (23.6 – 27.4)
Mood Disorder Yes	---	2.04 (1.86 – 2.24)	3.25 (3.04 – 3.47)	8.66 (7.86 – 9.53)
Prevalence % (95% CI)	5.8 (5.7 – 5.9)	11.4 (10.5 – 12.2)	17.4 (16.6 – 18.2)	34.4 (32.3 – 36.6)
Suicidal Thoughts in the Past Year Yes	---	1.67 (1.31 – 2.13)	1.64 (1.38 – 1.96)	3.39 (2.73 – 4.20)
Prevalence % (95% CI)	17.1 (16.1 – 18.2)	25.5 (21.1 – 29.8)	25.0 (22.3 – 27.8)	41.1 (36.3 – 46.0)
Mental Health Status Fair/Poor	---	2.44 (2.18 – 2.72)	4.15 (3.84 – 4.48)	10.74 (9.61 – 12.0)
Prevalence % (95% CI)	4.0 (3.9 – 4.2)	9.3 (8.4 – 10.2)	15.0 (14.2 – 15.8)	31.1 (28.9 – 33.4)
Binge Drinking More than once a month	----	1.04 (0.95 – 1.14)	Moderately Food Insecure Females 1.25 (1.07 – 1.46)	1.68 (1.48 – 1.90)
Prevalence % (95% CI)	16.8 (16.5 – 17.0)	17.3 (16.0 – 18.5)	19.5 (18.5 – 20.6)	25.3 (22.9 – 27.6)

*controlling for sex

Table 26 presents results on the prevalence of mental health outcomes at each level of

food insecurity and the odds of each level of food insecurity experiencing each of the mental

health outcomes compared with food secure individuals, controlling for sex. Several conclusions can be made from these data. In reference to the second research question, there is a steep food insecurity gradient on five of seven mental health outcomes: depressive thoughts in the past month, major depressive episodes, anxiety disorders, mood disorder, and mental health status. There is a shallow food insecurity gradient on suicidal thoughts, with marginally and moderately food insecure individuals experiencing the same odds of having suicidal ideation. Interestingly, marginally food insecure individuals are not statistically significantly more likely to report binge drinking compared with food secure individuals. Moderately food insecure females are 1.25 times more likely to report binge drinking compare to moderately food insecure males and food secure females; this interaction will be discussed further in later sections. Severely food insecure individuals are 1.68 times more likely to report binge drinking compared to food secure individuals.

Table 27 presents the odds of reporting poor mental health outcomes at each level of food insecurity, stratified by sex. In six out of seven mental health outcomes (all outcomes except binge drinking), sex does not act as an effect modifier. Therefore, food insecure males and females have statistically significantly similar odds of reporting: depressive thoughts in the past month, major depressive episodes in the past year, anxiety disorders, mood disorders, fair/poor mental health status and suicidal thoughts in the past year, at each level of food insecurity severity. This finding is a substantive addition to the literature on food insecurity and mental health, as previous studies have focused on the gender gap in food insecurity and mental health independently, while ignoring the similar hazardous experience felt by males and females in food insecure households.

Table 27: Summary of Sex-Stratified Results Addressing Risk of Seven Mental Health Outcomes by Food Insecurity Status

Mental Health Outcome	Odds Ratio		
	Marginally Food Insecure (95% CI)	Moderately Food Insecure (95% CI)	Severely Food Insecure (95% CI)
Depressive Thoughts in the Past Month (Yes)			
Males	2.25 (1.90 - 2.67)	3.27 (2.84 - 3.76)	8.32 (6.48 - 10.69)
Females	1.92 (1.65 - 2.24)	2.83 (2.54 - 3.16)	6.10 (4.96 - 7.52)
Major Depressive Episodes in the Past Year (Yes)			
Males	2.46 (1.90 - 3.19)	3.79 (3.19 - 4.51)	11.45 (9.27 - 14.16)
Females	2.00 (1.63 - 2.46)	3.50 (3.09 - 3.96)	9.30 (7.43 - 11.63)
Anxiety Disorder (Yes)			
Males	2.28 (1.92 - 2.70)	2.80 (2.47 - 3.17)	6.18 (5.33 - 7.18)
Females	2.10 (1.87 - 2.36)	3.03 (2.78 - 3.30)	7.31 (6.37 - 8.39)
Mood Disorder (Yes)			
Males	2.27 (1.92 - 2.67)	3.24 (2.910 - 3.60)	8.51 (7.35 - 9.84)
Females	1.92 (1.72 - 2.14)	3.25 (3.01 - 3.51)	8.78 (7.72 - 9.99)
Suicidal Thoughts in the Past Year (Yes)			
Males	1.72 (1.21 - 2.44)	1.77 (1.38 - 2.29)	2.88 (2.13 - 3.90)
Females	1.64 (1.19 - 2.24)	1.57 (1.28 - 1.91)	3.88 (2.91 - 5.16)
Mental Health Status (Fair/Poor)			
Males	2.48 (2.09 - 2.93)	4.22 (3.79 - 4.70)	10.77 (9.09 - 12.76)
Females	2.40 (2.07 - 2.78)	4.10 (3.77 - 4.46)	10.71 (9.33 - 12.29)
Binge Drinking (More than once a month)			
Males	1.03 (0.91 - 1.16)	1.24 (1.13 - 1.37)	1.64 (1.40 - 1.93)
Females	1.18 (1.02 - 1.37)	1.56 (1.40 - 1.74)	1.90 (1.55 - 2.34)

These findings will be further discussed in terms of public health importance in later sections. The results of the primary analysis will be discussed in detail next.

5.2.1 Sex Gap on Seven Mental Health Outcomes

A pervasive sex gap is apparent with women reporting higher rates of depressive thoughts in the past month, major depressive episodes, anxiety disorder, mood disorder and self-reported mental health status, and men reporting higher rates of suicidal thoughts in the past year and binge drinking. This sex gap has been reported consistently throughout decades of health research. Typically, the ratio of mental health disorders such as depression, anxiety, and mood disorders are 2:1 female to male (Culbertson, 1997; Aneshensel, 1992; Gove, 1978; Mirowsky & Ross, 1986). This study found that females had between 1.71 and 1.86 the odds of reporting depressive thoughts in the past month, major depressive episodes, anxiety disorders and mood disorders compared to males, controlling for food insecurity. Males had slightly higher odds of reporting having had suicidal thoughts in the past year and females had 13% more of a risk of reporting their mental health status as fair or poor, controlling for food insecurity. Chapter 2 presented the theory that males and females do experience similar rates of mental health outcomes but that the two sexes display their stresses through different mental health outcomes. Males are hypothesized to experience higher rates of externalizing illness, such as antisocial personality disorders, alcoholism, and drug abuse. Whereas females are more likely to experience internalizing disorders such as distress, depression, anxiety and mood disorders (Aneshensel, Phelan, & Bierman, 2013). In this thesis, only one externalizing illness was analyzed: binge drinking. Males had a higher prevalence of binge drinking compared with females, but moderately food insecure females had statistically significantly higher of odds of reporting binge drinking compared with moderately food insecure males and food secure females. This finding will be interpreted in Section 5.4.

5.2.2 Food Insecurity Gradient on Seven Mental Health Outcomes

A steep food insecurity status gradient was found on five out of seven of the mental health outcome variables (depressive thoughts in the past month, major depressive episodes, anxiety disorder, mood disorder and self-reported mental health status). In addition, a shallow food insecurity status gradient was found in the remaining two mental health outcomes (suicidal thoughts in the past year and binge drinking). There is ample evidence in the literature on the deleterious effect of food insecurity on mental health, particularly through the unique stressors experienced by food insecure individuals. These include the biological and social implications of not having enough money to feed yourself or your family, and the lack of structural change to allow individuals to alter their circumstances and become food secure. Food insecurity has been associated with increased odds of depression, distress, anxiety, lowered scores on mental health indexes, and suicidal ideations (Davison, Marshall and Tecson, 2015; Casey, Goolsby, Berkowitz, Frank, Cook, Cutts, African, Zaldiyar, Levenson, Heeren, & Meyers, 2004; Heflin, Siefert, & Williams, 2005; Klesges, Pahor, Shorr, Wan, Williamson, & Guralnik, 2001; Laraia, Siega-Riz, Gundersen, & Dole, 2006; Temple, 2008; Vozoris & Tarasuk, 2003; Whitaker et al., 2006; Siefert, Heflin, Corcoran, & Williams, 2004; Stuff, Casey, Szeto, Gossett, Robbins, Simpson, Connell, & Bogel, 2004).

The results of this thesis satisfy three of Hill's criteria for causation: consistency, strength, and dose response. This thesis supports the commonly cited association between household food insecurity and major depressive episodes, depressive thoughts in the past month, anxiety disorders, mood disorders, suicidal thoughts and mental health status. In addition, this thesis begins to disentangle the impact of the intersection of sex and food insecurity on binge drinking, which is currently an understudied aspect of food insecurity and mental health. The

relationship between food insecurity and mental health is strong, with highly significant relationships and consistently high odds ratios. Of particular interest is the strength of severe food insecurity on the odds of reporting mental health outcomes, a relationship which is significant on all seven mental health outcomes at the severely food insecure level. These odds ratios vary in strength by type of mental health outcome, for example at the lower level, severely food insecure individuals have 1.68 times the odds of reporting binge drinking compared to food secure individuals. At its most extreme, severely food insecure individuals have 10.06 and 10.74 times the odds of reporting major depressive episodes and fair or poor mental health status, respectively. Importantly, these relationships are maintained despite controlling for covariates such as total income, income source, ethnicity, immigration status, age, education, household composition, marital status, sense of belonging in the community and sex (see Appendix B). Finally, this thesis supports a dose-response argument for causality. For five out of seven mental health outcomes (depressive thoughts in the past month, major depressive episodes, anxiety disorders, mood disorders, and mental health status), increased odds of reporting selected mental health outcomes are associated with worsening food insecurity status. For suicidal thoughts and binge drinking, a dose response argument is supported for moderate and severe food insecurity, but not marginal food insecurity.

The odds of reporting mental health problems at each level of food insecurity are noteworthy but of particular concern is the odds of poor mental health outcomes at the severe food insecurity level. This will be further discussed in the following sections.

5.2.3 Sex Differences in Mental Health Outcomes at Each Level of Food Insecurity

Prior to the inclusion of food insecurity status, the sex gap in five of seven mental health outcomes was pronounced. After the consideration of food insecurity status amongst those experiencing food insecurity (marginally food insecure, moderately food insecure and severely food insecure) there were no statistically significant sex differences in six of the seven mental health outcomes. Despite this sex gap neutralization, a steep food insecurity gradient in mental health outcomes persisted. Those reporting severe food insecurity had high odds (between 3.38 and 10.1 dependent on the outcome) of reporting poorer mental health outcomes compared to those who were food secure.

Gender is one of the most ubiquitous social determinants of health, so much so that a discussion of sex and gender must be included in all research projects seeking federal funding in Canada (CIHR, 2015). Despite the power of gender as a determinant of health, Canadians suffering from food insecurity are such a profoundly marginalized population, that males and females who are food insecure have similar rates of disease in six of seven mental health outcomes tested in this thesis. This can be interpreted in the intersectionality framework as males and females sharing more in common as a group of food insecure Canadians, likely through the shared chronically stressful experience of being food insecure, than as separate groups distinguished by sex. Given the highly interconnected and potentially bidirectional relationship between and among: sex, food insecurity and mental health outcomes, the elimination of a mental health causing condition (food insecurity) could not only reduce the number of Canadians who are food insecure but could also reduce the rates of mental health outcomes for that group. Moreover, given the sex neutralizing effect of food insecurity on mental health outcomes, population health intervention to address severe food insecurity could theoretically result in

similar positive outcomes for both sexes. In summary, household food insecurity is such a chronically stressful experience that a previously stable gender gap in mental health has been reduced to gender neutrality.

5.3 Study's Findings in Relation to Other Studies

To the author's knowledge, only one paper has examined the relationship between food insecurity and mental health outcomes for each sex. Carter, Kruse, Blakely, and Collings (2011) studied the impact of food security on psychological distress in New Zealand by sex. The crude relationship between food insecurity and psychological distress was strong (OR 3.4) and was reduced with the addition of covariates. Interestingly, the authors observed a sex blunting effect on the relationship between food insecurity and psychological distress. Food insecure females had marginally significantly higher odds of reporting psychological distress compared with food insecure males (Carter et al., 2011). In Carter and associates' paper, as well as this thesis, the previously wide sex gap in mental health was substantially reduced by the inclusion of food insecurity and sex interactions. In this thesis, these differences were reduced to insignificance for six out of seven mental health outcomes.

5.4 Summary of Secondary Analysis

As mentioned in Chapter 4, all significant variables, effect modifiers, and potential confounders from the adjusted analysis were included in an all-inclusive multivariable model. This model was then reduced through backwards elimination at $p < 0.05$.

Table 28: Effect Modifiers on the Relationship between Food Insecurity and Mental Health Outcomes

Mental Health Outcome	Intersecting Variable with Food Insecurity	Level of Intersection	Odds Ratio (95% CI)
Major Depressive Episodes in the Past Year	Education	Moderate FI & Education	0.73 (0.58 – 0.91)
	Household Composition	Severe FI & Couple without kids	1.94 (1.26 – 2.98)
Anxiety Disorder	Age	Moderate FI & Age	1.012 (1.006 – 1.018)
	Education	Marginal FI & Education	0.67 (0.53 – 0.86)
	Source of Income	Marginal FI* Gov.Assist	1.37 (1.05 – 1.80)
		Severe FI & Gov. Assist	1.69 (1.34 – 2.15)
	Household Composition	Marginal FI & Couple without kids	0.73 (0.59 – 0.91)
	Immigration Status	Severe FI & less than 10 years	0.29 (0.10 – 0.90)
Mood Disorder	Source of Income	Moderate FI & Gov.Assist	1.20 (1.05 – 1.38)
	Household Composition	Moderate FI & Couple with no kids	1.29 (1.08 – 1.53)
	Ethnicity	Moderate FI & Ethnicity	0.79 (0.64 – 0.97)
Thoughts of Suicide	Age	Severe FI & Age	1.018 (1.002 – 1.035)
Self- Reported Mental Health Status	Age	Marginal & Age	1.015 (1.006 – 1.024)
	Education	Moderate FI & Education	0.82 (0.70 – 0.96)
	Household Composition	Severe & Couple without kids	1.53 (1.14 – 2.06)
	Immigration	Moderate FI & More than 10 years	0.63 (0.47 – 0.84)
		Marginal FI & Less than 10 years	1.90 (1.09 – 3.32)
Binge Drinking	Sex	Moderate FI & Sex	1.32 (1.11 – 1.57)
	Total Income	Severe FI & Income	0.39 (0.16 - 0.90)
	Household Composition	Moderate FI & Couple with kids	0.79 (0.65 – 0.95)

One mental health outcome, depressive thoughts in the past month, did not yield any statistically significant effect modifiers or confounders. In this relationship, the food insecurity gradient remained despite controlling for sex, age, marital status, total income, source of income, ethnicity, sense of belonging, and cycle of CCHS. Therefore, food insecurity is independently associated with depressive thoughts in the past month, controlling for a variety of covariates. The multivariable analysis further presented many candidates for intersectionality theory; these findings are summarized in Table 28.

The multivariable analysis identified seven effect modifiers between food insecurity and various mental health outcomes. Effect modification refers to the intersection between covariates and the exposure variable (food insecurity) to change in magnitude in the outcome variable due to the covariate. The seven covariates: age, household composition, education, source of income, immigration status, ethnicity and sex will now be discussed individually.

Age

Age acted as an effect modifier on the relationship between food insecurity and anxiety disorders, thoughts of suicide in the past year and self-reported mental health status. In all outcomes, the odds of reporting mental health outcomes at each level of food insecurity increased with age compared with food secure individuals. These odds ratios are statistically significant but weak, ranging from 1.01 – 1.02. Given the exclusion criteria employed in this thesis (<18 and >/=65 years), these estimates are unlikely to be a true picture of the intersection between age and food insecurity on mental health outcomes. This criterion was employed due to Canadians over the age of 64 becoming eligible for seniors' pensions which is associated with lower rates of food insecurity (Emery, Fleisch & McIntyre, 2013). According to one study using

the CCHS, the prevalence of severe food insecurity is fairly uniform across age groups (2.0% -
2.7%), with the exception of those 65 or older who have a prevalence of severe food insecurity
of just 0.7% (Statistics Canada, 2012). In addition, age also impacts mental health; more than
20% of adults over the age of 60 suffer from a mental or neurological disorder, particularly
dementia and depression. In addition, older people experience increased life stressors related to
issues such as loss of mobility, chronic pain, physical problems, bereavement, lowered
socioeconomic status, isolation, loss of independence and loneliness (WHO, 2015). While
estimates on the intersectionality of age and food insecurity on mental health outcomes are not
accurate in this thesis, the impact of age on food insecurity and mental health individually has
been studied extensively and thus, researchers should study the distinct impact age may play on
mental health when combined with food insecurity. Therefore, age is a candidate for
investigation through the intersectionality theory

Household Composition

Household composition has been shown to have an impact on both food insecurity and
mental health independently. Past studies have shown that household composition is linked to
mental health outcomes and that the relationship is gendered. Single individuals have higher
levels of depression compared with coupled individuals (Wu & DeMaris, 1996). Interestingly,
married women have higher rates of depression compared with married men, while single men
have higher rates of depression compared with single women (Gove & Tudor, 1973; Gove, 1978;
Radloff, 1975). Household composition is also related to food insecurity. Amongst all household
structures lone mothers are the most likely to be food insecure (Che & Chen, 2001, Tarasuk,
2001a). It is clear from the descriptive studies based on pan-Canadian data, that household
structures that only include one member (divorced, separated, widowed, or single) have higher

rates of food insecurity likely due to the absence of an additional income source. In addition, households with children under the age of 18 are also at increased risk of food insecurity. This affords a triple food insecurity vulnerability to female lone mothers with children under the age of 18 (Roshanafshar & Hawkins, 2015; Tarasuk et al., 2014). According to Tarasuk and associates (2014), 34.3% of female lone mothers with children under the age of 18 report some level of food insecurity with 6.6% reporting severe food insecurity.

Age of children is also an important factor in the relationship between food insecurity and household composition. While female lone mothers are the household structure most at risk for food insecurity when the children are under the age of 18, single, unattached individuals living alone or with others are the most at risk for food insecurity compared with all other household structures with children over of age of 18 (Tarasuk et al,. 2014). Many researchers have examined depression and food insecurity in one gender; these studies tend to focus on lone-mothers or coupled mothers with children (Whitaker, Philips, Orzol, 2006; Melchoir et al., 2009). Researchers studying this subject have hypothesized that due to gender roles and lone-motherhood the female in these households tend to take responsibility for feeding the family (Tarasuk, 2001a, Hamelin et al., 2002; Hadley & Crooks, 2012). In a food insecure household, this can be an extremely stressful process and can result in higher rates of depression in mothers (Whitaker et al, 2006). Melchoir and associates (2009) argued the reverse temporality of the relationship, concluding that mothers with pre-existing depression may be unlikely to be able to buffer their families against food insecurity. One recent study also examined depression and a measure of chaos among food insecure families with children and found high levels of depression in the families with food insecurity and high scores on the measure of chaos (Pinard, Calloway, Frick, & Yaroch, 2015).

The thesis did not distinguish household composition groups by the age of children. There were few children living at home over the age of 18 so that couples with children were grouped together, regardless of child age. This coding change may have reduced the validity of the estimates for the effect modification of household composition. Of all the covariates examined in this section, the most research has examined the effect of household structure on the relationship between food insecurity and mental health problems. Therefore, the estimates from this thesis will not be discussed in reference to other more robust studies on the subject.

Education

Education acted as an effect modifier on the relationship between food insecurity and major depressive episodes, anxiety disorders and self-reported mental health status. Interestingly, respondents having a post-secondary degree were not protected against major depressive episodes, poor/fair mental health status or anxiety disorders at the moderately and marginally food insecure level. This finding did not hold true at the severely food insecure level.

It has been established in this thesis that income is strongly associated with both food insecurity and mental health. One potential reason for the lack of protection of post-secondary education on mental health may be a high level of debt associated with obtaining the degree. In the past 25 years, inflation-adjusted tuition costs have increased by approximately 155% and the average Canadian student is graduating with $28,000 dollars in student debt (Canadian Federation of Students, 2015). Given the intense pressure to pay back loans after leaving university or college, recent graduates will often accept work in an unrelated field or in a position they are overqualified for which leads to skill degradation, falling behind in degree-related work experience and professional networking. In 2014, almost 28% of Canadians aged

143

15-24 years were unemployed or underemployed. Youth are also at the highest risk of being laid off in times of economic downturn; 50% of the job losses during the past recession were workers aged 15-24 (Candian Federation of Students, 2015). Recently graduated Canadians are graduating with increasing amount of debt, which puts them at risk of food insecurity due to depleted resources (Canadian Federation of Students, 2015). Moreover, the stresses associated with bearing that debt in a weak economy in combination with uncertain job stability or prospects place undue stress on young Canadians which may result in poor mental health outcomes, as it did in three mental health outcomes in this study. Further sub-group analysis of the young need to be undertaken to substantiate this intersection but if the finding held, it would support more social safety net programs to help young Canadians and new graduates.

Source of Income

Source of income acted as an effect modifier on the relationship between food insecurity and anxiety disorders and mood disorders. Marginally and severely food insecure respondents who received government assistance were more likely to report having an anxiety disorder compared with those receiving wages who were marginally or severely food insecure or in comparison with food secure respondents receiving government assistance. It is plausible that the stigma associated with receiving government assistance could augment the stress associated with the experience of food insecurity thereby resulting in a higher burden of anxiety and mood disorders, compounded with the low income resulting from relying primarily on government assistance. Past studies have shown that households that rely primarily on social assistance are three-fold more likely to experience food insecurity (Roshanafshar & Emma Hawkins, 2015). Unfortunately, based on the cross-sectional findings of this thesis we cannot determine temporality of the relationship between food insecurity and mental health. One would expect that

if the stigma of receiving social assistance and the stresses of food insecurity were working together to create a uniquely disadvantaged social position on mental health outcomes, we would expect to see this interaction on self-reported mental health and depressive thoughts. Instead, we only see this interaction on anxiety and mood disorders, which through diagnosis might afford the respondent disability benefits (which are included in the government assistance group). It is also plausible that respondents with severe mental health problems receive benefits due to their inability to work and their mental health condition results in their food insecure status. More longitudinal studies need to be performed to truly understand this unique intersection.

Immigration Status

Immigration status acted as an effect modifier on the relationship between food insecurity and anxiety disorders and self-reported mental health. For anxiety disorders, severely food insecure immigrants who arrived less than 10 years ago were approximately 70% less likely to report anxiety disorders compared to food secure immigrants who arrived less than 10 years ago, and compared to severely food insecure individuals who were Canadian-born. In addition, two interaction terms existed on self-reported mental health status: moderately food insecure individuals who immigrated more than 10 years ago were approximately 37% less likely to report their mental health as fair/poor compared to food secure individual who immigrated to Canada more than 10 years ago, and compared to moderately food insecure individuals who were Canadian-born. Finally, marginally food insecure individuals who immigrated less than 10 years ago were 90% more likely to report their mental health status are fair/poor compared to food secure individuals who immigrated less than 10 years ago, and compared to marginally food insecure individuals who were Canadian-born.

Interactions by immigration status are often cited as an indicator of the "healthy immigrant effect" whereby foreign-born status confers a health advantage (Vang, Sigouin, Flenon, & Gagnon, 2015). In this thesis, the data do not support a uniform healthy immigrant effect. This could indicate that other factors such as social support, help-seeking behaviours and cultural factors must be examined in the context of its effects on food insecurity and mental health. There is a paucity of literature on the unique experience of being an immigrant and food insecure and its impact on mental health. This type of research is needed in order to provide culturally competent programs to address food insecurity and mental health respectively as well as together.

Ethnicity

Ethnicity acted as an effect modifier on the relationship between food insecurity and mood disorders. The ethnicity variable in this thesis was dichotomized as visible minority or non-visible minority. As a result, many ethnic groups were included in the visible minority group; these ethnic groups do not have a uniform prevalence distribution on mental health outcomes and food insecurity. In addition, given the exclusion of Aboriginal peoples living on reserve from the CCHS (arguably the most disadvantaged ethnic group in Canada) this interaction may not be an accurate estimate of the intersection between ethnicity and food insecurity on mental health outcomes. While the CCHS does include Aboriginal peoples living off-reserve, the sample size is too small to conduct multivariable analyses. Some researchers have begun to disentangle the relationship between race, social class and depression (Rosenfield, 2012;Almeida-Filho, Lessa, Magalhaes, Araujo, Aquino, James, & Kawachi, 2004); hopefully, future investigations will extend to include food insecurity given the high prevalence of food insecurity amongst Aboriginal and African Canadians.

Sex

According to the multivariable analysis, sex acted an effect modifier on one mental health outcome—binge drinking. Moderately food insecure females were more likely to binge drink compared with moderately food insecure males and food secure females. This finding can be interpreted as a possible coping mechanism to address the additional stress felt by women at the moderately food insecure level. Females predominantly bear the responsibility for managing resources in food insecure households (DeVault, 1991; Kenney, 2008). Strategies for managing household food insecurity can include borrowing, stealing, or pawning belongings for money for food, waiting in line at the food bank or other food charity programs, and purchasing and preparing meals (often viewed as substandard) for their families (Tarasuk, 2001a). It has been established in the literature that these strategies are distinctly stressful and stigmatizing experiences and, given their responsibility for the managed experience of food insecurity, they are most often experienced by the female in the household (Tarasuk, 2001a, Hamelin et al., 2002; Hadley & Crooks, 2012). The increased odds of binge drinking among moderately food insecure females may, therefore, be an indicator of the moderately food insecure female's attempt to cope with the stressful experience of managing a food insecure household. This theory is supported by the finding that women have a significantly higher prevalence of mental health comorbidities, such as depression and anxiety, compared with men. It has been shown that these disorders typically predate the onset of substance-abuse problems (Brady & Randall, 1999). Given that moderate food insecurity encompasses food anxiety, it would be expected that there is a higher risk of anxiety disorders at the moderately food insecure level (moderately food insecure individuals have 2.95 times the odds of reporting anxiety disorders compared to food secure individuals). Females might, therefore, be binge drinking to cope with the outcomes of

their anxiety disorders which are related to their status as food insecure. At the moderate level there is not enough money to purchase food of high quality, variety, cultural appropriateness or safety, but moderately food insecure females may be able to find room in the budget for binge drinking (Tarasuk, 2001a). This flexibility may not be available at the severely food insecure level where the quantity of food is reduced and resources are severely constrained.

5.5 Intersectionality Theory

By way of summary of the previous sections, binge drinking was the only mental health outcome that had evidence of an intersectional relationship between food insecurity and sex. Therefore, this thesis did not find that sex and food insecurity intersect to create unique social roles on mental health outcomes. The multivariable analysis presented other variables that intersect with food insecurity on mental health outcomes and could be candidates for further study using an intersectionality lens. In particular, the impact of the intersection between food insecurity and income source, age, education, immigration status, and ethnicity on mental health outcomes need to be studied further.

Intersectionality theory is a strong framework for a more holistic health research as it accounts for the unique social roles each respondent experiences, rather than reducing the individual to one social group. Intersectionality theory incorporates two or more social groups to see whether the interaction of the multiple groups creates a unique social position relative to health outcomes. The present thesis contributes to the literature on the intersectionality of sex and food insecurity on a number of mental health outcomes. While we did not find evidence of intersectionality on six of the seven outcomes, this could be due to the chronically stressful experience of being food insecure. This stressful experience may have overwhelmed the sex

differences in mental health, for the food insecure sub-group. It appears in fact that food insecurity is a sex neutralizing phenomenon in terms of mental health outcomes.

5.6 Implications of Research

Food insecurity is a chronically stressful condition that results in higher odds of indicators of poor mental health

Food insecurity is an experience that encompasses four main dimensions (quantitative, qualitative, social and psychological), each of which contributes unique stresses and burdens. The quantitative dimension can be colloquially described as "hunger", specifically, it refers to when a household does not have enough food to fill the household's food need (Tarasuk, 2001a). This varies in severity and at its most extreme can result in going a full day or days without eating. The quantitative dimension of food insecurity is related to fatigue, weakness, illness and diminished productivity.

The qualitative dimension of food insecurity refers to the quality of food obtained for the household. Rather than reducing the quantitative amount of food in the household, families will often first reduce nutritional adequacy, safety, variety, or cultural appropriateness of their food (Engler-Stringer & Berenbaum, 2007; Tarasuk, 2001a). This experience creates feelings of guilt, shame, frustration at the meals provided or at their inability to adequately provide for themselves or their families.

The social dimension of food insecurity involves obtaining food through deviations from social or cultural norms such as stealing or borrowing money, getting food from charity programs, pawning belongings to purchase food or delaying bills to be able to afford food

(Tarasuk, 2001a). The outcomes of the social dimension of food insecurity include feelings of social exclusion, alienation, powerlessness, guilt, and stigma (Hamelin et al., 2001).

The final dimension of food insecurity is the psychological dimension; this is most commonly associated with food anxiety. Food anxiety is a preoccupation or obsession with food (Tarasuk, 2001a). Food anxiety results in the constant feeling of worry and anxiety over how to feed yourself or your family.

In essence, food insecurity is a managed experience. Food insecure households must be continually negotiating resources in order to feed themselves or their family on insufficient funds. This chronically stressful experience results in adverse mental health outcomes for food insecure Canadians (Davison, et al., 2015; Casey, et al., 2004; Heflin et al., 2005; Klesges, Pahor, Shorr, Wan, Williamson, & Guralnik, 2001; Laraia, Siega-Riz, Gundersen, & Dole, 2006; Temple, 2008; Vozoris & Tarasuk, 2003; Whitaker et al., 2006; Siefert et al., 2004; Stuff, et al., 2004).

Severe food insecurity is a toxic stressor and must be eliminated

Toxic stress is typically understood as "…prolonged activation of the stress response, with a failure of the body to recover fully" (Franke, 2014, p.392). Toxic stressors are typically discussed in children, whereby toxic stresses such as physical, emotional or sexual abuse, neglect, and food scarcity negatively impact the development of the brain and result in worse health outcomes in the child and as they mature into adults. Despite this, toxic stressors can affect anyone, not just children (Franke, 2014). Toxic stressors can be understood as the ongoing stresses that have a distinct impact on the body, but that cannot be readily altered or changed. This thesis posits severe food insecurity as a toxic stressor due to the distinctly stressful nature of

the quantitative and qualitative reductions in food as well as the social and psychological implications of being unable to afford food for oneself or one's family. Individuals who are living in poverty, and unlikely to have enough income to afford food, have typically been living in poverty for three or more years; (Bane & Ellwood, 1986; Finnie & Sweetman, 2003; Rodgers & Rodgers, 1993) and the likelihood of remaining in poverty increases the longer an individual is in that state (Bane & Ellwood, 1986; Riegg, Cellini, McKernan, & Ratcliff, 2008; Stevens, 1995). Therefore, in the absence of structural policy change to address poverty and food insecurity, many individuals will continue to live in poverty and be subject to severe food insecurity and thus the toxic stressor continues to influence the individual's wellbeing. Given the extremely high odds ratios observed for mental health outcomes at the severe food insecurity level, we can see that severe food insecurity in particular wreaks havoc on an individuals' mental health and that population health interventions need to take place to relieve this health burden.

A policy analysis of the means to eliminate severe food insecurity in Canada is beyond the scope or this thesis but two observations bear comment. The first is that current intervention strategies to reduce food insecurity in Canada are primarily volunteer run local programs which address food insecurity by attempting to fill the food need. Some examples of programs include food banks, community kitchens, community gardens and school feeding programs. Many of these programs, school feeding programs and food banks, in particular, have been regarded as a solution to food insecurity since their inception, dating to the 1980s recession. At the time, these programs were seen as a short-term emergency solution to unexpected economic turmoil (Wakefield, Fleming, Klassen, & Skinner, 2012). These short-term solutions have persisted as the main response to food insecurity in Canada, despite the refinement of the definition of food insecurity to one that recognizes food insecurity to be a problem of insufficient income

(McIntyre, 2011). Structural changes to address poverty, such as the provision of a Guaranteed Annual Income, have been elusive.

It is clear that the food-based response to food insecurity has failed; what originally arose as emergency food provisions have now become the institutionalized form of hunger relief in Canada (Wakefield, et al., 2012). In fact, one study estimated that in 2011 the number of people living in food insecure households was 4.6 times higher than the number of people living in households receiving food from food banks (Loopstra & Tarasuk, 2015). Therefore, food banks are not an effective solution at even meeting the food needs of food insecure families, let alone enabling households to leave food insecurity. Poppendieck (1998) has argued that food-based programmes are unable to cope with the growing hunger problem in a stable, efficient and culturally appropriate way. In addition, she argued that the continuation of these programs enable government inactivity on more progressive policy options to address food insecurity. Unfortunately, the demand for emergency food has not slowed but is growing. In 1998, there were 2,141 food banks in Canada and in 2007 there were 3,540 (McIntyre, 2011). Therefore, food banks have become embedded as the primary way of combating hunger (Riches, 2002).

A second observation is that food insecurity in Canada can be understood as a contested issue, meaning that the way the problem of food insecurity is framed has led to divergent policy intervention perspectives--food-based, income-based, or rarely a mixture of the two. Each of these approaches has a different perspective on how policy interventions might mitigate the issue of food insecurity in Canada. Food insecurity is a population health problem and population health problems need policy solutions (Mah, Hamill, Rondeau & McIntyre, 2014). Food insecurity has a substantial cost to public funds. One study concluded that total health care costs increased with food insecurity, annual health care costs were approximately 16%, 32% and 76%

152

higher for those in marginally, moderately and severely food insecure household compared to

food secure households, respectively (Tarasuk, Cheng, de Oliveria, Dachner, Gundersen &

Kurdyak, 2015). In Canada, the only government-run response to food insecurity is income

assistance (McIntyre, Pow & Emery, 2015). Income assistance is clearly insufficient in

addressing household food insecurity as those who rely on social assistance as their primary

income are more likely to be food insecure than any other income source (Tarasuk, 2001a). In

addition, households receiving income support in Canada make up 65% of households using

food banks. Even among the severely food insecure, those who often go hungry, only 40% of

households use the food bank (Loopstra & Tarasuk, 2015). It is clear that effective public health

approaches need to first address the root cause of food insecurity—insufficient income. Once an

adequate level of income is secured, progressive public health programmes can be developed to

help households with their more complex needs, such as programs to ensure households are able

to plan and provide nutritionally balanced meals.

According to Schon and Rein (1994), the divergence in the framing of a policy problem

(food-based vs income based) could point to one of the reasons for a lack of effective policy on

food insecurity in Canada. According to these authors, when examining policy issues that are

particularly stubborn or resistant to change ('intractable policy controversies') a conflict in how

the policy problem is framed is usually central to the problem (Mah, et al., 2014).

5.7 Areas for Future Study

Several gaps in the literature have been identified throughout this research that would be

candidates for further study. Ideally, this thesis would have studied gender rather than sex.

Currently Canada's largest survey on health behaviours and outcomes does not delineate by

153

gender, rather offering only two sex categories from which respondents can choose. This is a substantial deficiency in the ability of the CCHS to study gender-based problems. Therefore, one area for future study is assessing how one might extract gender from the CCHS. One such attempt was a study that examined parents' differential understanding of child feeding according to gender (Potestio, 2011).

Second, the multivariable analysis presented multiple candidate variables and relationships for future analysis using intersectionality theory on the relationship between food insecurity and mental health. In particular age, ethnicity and source of income should be examined further in the context of intersectionality theory to see how they may interact with household food insecurity status to result in a unique mental health burden. This thesis restricted the dataset by age and did not include on-reserve Aboriginal peoples. This reduced this project's ability to accurately interpret estimates on intersections by age and ethnicity.

In addition, how other social categories (e.g., age, sex, education) intersect with food insecurity to result in unique mental health outcomes needs to be examined using the intersectional framework. This framework is a powerful tool for quantitative researchers to move away from reducing individuals to single social categories and try to understand the holistic and unique nature of the social location of individuals in large datasets.

Finally and most importantly, food insecurity in Canada is an unfair mental health burden to place on individuals and families and can therefore be considered a health inequity that must be addressed. Thus, population health intervention work needs to occur in order to reduce food insecurity and as a result, reduce the mental health burden of Canadians. Such population health interventions can include income supports, income volatility protection, labour protections,

social protections or transfers and better access to higher education (McIntyre, 2013). In addition to promoting population health interventions, longitudinal studies on the effect of progressive food insecurity policy need to take place to analyze the effect of such policy on the removal or reduction of severe food insecurity in Canada, and subsequent reduction in mental health outcomes due to food insecurity.

5.8 Strengths and Limitations

There are several strengths and limitations of this thesis.

5.8.1 Strengths

One strength of this thesis is that it addressed an important theoretical, social and political issue -- food insecurity and mental health. In addition, it examined this important public health issue distinctly for each sex. This was done in order to contribute to the intersectionality literature by examining the intersection of two important social determinants of health: food insecurity and gender/sex. Despite not finding evidence of intersectionality of sex and food insecurity on mental health outcomes (with the exception of binge drinking), the multivariable analysis presented interesting candidates for study in the context of intersectionality theory.

Another strength of this thesis is that it employed a very large and robust dataset. This dataset was assembled by pooling four cycles of the CCHS, in order to generalize to the Canadian population aged 18-64, who lived in the ten provinces and answered the HFSSM. This robust dataset allows for accurate estimates, using a validated module, of a relatively rare condition—food insecurity categorized into four levels.

In addition, many mental health conditions were examined and both externalizing and internalizing illnesses were included in the analysis. The master file version of the CCHS was used in order to obtain finer categories on variables such as income source and mental health conditions.

5.8.2 Limitations

A longitudinal survey would have been ideal to study the temporality of the relationship between mental health and food insecurity. Given the often inaccessibility of Canada's poorest, most marginalized individuals, however, the use of cross-sectional data on a vulnerable population was the best available method to answer an exploratory research question which also provides responses on a variety of chronic health conditions including mental illnesses.

Another limitation is the generalizability of the findings to all severely food insecure individuals given that CCHS does not include non-domiciled Canadians. Therefore, persons most at risk for both food insecurity and mental illness, namely the homeless, are missing from the sample. In addition, the CCHS does not cover other populations who are most vulnerable to food insecurity such as Aboriginal peoples living on reserve or those living in remote locations.

Many interview questions were not asked in all provinces. The CCHS questions are divided into common core content and optional content. The common core content questions are asked in every province and territory whereas the optional component is tailored to the region. As a result, several of the outcome variables used in this study were not asked in all provinces. The outcome "Thoughts of suicide in the past year" was only asked in Newfoundland and Labrador, Quebec, Ontario, Saskatchewan, Alberta and British Columbia. The outcome "Major Depressive Episode in the Past 12 Months" was considered optional content in CCHS surveys; asked in Prince Edward Island, Nova Scotia, Quebec, Ontario, Saskatchewan, Alberta and

British Columbia. The outcome variable "Major depression in the past month" was only asked in Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Saskatchewan, Alberta and British Columbia. Therefore, the models using these variables cannot be generalized to Canada as a whole.

Questions aimed at measuring social support (affective, tangible, emotional or social support) were also part of the optional component and were, therefore, not asked in all provinces. As opposed to the outcome variables discussed above, the social support variables were only asked in four geographic regions. Each variable was asked in four of the following provinces or territories: Quebec, Alberta, British Columbia, the Northwest Territories, Nunavut, or the Yukon. Given that all respondents from the northern territories were excluded from this dataset, the sample size for these social support variables was far too low to conduct data analysis more complex than bivariate descriptive statistics. Therefore, this study is limited in its consideration of social support variables. In lieu of the social support variables, sense of the belonging in the community and, to a lesser extent, marital status was used in this study as indicators of social support.

Another limitation of this study is the problem of physician-diagnosed mental illness. The diagnosis or admission of a diagnosis of mental illness is gendered with males far less likely to seek out medical care for a diagnosis and less likely to admit to a diagnosis of mental illness (Brown & Whitfield, 2013). In this thesis, this limitation could provide some interesting insights regarding male norms related to reporting mental illness. For example, two of the outcome variables (physician-diagnosed anxiety disorder and physician- diagnosed mood disorder) are named "physician diagnosed" but in actuality are self-reported physician diagnoses, which may

be gendered as well, with males less likely to admit to a diagnosis of mental illness (Brown & Whitfield, 2013).

It should be noted that in quantitative research there is a fine balance between Type I and Type II error. In this thesis, the robust sample size was chosen in order to assess a fairly rare condition—household food insecurity. This large sample size puts this study at risk of Type I error or the probability of rejecting a null hypothesis when it is in fact true (Oleckno, 2008). One way to avoid the probability of committing Type I error is narrowing the confidence intervals to increase the difficulty of rejecting a null hypothesis. This thesis employed a bootstrapping method which results in more narrow confidence intervals. In addition, while Type I error cannot be avoided, failing to find a statistically significant sex difference in 6 mental health outcomes when food insecurity is considered strengthens confidence in the validity of the findings.

This study aimed to examine the relationship between food insecurity, sex/gender and mental illness in a comprehensive way. Therefore, a wide variety of types of mental health outcomes were selected for analysis. In an effort to encompass mental health conditions that disadvantaged men as well as women, both internalizing and externalizing mental illnesses were included in the study. Unfortunately, many of the externalizing mental health conditions have an inherent stigma associated with them such as alcohol dependency, illicit drug use, and problem gambling. This stigma could have resulted in very low response rates for questions trying to gauge these measures, alternatively these variables could be measuring rarer conditions; resulting in a low sample size. As a result, the only "externalizing" mental health condition that had a sample size large enough to be included in this analysis was binge drinking. Therefore, the mental health conditions chosen as outcomes for this analysis are predominantly "internalizing"

mental health conditions and are theorized to disproportionally affect women (Afifi, 2007, Aneshensel, Phelan and Bierman, 2012).

Finally, many of the variables, including mental health outcomes, included in this analysis were at the individual level but the HFSSM produces a household-level variable. Therefore, it must be stated that the level of food insecurity felt by a household does not necessarily mean each individual in that household experiences the same level of food insecurity. A common example is children often do not experience the same level of food insecurity as their parents as their parents will often limit their food intake in order to fully feed their children (Radimer et al, 1992; Hamelin, Beaudry, & Habicht, 2002; Tarasuk & Maclean, 1990). Given that all respondents below the age of 18 were eliminated from this dataset, this study primarily analyzed adults in the household and, therefore,it is more likely that the household food insecurity level was related to their individual food insecurity level, although this might not always have been the case.

5.8.2.1 Potential Impact of Bias

Bias refers to any type of systematic, or non-random, error in the design or procedure of the study. This type of bias affects the internal validity of the study thus impacting its accuracy. Bias can lead to an overestimation (positive bias) or underestimation (negative bias) of association (Oleckno, 2008).

Selection Bias

Selection bias refers to systematic error that result from study design defect or other factors that affect who participates in the study (Patten, 2015). In this thesis, the main selection bias issue arises from the CCHS's sampling strategy. The CCHS does not include any

respondents who are not living in homes, who are living on reserve, or in remote regions. This criterion affects the accuracy of the estimate of household food insecurity given it does not include the homeless population, Aboriginal Canadians living on reserve or those living in remote regions, all of whom have high rates of food insecurity. This bias can be best understood as a negative bias as this selection bias would likely result in an underestimation of the prevalence of food insecurity in Canada.

Information Bias

Information bias refers to systematic error from a measurement flaw that results in misclassification of a respondent in exposure or outcome groups (Oleckno, 2008).

 The main type of information bias at work in this thesis is reporting bias. Reporting bias refers to subjects intentionally or unintentionally under- or over-reporting certain behaviours or characteristics. This thesis utilizes variables that could be subject to social desirability effect, such as many of the outcome variables: binge drinking, suicidal thoughts, anxiety disorders and mood disorders. There is evidence that men, in particular, are less likely to report mental health issues due to the stigma associated with being mental unwell and cultural stereotypes, societal expectations and personal ideas of the male role (Brown & Whitfield, 2013).

5.9 Conclusions

The gender gap in mental health, prior to the inclusion of food insecurity, has been well-established in past research. Food insecurity status has a gender neutralizing effect on six mental health outcomes, as males and females experience the same odds of reporting poor mental health outcomes. Food insecurity is a source of chronic stress in adults, overwhelmingly the normal buffering capacity that men use to withstand either reporting health problems or to actually

succumbing to them. We theorized that while severe food insecurity in adults may not be changing the latent brain, it may be adding an oppressive experience on a pre-existing vulnerability and producing negative mental health outcomes based on this distinct combination of past and present stressors. Therefore, severe food insecurity could be understood as a toxic stressor with real effects on an individual's mental health.

The association between mental health and food insecurity has been observed repeatedly, and replicated in this study, and the relationship has remained despite controlling for socioeconomic and other demographic variables. Recently, theorists have begun to hypothesize a bidirectional relationship between food insecurity and mental health, whereby poor mental health results in a loss of productivity which can result in depletion in financial and social resources needed to avoid food insecurity. This hypothesized bi-directionality of effect gives one the unique opportunity to decrease the burden of both conditions (in this case food insecurity and mental health conditions) by reducing the prevalence of one of the stressors in the causal pathway, particularly, the greatest stressor--severe food insecurity.

Many studies have been published on the deleterious effect of food insecurity and mental health in a variety of geographic locations. These studies all conclude that food insecurity results in, or is associated with, serious harms for individuals' mental health status. While this thesis contributes to the growing body of literature on the nature of the relationship between food insecurity and mental health outcomes, it is yet another descriptive study of the misery of being food insecure in Canada. The time has come to utilize the knowledge from the dozens of papers discussing this issue and promote progressive policy changes to address the most severe food insecurity and reduce not one but two negative outcomes in the lives of vulnerable Canadians.

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Appendix A

Table A1: Coding of Study Variables

Original Variable Name	Question	Recoding	New Variable Name	Provinces Covered	Individual or House-hold Level
sui_2 yes=1 no=2 not applicable=6	Have you ever seriously considered committing suicide or taking your own life? Has this happened in the past 12 months?	No recoded to 0. Not applicable collapsed into No (as per prompt question).	**Suiyear** Yes=1 No=0	Newfoundland&Labrador Quebec Ontario Saskatchewan Alberta British Columbia	Individual
Gen_02b Excellent=1 Very good=2 Good=3 Fair=4 Poor=5	In general, would you say your mental health is: (excellent, very good, good, fair, or poor)?	Fair and Poor collapsed into "Fair/Poor". Good,Very good and Excellent collapsed into one category.	**Selfmh** Fair/Poor=1 Good+=0	All provinces	Individual
ccc_280 yes=1 no=2	Remember, we are interested in conditions diagnosed by a health professional. Do you have a mood disorder such as depression, bipolar disorder, mania or dysthymia?	No recoded to 0	**mooddis** Yes=1 No=0	All provinces	Individual
ccc_290 yes=1 no=2	Do you have an anxiety disorder such as a phobia, obsessive-compulsive disorder or a panic disorder?	No recoded to 0	**Anxdis** Yes=1 No=0	All provinces	Individual
Alc_3 Never=1 Less than once a month=2 Once a month=3 2-3 times a month=4 Once a week=5	How often in the past 12 months have you had 5 or more drinks on one occasion?	Never, less than once a month and once a month were collapsed into one group "once a month or	**Alcfreq5** "once a month or less"=0 "more than once a month"=1	All provinces	Individual

More than once a week=6		less". All other groups were collapsed into group "more than once a month"			
Dis_10g All of the time=1 Most of the time=2 Some of the time=3 A little of the time=4 None of the time=5	(During the past month, about how often did you feel) sad or depressed?	All of the time, most of the time and some of the time were collapsed into group "yes". A little of the time and none of the time were collapsed into group "no"	**Deprmos** "yes"=1 "no"=0	Prince Edward Island Nova Scotia Quebec Ontario Saskatchewan Alberta British Columbia	Individual
Dpsdsf 0-8 scale probability of caseness: 0=0.00 1=0.05 2=0.25 3=0.50 4=0.80 +4=0.90	Derived Variable Based on questions: DPS_02, DPS_05, DPS_06, DPS_08A, DPS_08B, DPS_10, DPS_11, DPS_12, DPS_13, DPS_16, DPS_17, DPS_18, DPS_19, DPS_21A, DPS_21B, DPS_23, DPS_24, DPS_25, DPS_26 This variable assesses the depression level of respondents who felt depressed or lost interest in things for 2 weeks or more last year. These include normal	0 through 4 recoded as "no". 4+ recoded as "yes" Classification of depression is based on an affirmative response to the original screening question and 5 out of 9 of the depression questions. This relates to 90% predictive probability of caseness.	**Depressyear** "No"=0 "Yes"=1	Newfoundland&Labrador Prince Edward Island Nova Scotia New Brunswick Quebec Saskatchewan Alberta British Columbia	Individual

		periods of sadness (for example, after the death of a loved one), as well as "serious" depression. Based on Composite International Diagnostic Interview (Kessler & Mroczek)				
Dhh_age Continuous 18-65	What is your age?	No recoding	**Agecont** Continuous 18-65	All provinces	Individual
Dhh_sex Male=1 Female=2	Is respondent male or female?	Recoded male=0, female=1	**Sex** Female=1 Male=0	All provinces	Individual
Dhh_ms Married=1 Common-law=2 Widowed=3 Separated=4 Divorced=5 Single, never married=6	What is your marital status? Are you married, living common-law, widowed, separated, divorced, or single, never married?	Collapsed married and common law into one group. Collapsed widowed, separated and divorced in one group.	**Marstat3** Married or common-law=1 Divorced, widowed or separated=2 Single=3	All provinces	Individual
Gen_10 Very strong=1 Somewhat strong=2 Somewhat weak=3 Very weak=4	How would you describe your sense of belonging to your local community? Would you say it is: (very strong, somewhat strong, somewhat weak, or very weak)?	Collapsed very strong and somewhat strong in one group. Collapsed somewhat weak and very weak into one group.	**Belongcom** Strong=0 Weak=1	All provinces	Individual
Sdc_3 Not applicable=9996	In what year did you first come to Canada to live?	"Not applicable" group refers to Canadian-born respondents from the previous two	**Immig2** More than 10 years=0 Less than 10 years ago=1 Canadian Born=2	All provinces	Individual

		categories. According to the year of cycle the respondents come from, 10 years from the year of the survey is used as a threshold. Immigrant respondents are divided into less than 10 years ago or more than 10 years ago.				
Edudh04 Less than secondary school graduation=1 Secondary school graduation=2 Some post-secondary=3 Post-secondary graduation=4	Derived Variable Highest level is selected among education levels for all members of household	Less than secondary graduation, secondary school graduation and some post-secondary are collapsed into one group.	**Educ** Post-secondary graduation=0 Less than post-secondary graduation=1	All provinces	Household
Dhhdecf 1=Unattached individual 2=Unattached individual living with others 3=Couple alone 4=Couple with no children, others 5=Couple with children <25 6=Couple with children <25, other 7=Couple all children >=25 8=Couple all children >=25, other 9=Female lone parent children <25 10=Female lone parent children <25, others 11=Female lone parent children	Derived variables Based on age, sex, and household size.	1, 2 collapsed into "single". 3, 4 collapsed into "couple with no kids". 5, 6, 7, 8 collapsed into "couple with kids. 9, 10, 11, 12 collapsed into "female lone parent" 13, 14, 15, 16 collapsed into "male lone parent"	**Household2** Single=1 Couple with no kids=2 Couple with kids=3 Female lone parent=4 Male lone parent=5	All provinces	Household

>=25 12=Female lone parent all children >= 25 others 13=Male lone parent, children <25 14=Male lone parent children <25, others 15=Male lone parent, children >=25 16=Male lone parent children >=25, others					
Inc_2 1=Wages and salaries 2=Income from self-employment 3=Dividends and interest 4=Employment insurance 5=Worker's compensation 6=Benefits from Canada or Quebec pension 7=Retirement pensions 8=Old age security and GIS 9=Child tax benefit 10=Provincial, municipal social assistance or welfare 11=Child support 12=Alimony 13=Other	What was the main source of income?	1, 2 collapsed into "wages" 4, 5, 6, 8, 9, 10 collapsed into "government assistance" 7, 11, 12, 13 collapsed into other	**Income** "wage"=1 "government assistance"=2 "other"=3	All provinces	Household
Incdhh	What is your best estimate of the total income, before taxes and deductions, of all household members from all sources in the past 12	Originally a continuous variable. Recoded into a dichotomous variable. 0 includes everyone with a total	**Totalinc** 0= "80K or higher" 1= "less than 80K"	All provinces	Household

185

	months?	household income of 80,000 or above. 1 included everyone who responded their total household income was less than 80,000.			
Sdcdcgt & sdcabt	Cultural or racial origin?	Sdcdcgt and sdcabt were derived variables based on variables sdc_42A – sdc_4V in which respondents are asked whether they identify with a wide variety of ethnic or cultural origins. Sdcdcgt is a categorical variable with 13 cultural or ethnic origins while sdcabt is a categorical variable identifying the respondent as Aboriginal (North American Indian, Metis or Inuit). A new binary variable was created by combining these two variables are recoding the ethnic and cultural	**Ethnic2** 0= "non-visible minority" 1= "visible minority"	All provinces	Individual

		origins into either "visible minority" (all categories, except "white") and non-visible minority (including only those who reported themselves as white).			
Geo_prv	Province of residence of respondent	This variable was created in order to restrict the dataset to include only those who live in the ten Canadian provinces. Therefore respondents who responded "Yukon" (60), "Northwest Territories" (61), or "Nunavut" (62) were dropped form the sample.	**Province** 1= Newfoundland and Labrador 2= Prince Edward Island 3= Nova Scotia 4= New Brunswick 5= Quebec 6 = Ontario 7= Manitoba 8= Saskatchewan 9= Alberta 10= British Columbia	All provinces	Household
Fsc_02 Fsc_03 Fsc_04 Fsc_05 Fsc_06 Fsc_07 Fsc_08 Fsc_09 Fsc_10 Fsc_11 Fsc_12 Fsc_13 Fsc_14 Fsc_15 Fsc_16	This variable is based on a set of 18 questions and indicates whether households both with and without children were able to afford the food they needed in the previous 12 months. It captures four kinds of situations: 1) Food Secure:	This variable was created in by dividing the questions into those pertaining to children (aged 15 and under) and adults. Those who are in the "food secure" group did not answer affirmatively to any of the adult or children food	**Food** 0= Food secure 1= Marginally food insecure 2= Moderately food insecure 3= Severely food insecure	Cycle 3.1(2005): Newfoundland and Labrador, New Brunswick, Manitoba and Saskatchewan were not administered this module 2007-2008: All provinces were administered HFSSM 2009-2010: Prince Edward Island and New Brunswick were not administered the HFSSM 2011-2012: All provinces were administered HFSSM.	Household

	Household members show no or minimal evidence of food insecurity.	situation questions			
	2) Marginally Food Insecure: Household members feel anxious about running out of food or compromise on the quality of foods they eat by choosing less expensive options. Little or no reduction in the household members' food intake is reported.	Those in the "marginally food insecure group" answered affirmatively to at least one food situation question either for adults or children.			
	3) Moderately Food Insecure: Food intake for adults in the household has been reduced to an extent that implies that adults have repeatedly experienced the physical sensation of hunger. In most (but not all) food insecure households with children, such reductions are not observed at this stage for children.	Those in the "moderately food insecure" group must have answered affirmatively to 2-5 adult food situation questions or 2-4 child food situation questions			
	4) Severe food Insecure: At this level, all households with children have reduced	Those in the "severely food insecure group" must have answered affirmatively to with 6 or more of the adult food situation questions or 5 or more of the child food situation questions.

Given the importance of this variable to the research question respondents who refused | | | |

	the children's food intake to an extent indicating that the children have experienced hunger. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake.	to answer the food security component were excluded from the sample.			

Appendix B

Table B1: Crude and Adjusted Summary Table for Depression in the Past Month

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.09	1.86 – 2.34	<0.001	
Moderately FI	3.10	2.84 – 3.39	<0.001	
Severely FI	6.95	5.90 – 8.19	<0.001	
ADJUSTED by SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.05	1.82 – 2.30	<0.001	
Moderately FI	3.00	2.74 – 3.28	<0.001	
Severely FI	7.13	6.06 – 8.39	<0.001	
Sex				
Male	Referent			Interaction
Female	1.79	1.70 – 1.88	<0.001	Not Sig.
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.04	1.82 – 2.29	<0.001	
Moderately FI	3.05	2.79 – 3.34	<0.001	
Severely FI	6.93	5.88 – 8.17	<0.001	
Age	0.96	0.94 – 0.97	<0.001	
Interaction				
MarginalFI * Age			0.056	
ModerateFI * Age	1.01	1.00 – 1.02	0.036	Interaction
SevereFI * Age	1.02	1.00 – 1.03	0.003	Significant
Backwards elimination				
SevereFI * Age	1.02	1.00 – 1.03	0.005	
ADJUSTED by EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.07	1.83 – 2.33	<0.001	
Moderately FI	3.09	2.82 – 3.39	<0.001	
Severely FI	6.81	5.74 – 8.08	<0.001	
Education				
Completed post-sec or higher	Referent			
Less than completed post-sec	1.06	1.00 – 1.13	0.039	Interaction
				Not Sig.
ADJUSTED by MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.96	1.74 – 2.20	<0.001	
Moderately FI	2.88	2.64 – 3.15	<0.001	
Severely FI	5.81	4.92 – 6.86	<0.001	
Marital Status				
Married or common law (ref.)	Referent			
Divorced, widowed or separated (DWS)	1.77	1.64 – 1.91	<0.001	
Single	1.49	1.41 – 1.57	<0.001	
Interaction				
MarginalFI * DWS	0.56	0.41 – 0.77	<0.001	

ModerateFI * DWS			0.498	
SevereFI * DWS			0.958	
MarginalFI * Single			0.117	
ModerateFI * Single			0.885	Interaction
SevereFI * Single			0.126	Significant
Backwards elimination				
MarginalFI * DWS	0.62	0.46 – 0.82	0.001	
ADJUSTED by TOTAL FAMILY INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.84	1.64 – 2.08	<0.001	
Moderately FI	2.78	2.53 – 3.05	<0.001	
Severely FI	6.13	5.16 – 7.29	<0.001	
Income				
80 000 a year or more	Referent			Interaction
Less than 80 000 a year	1.44	1.36 – 1.53	<0.001	Not Sig.
ADJUSTED by MAIN SOURCE OF INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.03	1.80 – 2.29	<0.001	
Moderately FI	2.92	2.67 – 3.20	<0.001	
Severely FI	6.00	5.07 – 7.12	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	1.41	1.31 – 1.52	<0.001	Interaction
Other	1.43	1.26 – 1.62	<0.001	Not Sig.
ADJUSTED by HOUSEHOLD COMPOSITION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.91	1.70 – 2.15	<0.001	
Moderately FI	2.80	2.55 – 3.06	<0.001	
Severely FI	5.67	4.80 – 6.71	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.66	0.62 – 0.70	<0.001	
Couple with kids	0.68	0.64 – 0.72	<0.001	
Female lone parent	1.15	1.04 – 1.27	0.006	
Male lone parent	0.92	0.76 – 1.10	0.359	
Interaction				
MarFI*Couple no kids	1.47	1.11 – 1.94	0.008	
ModFI* Couple no kids			0.056	
SevFI* Couple no kids			0.057	
MarFI* Couple kids			0.051	
ModFI* Couple kids			0.749	
SevFI* Couple kids			0.722	
MarFI*Female lone			0.429	
ModFI* Female lone			0.640	
SevFI* Female lone			0.871	
MarFI* Male lone			0.610	
ModFI* Male lone			0.379	Interaction
SevFI* Male lone			0.999	Significant
Backwards Elimination			P=0.025	
MarFI*Couple no kids	1.49	1.14 – 1.95	0.004	
MarFI* Couple kids	1.37	1.05 – 1.79	0.021	

ADJUSTED by ETHNICITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.13	1.90 – 2.40	<0.001	
Moderately FI	3.16	2.89 – 3.45	<0.001	
Severely FI	6.94	5.90 – 8.17	<0.001	
Ethnicity				
Non-visible minority	Referent			Interaction
Visible minority	0.86	0.80 – 0.93	<0.001	Not sig.
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.11	1.88 – 2.36	<0.001	
Moderately FI	3.13	2.86 – 3.42	<0.001	
Severely FI	6.94	5.90 – 8.16	<0.001	
Years Since Immigration				
More than 10 years ago	0.89	0.81 – 0.98	0.015	
Less than 10 years ago	0.88	0.78 – 0.99	0.031	Interaction
Canadian Born	Referent			Not sig.
ADJUSTED by SENSE OF BELONGING IN COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.04	1.82 – 2.29	<0.001	
Moderately FI	3.00	2.75 – 3.29	<0.001	
Severely FI	6.52	5.49 – 7.74	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	1.62	1.54 – 1.70	<0.001	Not sig.
ADJUSTED by CYCLE of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.10	1.87 – 2.35	<0.001	
Moderately FI	3.16	2.89 – 3.45	<0.001	
Severely FI	7.13	6.06 – 8.39	<0.001	
Cycle				
3.1	Referent			
2007-2008	1.18	1.10 – 1.26	<0.001	
2009-2010	0.99	0.93 – 1.05	0.696	Interaction
2011-2012	0.77	0.72 – 0.82	<0.001	Not sig.

Table B2: Crude and Adjusted Summary Table for Major Depressive Episodes in the Past Year

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.22	1.89 – 2.59	<0.001	
Moderately FI	3.75	3.39 – 4.15	<0.001	
Severely FI	10.06	8.63 – 11.71	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.16	1.84 – 2.53	<0.001	
Moderately FI	3.60	3.25 – 3.99	<0.001	
Severely FI	10.22	8.78 – 11.90	<0.001	
Sex				
Male	Referent			Interaction
Female	1.71	1.58 – 1.84	<0.001	Not Sig.
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.14	1.82 – 2.50	<0.001	
Moderately FI	3.63	3.28 – 4.02	<0.001	
Severely FI	10.03	8.61 – 11.69	<0.001	
Age	0.99	0.989 – 0.994	<0.001	
Interaction				
MarFI*Age			0.247	
ModFI*Age	1.012	1.004 – 1.020	0.004	Interaction
SevFI*Age			0.066	Significant
Backwards Elimination				
ModFI*Age	1.011	1.003 – 1.019	0.008	
ADJUSTED by EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.19	1.86 – 2.59	<0.001	
Moderately FI	3.65	3.28 – 4.05	<0.001	
Severely FI	9.75	8.30 – 11.44	<0.001	
Education				
Completed post-sec or higher	Referent			
Less than completed post-sec	1.08	0.99 – 1.17	0.086	
Interaction				
MarginalFI * Education			0.176	
ModerateFI * Education	0.74	0.59 – 0.92	0.006	Interaction
SevereFI * Education			0.126	Significant
Backwards elimination				
ModerateFI * Education	0.77	0.62 – 0.96	0.018	
ADJUSTED BY MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.04	1.74 – 2.40	<0.001	
Moderately FI	3.33	3.01 – 3.69	<0.001	
Severely FI	7.76	6.65 – 9.06	<0.001	
Marital Status				
Married or common law	Referent			
Divorced, widowed or separated (DWS)	2.21	1.99 – 2.45	<0.001	Interaction

Single	1.76	1.62 – 1.90	<0.001	Not sig.

ADJUSTED by TOTAL FAMILY INCOME

Food Security Status				
Food Secure	Referent			
Marginally FI	2.02	1.72 – 2.38	<0.001	
Moderately FI	3.34	3.00 – 3.72	<0.001	
Severely FI	8.81	7.51 – 10.34	<0.001	
Income				
80 000 a year or more	Referent			Interaction
Less than 80 000 a year	1.39	1.27 – 1.52	<0.001	Not Sig.

ADJUSTED by SOURCE OF INCOME

Food Security Status				
Food Secure	Referent			
Marginally FI	2.17	1.85 – 2.55	<0.001	
Moderately FI	3.57	3.21 – 3.97	<0.001	
Severely FI	8.88	7.56 – 10.43	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	1.29	1.17 – 1.43	<0.001	Interaction
Other	1.53	1.29 – 1.82	<0.001	Not Sig.

ADJUSTED by HOUSEHOLD COMPOSITION

Food Security Status				
Food Secure	Referent			
Marginally FI	2.03	1.73 – 2.38	<0.001	
Moderately FI	3.27	2.94 – 3.64	<0.001	
Severely FI	7.71	6.59 – 9.02	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.61	0.56 – 0.66	<0.001	
Couple with kids	0.58	0.53 – 0.64	<0.001	
Female lone parent	1.21	1.06 – 1.38	0.004	
Male lone parent	0.86	0.66 – 1.13	0.277	
Interaction				
MarginalFI * Couple w/o kids			0.082	
ModerateFI * Couple w/o kids	1.35	1.02 – 1.80	0.038	
SevereFI * Couple w/o kids	1.91	1.24 – 2.97	0.004	
MarginalFI * Couple with kids			0.102	
ModerateFI * Couple with kids			0.450	
SevereFI * Couple with kids			0.697	
MarginalFI * Female lone			0.488	
ModerateFI * Female lone			0.460	
SevereFI * Female lone			0.246	
MarginalFI * Male lone			0.956	Interaction
ModerateFI * Male lone			0.788	Significant
SevereFI * Male lone	0.17	0.04 – 0.74	0.018	
Backwards elimination				
SevereFI*Couple w/o kids	1.94	1.26 – 2.98	0.003	P=0.025
SevereFI*Male lone	0.17	0.04 – 0.76	0.020	

ADJUSTED by ETHNICITY

Food Security Status				
Food Secure	Referent			
Marginally FI	2.25	1.92 – 2.63	<0.001	
Moderately FI	3.85	3.48 – 4.27	<0.001	
Severely FI	10.17	8.72 – 11.85	<0.001	

Ethnicity				
Non-visible minority	Referent			Interaction
Visible minority	0.82	0.73 – 0.92	0.001	Not sig.
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.26	1.94 – 2.65	<0.001	
Moderately FI	3.84	3.47 – 4.25	<0.001	
Severely FI	10.02	8.61 – 11.66	<0.001	
Years Since Immigration				
More than 10 years ago	0.75	0.64 – 0.87	<0.001	
Less than 10 years ago	0.53	0.44 – 0.65	<0.001	Interaction
Canadian Born	Referent			Not sig.
ADJUSTED by SENSE OF BELONGING IN COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.11	1.81 – 2.47	<0.001	
Moderately FI	3.58	3.23 – 3.96	<0.001	
Severely FI	9.25	7.91 – 10.82	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	1.61	1.50 – 1.73	<0.001	Not sig.
ADJUSTED by CYCLE of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.20	1.88 – 2.58	<0.001	
Moderately FI	3.73	3.37 – 4.12	<0.001	
Severely FI	10.08	8.65 – 11.75	<0.001	
Cycle of CCHS				
3.1	Referent			
2007/08	1.17	1.07 – 1.28	0.001	
2009/10	1.01	0.92 – 1.11	0.825	Interaction
2011/12	1.37	1.21 – 1.54	<0.001	Not sig.

Table B3: Crude and Adjusted Summary Table for Anxiety Disorder

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.20	1.98 – 2.45	<0.001	
Moderately FI	3.10	2.88 – 3.33	<0.001	
Severely FI	6.78	6.10 – 7.53	<0.001	
ADJUSTED by SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.16	1.95 – 2.40	<0.001	
Moderately FI	2.95	2.74 – 3.17	<0.001	
Severely FI	6.83	6.15 – 7.58	<0.001	
Sex				
Male	Referent			Interaction
Female	1.79	1.70 – 1.88	<0.001	Not Sig.
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.22	2.00 – 2.47	<0.001	
Moderately FI	3.12	2.90 – 3.35	<0.001	
Severely FI	6.79	6.11 – 7.54	<0.001	
Age	1.00	1.000 – 1.004	0.021	
Interaction				
MarginalFI * Age	1.008	1.000 – 1.015	0.034	
ModerateFI * Age	1.012	1.007 – 1.018	<0.001	Interaction
SevereFI * Age	1.013	1.006 – 1.021	0.001	Significant
Backwards elimination				
ModerateFI * Age	1.012	1.006 – 1.017	<0.001	P=0.025
SevereFI * Age	1.013	1.005 – 1.021	0.001	
ADJUSTED BY EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.18	1.95 – 2.44	<0.001	
Moderately FI	2.98	2.77 – 3.22	<0.001	
Severely FI	6.48	5.81 – 7.23	<0.001	
Education				
Completed post-sec or higher	Referent			
Less than completed post-sec				
	1.26	1.19 – 1.33	<0.001	
Interaction				
MarginalFI * Education	0.76	0.61 – 0.95	0.014	
ModerateFI * Education			0.394	Interaction
SevereFI * Education			0.576	Significant
Backwards elimination				
MarginalFI * Education	0.77	0.62 – 0.95	0.016	
ADJUSTED by MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.11	1.90 – 2.34	<0.001	
Moderately FI	2.88	2.68 – 3.10	<0.001	
Severely FI	5.78	5.19 – 6.43	<0.001	
Marital Status				

Married or common law	Referent			
Divorced, widowed or separated (DWS)	1.64	1.53 – 1.76	<0.001	
Single	1.41	1.33 – 1.49	<0.001	
Interaction				
MarFI*DWS	1.36	1.03 – 1.79	0.030	
ModFI*DWS			0.997	
SevFI*DWS			0.654	
MarFI*Single			0.183	
ModFI*Single			0.697	Interaction
SevFI*Single			0.125	Significant
Backwards Elimination				
SevFI*Single	0.79	0.64 – 0.97	0.026	
ADJUSTED by TOTAL FAMILY INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.98	1.77 – 2.21	<0.001	
Moderately FI	2.76	2.56 – 2.99	<0.001	
Severely FI	6.08	5.45 – 6.79	<0.001	
Income				
80 000 a year or more	Referent			Interaction
Less than 80 000 a year	1.37	1.29 – 1.46	<0.001	Not Sig.
ADJUSTED by MAIN SOURCE of INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.06	1.85 – 2.30	<0.001	
Moderately FI	2.64	2.45 – 2.84	<0.001	
Severely FI	5.07	4.55 – 5.65	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	2.12	2.00 – 2.25	<0.001	
Other	1.76	1.58 – 1.96	<0.001	
Interaction				
MarginalFI * Gov.Assist	1.46	1.15 – 1.86	0.002	
ModerateFI * Gov.Assist			0.209	
SevereFI * Gov.Assist	1.45	1.15 – 1.84	0.002	
MarginalFI * Other			0.305	
ModerateFI * Other			0.600	Interaction
SevereFI * Other			0.963	Significant
Backwards elimination				
MarginalFI * Gov.Assist	1.40	1.11 – 1.77	0.005	P=0.025
SevereFI * Gov.Assist	1.42	1.14 – 1.77	0.002	
ADJUSTED by HOUSEHOLD COMPOSITION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.08	1.87 – 2.31	<0.001	
Moderately FI	2.85	2.64 – 2.07	<0.001	
Severely FI	5.62	5.04 – 6.26	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.78	0.73 – 0.82	<0.001	
Couple with kids	0.66	0.62 – 0.71	<0.001	
Female lone parent	1.10	1.00 – 1.20	0.048	
Male lone parent	0.71	0.59 – 0.85	<0.001	
Interaction				
MarginalFI * Couple w/o kids			0.791	

ModerateFI * Couple w/o kids			0.498	
SevereFI * Couple w/o kids			0.084	
MarginalFI * Couple with kids	0.77	0.59 – 0.995	0.046	
ModerateFI * Couple with kids	0.82	0.68 – 0.98	0.032	
SevereFI * Couple with kids			0.123	
MarginalFI * Female lone			0.258	
ModerateFI * Female lone			0.073	
SevereFI * Female lone			0.605	
MarginalFI * Male lone			0.902	
ModerateFI * Male lone	0.47	0.29 – 0.76	0.002	Interaction
SevereFI * Male lone			0.435	Significant
Backwards elimination				
MarginalFI*Couple with kids	0.73	0.59 – 0.91	0.006	P=0.025
ModerateFI * Male lone	0.51	0.32 – 0.81	0.005	
ADJUSTED by ETHNICITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.32	2.09 – 2.58	<0.001	
Moderately FI	3.32	3.09 – 3.57	<0.001	
Severely FI	7.04	6.34 – 7.82	<0.001	
Ethnicity				
Non-visible minority	Referent			Interaction
Visible minority	0.56	0.50 – 0.59	<0.001	Not sig.
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.32	2.09 – 2.58	<0.001	
Moderately FI	3.28	3.05 – 3.52	<0.001	
Severely FI	6.68	6.02 – 7.42	<0.001	
Years Since Immigration				
More than 10 years ago	0.60	0.55 – 0.66	<0.001	
Less than 10 years ago	0.22	0.18 – 0.28	<0.001	
Canadian Born	Referent			
Interaction				
MarginalFI * More			0.917	
ModerateFI * More			0.519	
SevereFI * More			0.997	
MarginalFI * Less			0.169	
ModerateFI * Less			0.560	Interaction
SevereFI * Less	0.23	0.09 – 0.58	0.002	Significant
Backwards elimination				
SevereFI * Less	0.25	0.10 – 0.62	0.003	
ADJUSTED by SENSE of BELONGING in COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.14	1.92 – 2.38	<0.001	
Moderately FI	3.01	2.80 – 3.24	<0.001	
Severely FI	6.46	5.80 – 7.20	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	1.49	1.42 – 1.57	<0.001	Not sig.
ADJUSTED by CYCLE of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.19	1.97 – 2.43	<0.001	

Moderately FI	3.07	2.86 – 3.30	<0.001	
Severely FI	6.75	6.08 – 7.51	<0.001	
Cycle of CCHS				
3.1	Referent			
2007/08	1.26	1.18 – 1.34	<0.001	
2009/10	1.11	1.04 – 1.19	0.003	Interaction
2011/12	1.45	1.35 – 1.55	<0.001	Not sig.

Table B4: Crude and Adjusted Summary Table for Mood Disorders

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.08	1.89 – 2.28	<0.001	
Moderately FI	3.41	3.20 – 3.64	<0.001	
Severely FI	8.51	7.72 – 9.38	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.04	1.86 – 2.24	<0.001	
Moderately FI	3.25	3.04 – 3.47	<0.001	
Severely FI	8.66	7.86 – 9.53	<0.001	
Sex				
Male	Referent			Interaction
Female	1.86	1.78 – 1.95	<0.001	Not Sig.
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.20	2.00 – 2.41	<0.001	
Moderately FI	3.57	3.34 – 3.81	<0.001	
Severely FI	8.70	7.88 – 9.60	<0.001	
Age	1.12	1.10 – 1.13	<0.001	
Interaction				
MarFI*Age	1.01	1.00 – 1.02	0.031	
ModFI*Age	1.01	1.00 – 1.01	0.001	Interaction
SevFI*Age			0.290	Significant
Backwards Elimination				
ModFI*Age	1.01	1.00 – 1.01	0.003	
ADJUSTED by EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.01	1.83 – 2.22	<0.001	
Moderately FI	3.31	3.09 – 3.54	<0.001	
Severely FI	8.16	7.38 – 9.03	<0.001	
Education				
Completed post-sec or higher	Referent			Interaction
Less than completed post-sec	1.23	1.17 – 1.29	<0.001	Not sig.
ADJUSTED BY MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.98	1.81 – 2.18	<0.001	
Moderately FI	3.12	2.92 – 3.33	<0.001	
Severely FI	7.13	6.45 – 7.87	<0.001	
Marital Status				
Married or common law	Referent			
Divorced, widowed or separated (DWS)	2.10	1.97 – 2.23	<0.001	Interaction
Single	1.29	1.22 – 1.35	<0.001	Not Sig.
ADJUSTED by TOTAL FAMILY INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.82	1.66 – 2.01	<0.001	
Moderately FI	2.99	2.80 – 3.21	<0.001	

Severely FI	7.53	6.81 – 8.34	<0.001	
Income				Interaction
80 000 a year or more	Referent			Not Sig.
Less than 80 000 a year	1.43	1.36 – 1.51	<0.001	
ADJUSTED by SOURCE OF INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.94	1.76 – 2.13	<0.001	
Moderately FI	2.88	2.69 – 3.08	<0.001	
Severely FI	6.24	5.65 – 6.90	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	2.34	2.22 – 2.46	<0.001	
Other	1.98	1.79 – 2.19	<0.001	
Interaction				
MarginalFI * Gov.Assist	1.31	1.05 – 1.63	0.016	
ModerateFI * Gov.Assist	1.16	1.00 – 1.34	0.044	
SevereFI * Gov.Assist	1.39	1.12 – 1.73	0.003	
MarginalFI * Other			0.591	
ModerateFI * Other			0.818	Interaction
SevereFI * Other			0.828	Significant
Backwards elimination				
SevereFI * Gov. Assist	1.31	1.07 – 1.60	0.008	
ADJUSTED by HOUSEHOLD COMPOSITION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.94	1.76 – 2.13	<0.001	
Moderately FI	3.09	2.89 – 3.30	<0.001	
Severely FI	6.58	5.96 – 7.26	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.70	0.67 – 0.74	<0.001	
Couple with kids	0.54	0.51 – 0.57	<0.001	
Female lone parent	1.00	0.92 – 1.09	0.953	
Male lone parent	0.72	0.60 – 0.86	<0.001	
Interaction				
MarFI*Couple no kids			0.801	
ModFI* Couple no kids			0.089	
SevFI* Couple no kids	1.30	1.00 – 1.70	0.048	
MarFI* Couple kids			0.453	
ModFI* Couple kids			0.363	
SevFI* Couple kids			0.094	
MarFI*Female lone			0.270	
ModFI* Female lone			0.903	
SevFI* Female lone			0.502	
MarFI* Male lone			0.414	Interaction
ModFI* Male lone			0.112	Significant
SevFI* Male lone			0.279	
Backwards Elimination				
ModFI* Couple no kids	1.19	1.01 – 1.40	0.034	
ADJUSTED by ETHNICITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.19	1.99 – 2.40	<0.001	

Moderately FI	3.66	3.43 – 3.91	<0.001	
Severely FI	8.79	7.98 – 9.69	<0.001	
Ethnicity				
Non-visible minority	Referent			
Visible minority	0.57	0.53 – 0.61	<0.001	
Interaction				
MarFI*Ethnicity	0.99	0.75 – 1.31	0.944	
ModFI*Ethnicity	0.82	0.68 – 0.99	0.038	
SevFI*Ethnicity	1.04	0.80 – 1.35	0.797	
Backwards Elimination				Interaction
ModFI*Ethnicity	0.82	0.68 – 0.98	0.033	Significant
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.17	1.98 – 2.38	<0.001	
Moderately FI	3.58	3.35 – 3.82	<0.001	
Severely FI	8.44	7.67 – 9.29	<0.001	
Years Since Immigration				
More than 10 years ago	0.72	0.66 – 0.78	<0.001	
Less than 10 years ago	0.30	0.26 – 0.35	<0.001	
Canadian Born	Referent			
Interaction				
MarginalFI *More			0.925	
ModerateFI * More			0.124	
SevereFI * More			0.191	
MarginalFI *Less			0.688	
ModerateFI * Less			0.133	Interaction
SevereFI * Less	0.40	0.18 – 0.88	0.024	Significant
Backwards elimination				
SevereFI * Less	0.44	0.20 – 0.98	0.043	
ADJUSTED by SENSE OF BELONGING IN COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.02	1.84 – 2.2	<0.001	
Moderately FI	3.34	3.13 – 3.57	<0.001	
Severely FI	8.12	7.35 – 9.98	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	1.54	1.47 – 1.61	<0.001	Not sig.
ADJUSTED by CYCLE of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.08	1.89 – 2.28	<0.001	
Moderately FI	3.40	3.18 – 3.63	<0.001	
Severely FI	8.48	7.69 – 9.35	<0.001	
Cycle of CCHS				
3.1	Referent			
2007 – 2008	1.16	1.10 – 1.24	<0.001	
2009-2010	1.13	1.06 – 1.20	<0.001	Interaction
2011-2012	1.24	1.16 – 1.32	<0.001	Not sig.

Table B5: Crude and Adjusted Summary Table for Thoughts of Suicide in the Past Year

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.65	1.30 – 2.11	<0.001	
Moderately FI	1.61	1.36 – 1.92	<0.001	
Severely FI	3.38	2.74 – 4.19	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.67	1.31 – 2.13	<0.001	
Moderately FI	1.64	1.38 – 1.96	<0.001	
Severely FI	3.39	2.73 – 4.20	<0.001	
Sex				
Male	Referent			Interaction
Female	0.84	0.74 – 0.95	0.006	Not Sig.
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.63	1.28 – 2.08	<0.001	
Moderately FI	1.59	1.33 – 1.90	<0.001	
Severely FI	3.35	2.70 – 4.16	<0.001	
Age	0.99	0.99 – 1.00	0.014	
Interaction				
MarginalFI * Age	1.02	1.00 – 1.04	0.017	
ModerateFI * Age			0.132	Interaction
SevereFI * Age	1.03	1.01 – 1.04	0.003	Significant
Backwards elimination				
SevereFI * Age	1.02	1.01 – 1.04	0.009	
ADJUSTED by EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.66	1.28 – 2.14	<0.001	
Moderately FI	1.52	1.28 – 1.81	<0.001	
Severely FI	3.23	2.58 – 4.04	<0.001	
Education				
Completed post-sec or higher	Referent			
Less than completed post-sec	1.16	1.01 – 1.33	0.034	Interaction Not Sig.
ADJUSTED BY MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.60	1.25 – 2.04	<0.001	
Moderately FI	1.52	1.28 – 1.81	<0.001	
Severely FI	2.97	2.39 – 3.68	<0.001	
Marital Status				
Married or common law	Referent			
Divorced, widowed or separated (DWS)	1.53	1.29 – 1.80	<0.001	
Single				
	1.52	1.32 – 1.76	<0.001	
Interaction				
MarFI*DWS	1.90	1.01 – 3.59	0.047	
ModFI*DWS			0.343	

SevFI*DWS			0.067	
MarFI*Single			0.442	
ModFI*Single			0.959	Interaction
SevFI*Single			0.283	Significant
Backwards Elimination				
MarFI*DWS	1.98	1.12 – 3.50	0.019	P=0.025
SevFI*DWS	2.16	1.38 – 3.38	0.001	
ADJUSTED by TOTAL FAMILY INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.70	1.31 – 2.19	<0.001	
Moderately FI	1.58	1.29 – 1.92	<0.001	
Severely FI	3.41	2.72 – 4.28	<0.001	
Income				
80 000 a year or more	Referent			Interaction
Less than 80 000 a year	1.10	0.93 – 1.30	0.263	Not Sig.
ADJUSTED by SOURCE OF INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.60	1.26 – 2.05	<0.001	
Moderately FI	1.46	1.23 – 1.74	<0.001	
Severely FI	2.91	2.33 – 3.63	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	1.38	1.19 – 1.61	<0.001	Interaction
Other	1.68	1.30 – 2.17	<0.001	Not Sig.
ADJUSTED by HOUSEHOLD COMPOSITION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.752	1.254 – 2.448	<0.001	
Moderately FI	1.362	1.054 – 1.759	<0.001	
Severely FI	3.076	2.319 – 4.079	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.76	0.64 – 0.89	0.001	
Couple with kids	0.92	0.78 – 1.07	0.280	
Female lone parent	1.12	0.90 – 1.39	0.294	
Male lone parent	1.21	0.80 – 1.82	0.360	
Interaction				
MarFI*Couple w/o kids				
ModFI* Couple w/o kids				
SevFI* Couple w/o kids				
MarFI*Couple with kids	*	*	*	
ModFI* Couple with kids				
SevFI* Couple with kids				
MarFI*Female lone				
ModFI* Female lone				
SevFI* Female lone				
MarFI*Male lone				
ModFI* Male lone				Interaction
SevFI* Male lone				Significant
Backwards Elimination				
MarFI*Couple with kids	0.53	0.30 – 0.94	0.029	
ADJUSTED by ETHNICITY				
Food Security Status				

Food Secure	Referent			
Marginally FI	1.67	1.31 – 2.13	<0.001	
Moderately FI	1.58	1.33 – 1.89	<0.001	
Severely FI	3.27	2.64 – 4.05	<0.001	
Ethnicity				
Non-visible minority	Referent			
Visible minority	1.35	1.12 – 1.62	0.001	
Interaction				
MarFI*Ethnicity			0.870	
ModFI*Ethnicity	0.63	0.40 – 0.99	0.046	Interaction
SevFI*Ethnicity			0.640	Significant
Backwards Elimination				
ModFI*Ethnicity	0.64	0.41 – 0.99	0.049	
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.65	1.29 – 2.10	<0.001	
Moderately FI	1.62	1.36 – 1.93	<0.001	
Severely FI	3.44	2.78 – 4.25	<0.001	
Years Since Immigration				
More than 10 years ago	1.23	0.98 – 1.54	0.081	
Less than 10 years ago	1.61	1.07 – 2.42	0.023	
Canadian Born	Referent			
Interaction				
MarFI*More				
ModFI*More				
SevFI*More				
MarFI*Less				Interaction
ModFI*Less	*	*	*	Significant
SevFI*Less				P<0.05
Backwards Elimination				
ModFI*Less	0.38	0.16 – 0.92	0.032	
ADJUSTED by SENSE OF BELONGING IN COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.61	1.26 – 2.06	<0.001	
Moderately FI	1.58	1.32 – 1.88	<0.001	
Severely FI	3.23	2.61 – 4.00	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	1.48	1.30 – 1.68	<0.001	Not sig.
ADJUSTED by Cycle of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.65	1.30 – 2.11	<0.001	
Moderately FI	1.62	1.36 – 1.92	<0.001	
Severely FI	3.38	2.73 – 4.18	<0.001	
Cycle of CCHS				
3.1	Referent			
2007 – 2008	1.02	0.88 – 1.17	0.806	
2009-2010	0.99	0.82 – 1.20	0.922	Interaction
2011-2012	0.94	0.72 – 1.23	0.655	Not sig.

*p<0.05: estimates are unavailable due to Statistics Canada vetting rules.

Table B6: Crude and Adjusted Summary Table for Self-Reported Mental Health Status

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.25	2.19 – 2.73	<0.001	
Moderately FI	4.20	3.89 – 4.53	<0.001	
Severely FI	10.75	9.62 – 12.00	<0.001	
ADJUSTED By SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.44	2.18 – 2.72	<0.001	
Moderately FI	4.15	3.84 – 4.48	<0.001	
Severely FI	10.74	9.61 – 12.00	<0.001	
Sex				
Male	Referent			Interaction
Female	1.13	1.07 – 1.19	<0.001	Not Sig.
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.56	2.29 – 2.87	<0.001	
Moderately FI	4.36	4.03 – 4.71	<0.001	
Severely FI	10.91	9.77 – 12.18	<0.001	
Age	1.01	1.00 – 1.01	<0.001	
Interaction				
MarginalFI * Age	1.02	1.01 – 1.03	<0.001	
ModerateFI * Age	1.01	1.01 – 1.02	<0.001	Interaction
SevereFI * Age	1.02	1.01 – 1.03	<0.001	Significant
ADJUSTED by EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.42	2.15 – 2.72	<0.001	
Moderately FI	4.07	3.76 – 4.42	<0.001	
Severely FI	10.20	9.06 – 11.48	<0.001	
Education				
Completed post-sec or higher	Referent			
Less than completed post-sec	1.37	1.28 – 1.45	<0.001	
Interaction				
MarFI*Education			0.101	Interaction
ModFI*Education	0.81	0.69 – 0.96	0.012	Significant
SevFI*Education			0.052	
Backwards Elimination				
ModFI*Education	0.85	0.72 – 0.99	0.041	
ADJUSTED BY MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.32	2.07 – 2.60	<0.001	
Moderately FI	3.82	3.53 – 4.13	<0.001	
Severely FI	8.78	7.83 – 9.86	<0.001	
Marital Status				
Married or common law	Referent			
Divorced, widowed or separated (DWS)	2.03	1.88 – 2.19	<0.001	Interaction
Single	1.46	1.38 – 1.56	<0.001	Not sig.

ADJUSTED by TOTAL FAMILY INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.18	1.94 – 2.44	<0.001	
Moderately FI	3.67	3.38 – 3.98	<0.001	
Severely FI	9.05	8.07 – 10.16	<0.001	
Income				
80 000 a year or more	Referent			
Less than 80 000 a year	1.66	1.55 – 1.78	<0.001	
Interaction				
MarginalFI * Income			0.327	
ModerateFI * Income			0.596	Interaction
SevereFI * Income	2.05	1.11 – 3.77	0.022	Significant
Backwards elimination				
SevereFI * Income	2.07	1.12 – 3.81	0.020	
ADJUSTED by SOURCE OF INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.34	2.08 – 2.62	<0.001	
Moderately FI	3.60	3.32 – 3.90	<0.001	
Severely FI	7.90	6.99 – 8.98	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	2.25	2.11 – 2.41	<0.001	Interaction
Other	2.14	1.89 – 2.43	<0.001	Not Sig.
ADJUSTED by HOUSEHOLD COMPOSITION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.26	2.02 – 2.54	<0.001	
Moderately FI	3.78	3.49 – 4.09	<0.001	
Severely FI	8.25	7.34 – 9.27	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.60	0.56 – 0.64	<0.001	
Couple with kids	0.56	0.52 – 0.60	<0.001	
Female lone parent	0.89	0.80 – 0.98	0.025	
Male lone parent	0.87	0.71 – 1.07	0.195	
Interaction				
MarginalFI * Couple w/o kids	1.42	1.07 – 1.87	0.014	
ModerateFI * Couple w/o kids			0.092	
SevereFI * Couple w/o kids	1.47	1.11 – 1.95	0.007	
MarginalFI * Couple with kids			0.522	
ModerateFI * Couple with kids			0.319	
SevereFI * Couple with kids			0.528	
MarginalFI * Female lone			0.475	
ModerateFI * Female lone	0.74	0.58 – 0.94	0.014	
SevereFI * Female lone			0.060	
MarginalFI * Male lone			0.846	
ModerateFI * Male lone			0.804	Interaction
SevereFI * Male lone			0.216	Significant
Backwards elimination				
MarginalFI * Couple w/o kids	1.38	1.08 – 1.78	0.011	
ModerateFI * Couple w/o kids	1.31	1.08 – 1.60	0.007	
SevereFI * Couple w/o kids	1.55	1.18 – 2.05	0.002	

ADJUSTED by ETHNICITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.46	2.20 – 2.76	<0.001	
Moderately FI	4.23	3.92 – 4.57	<0.001	
Severely FI	10.70	9.57 – 11.97	<0.001	
Ethnicity				
Non-visible minority	Referent			
Visible minority	0.93	0.86 – 1.01	0.071	
Interaction				
MarginalFI * Ethnicity			0.115	
ModerateFI * Ethnicity	0.69	0.56 – 0.85	<0.001	Interaction
SevereFI * Ethnicity			0.529	Significant
Backwards elimination				
ModerateFI * Ethnicity	0.71	0.58 – 0.87	0.001	
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.51	2.24 – 2.80	<0.001	
Moderately FI	4.29	3.97 – 4.64	<0.001	
Severely FI	10.71	9.59 – 11.96	<0.001	
Years Since Immigration				
More than 10 years ago	1.00	0.91 – 1.09	0.966	
Less than 10 years ago	0.55	0.47 – 0.64	<0.001	
Canadian Born	Referent			
Interaction				
MarginalFI * More			0.460	
ModerateFI * More	0.61	0.47 – 0.78	<0.001	
SevereFI * More			0.791	
MarginalFI * Less			0.378	
ModerateFI * Less	0.62	0.42 – 0.93	0.020	Interaction
SevereFI * Less			0.089	Significant
Backwards elimination				
ModerateFI * More	0.61	0.48 – 0.79	<0.001	P=0.025
ModerateFI * Less	0.62	0.42 – 0.92	0.017	
ADJUSTED by SENSE OF BELONGING IN COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.32	2.08 – 2.59	<0.001	
Moderately FI	4.03	3.72 – 4.35	<0.001	
Severely FI	9.75	8.73 – 10.88	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	2.19	2.07 – 2.32	<0.001	Not sig.
ADJUSTED by Cycle of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	2.44	2.18 – 2.73	<0.001	
Moderately FI	4.18	3.87 – 4.51	<0.001	
Severely FI	10.73	9.61 – 11.98	<0.001	
Cycle of CCHS				
3.1	Referent			
2007 – 2008	1.01	0.94 – 1.09	0.764	
2009-2010	1.05	0.97 – 1.13	0.240	Interaction
2011-2012	1.16	1.07 – 1.25	<0.001	Not sig.

Table B7: Crude and Adjusted Summary Table for Binge Drinking

	OR	95% CI	p-value	Interaction
CRUDE				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.04	0.95 – 1.14	0.429	
Moderately FI	1.20	1.12 – 1.30	<0.001	
Severely FI	1.68	1.48 – 1.90	<0.001	
ADJUSTED by SEX				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.07	0.98 – 1.18	0.131	
Moderately FI	1.36	1.26 – 1.47	<0.001	
Severely FI	1.72	1.51 – 1.96	<0.001	
Sex				
Male	Referent			
Female	0.31	0.30 – 0.32	<0.001	
Interaction				
MarginalFI * Sex			0.148	
ModerateFI * Sex	1.26	1.08 – 1.47	0.003	Interaction
SevereFI * Sex			0.274	Significant
Backwards Elimination				
ModerateFI * Sex	1.25	1.07 – 1.46	0.004	
ADJUSTED by AGE				
Food Security Status				
Food Secure	Referent			
Marginally FI	0.90	0.82 – 0.99	0.029	
Moderately FI	1.07	0.99 – 1.15	0.075	
Severely FI	1.57	1.38 – 1.78	<0.001	Interaction
Age	0.966	0.965 – 0.968	<0.001	Not sig.
ADJUSTED by EDUCATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.02	0.92 – 1.12	0.738	
Moderately FI	1.12	1.04 – 1.21	0.003	
Severely FI	1.49	1.31 – 1.70	<0.001	
Education				
Completed post-sec or higher	Referent			Interaction
Less than completed post-sec	1.35	1.30 – 1.41	<0.001	Not Sig.
ADJUSTED by MARITAL STATUS				
Food Security Status				
Food Secure	Referent			
Marginally FI	0.95	0.86 – 1.04	0.241	
Moderately FI	1.08	1.01 – 1.17	0.035	
Severely FI	1.30	1.14 – 1.48	<0.001	
Marital Status				
Married or common law	Referent			
Divorced, widowed or separated (DWS)	1.08	1.02 – 1.15	0.011	
Single	2.52	2.43 – 2.62	<0.001	
Interaction				
MarginalFI * DWS			0.746	
ModerateFI * DWS			0.837	
SevereFI * DWS			0.860	
MarginalFI * Single			0.384	

ModerateFI * Single			0.773	Interaction
SevereFI * Single	0.70	0.49 – 0.997	0.048	Significant
Backwards Elimination				
SevereFI * Single	0.69	0.53 – 0.90	0.006	
ADJUSTED by TOTAL FAMILY INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.04	0.95 – 1.15	0.389	
Moderately FI	1.23	1.14 – 1.33	<0.001	
Severely FI	1.69	1.48 – 1.92	<0.001	
Income				
80 000 a year or more	Referent			
Less than 80 000 a year	0.95	0.91 – 0.98	0.005	
Interaction				
MarginalFI * Income			0.101	
ModerateFI * Income			0.404	Interaction
SevereFI * Income	0.38	0.19 – 0.75	0.005	Significant
Backwards Elimination				
SevereFI * Income	0.38	0.19 – 0.75	0.006	
ADJUSTED by MAIN SOURCE of INCOME				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.07	0.97 – 1.17	0.183	
Moderately FI	1.26	1.17 – 1.36	<0.001	
Severely FI	1.80	1.58 – 2.05	<0.001	
Main Source of Income				
Wages	Referent			
Government Assistance	0.72	0.68 – 0.76	<0.001	Interaction
Other	0.82	0.73 – 0.92	0.001	Not Sig.
ADJUSTED by HOUSEHOLD COMPOSITION				
Food Security Status				
Food Secure	Referent			
Marginally FI	0.97	0.88 – 1.06	0.464	
Moderately FI	1.12	1.04 – 1.21	0.003	
Severely FI	1.30	1.15 – 1.48	<0.001	
Household Composition				
Single	Referent			
Couple with no kids	0.57	0.54 – 0.60	<0.001	
Couple with kids	0.59	0.56 – 0.62	<0.001	
Female lone parent	0.61	0.57 – 0.66	<0.001	
Male lone parent	1.10	0.98 – 1.24	0.093	
Interaction				
MarginalFI * Couple w/o kids			0.999	
ModerateFI * Couple w/o kids			0.920	
SevereFI * Couple w/o kids			0.113	
MarginalFI * Couple with kids			0.068	
ModerateFI * Couple with kids	0.64	0.53 – 0.77	<0.001	
SevereFI * Couple with kids			0.950	
MarginalFI * Female lone			0.687	
ModerateFI * Female lone	0.77	0.61 – 0.96	0.020	
SevereFI * Female lone			0.842	
MarginalFI * Male lone			0.933	
ModerateFI * Male lone			0.124	Interaction
SevereFI * Male lone			0.603	Significant
Backwards elimination				

ModerateFI * Couple with kids	0.70	0.59 – 0.83	<0.001	
ADJUSTED by ETHNICITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.08	0.98 – 1.18	0.109	
Moderately FI	1.26	1.17 – 1.36	<0.001	
Severely FI	1.73	1.53 – 1.96	<0.001	
Ethnicity				
Non-visible minority	Referent			Interaction
Visible minority	0.61	0.57 – 0.65	<0.001	Not sig.
ADJUSTED by IMMIGRATION				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.06	0.97 – 1.16	0.183	
Moderately FI	1.23	1.15 – 1.33	<0.001	
Severely FI	1.65	1.46 – 1.87	<0.001	
Years Since Immigration				
More than 10 years ago	0.43	0.39 – 0.46	<0.001	
Less than 10 years ago	0.37	0.33 – 0.43	<0.001	
Canadian Born	Referent			
Interaction				
MarginalFI * More			0.449	
ModerateFI * More	0.68	0.48 – 0.97	0.033	
SevereFI * More			0.211	
MarginalFI * Less			0.424	
ModerateFI * Less			0.217	Interaction
SevereFI * Less			0.089	Significant
Backwards elimination				
ModerateFI * More	0.69	0.48 – 0.98	0.038	
ADJUSTED by SENSE of BELONGING in COMMUNITY				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.03	0.94 – 1.13	0.474	
Moderately FI	1.18	1.09 – 1.27	<0.001	
Severely FI	1.64	1.45 – 1.86	<0.001	
Sense of Belonging in Community				
Strong	Referent			Interaction
Weak	1.14	1.10 – 1.19	<0.001	Not sig.
ADJUSTED by CYCLE of CCHS				
Food Security Status				
Food Secure	Referent			
Marginally FI	1.04	0.95 – 1.13	0.452	
Moderately FI	1.20	1.12 – 1.29	<0.001	
Severely FI	1.68	1.48 – 1.90	<0.001	
Cycle of CCHS				
3.1	Referent			
2007-2008	1.02	0.98 – 1.07	0.328	
2009-2010	1.01	0.96 – 1.06	0.761	Interaction
2011-2012	1.07	1.02 – 1.13	0.006	Not sig.