Are experiences of food insecurity associated with disordered eating among young adults living in Canadian urban centers?

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Background: Food insecurity and disordered eating represent two far-reaching and complex public health concerns in Canada, especially among young adults, and are each associated with multiple serious adverse health outcomes. Emerging evidence suggests a potential link between the conditions as both are characterized in part by food restriction and/or binge eating pathology. While it has been posited that food insecurity may increase risk of disordered eating, or risk of an eating disorder, little research on the link between these two conditions has been conducted in the Canadian context.

Objectives: The objectives of this study were to 1) characterize the prevalence of household food insecurity, risk of eating disorder and indicators of disordered eating and 2) examine the association between household food security status and risk of eating disorder, as well as indicators of risk (vomiting to lose weight, binge eating and preoccupation with thinness respectively) among young adults living in urban centers in Canada.

Methods: Cross-section analyses was conducted using data from the 2016 wave of the Canada Food Study. Multivariable survey logistic regression modelling was conducted to examine the associations between household food insecurity status and disordered eating behaviours, as well as eating disorder risk.

Results: Almost half of participants lived in food-insecure households (41.2%), nearly a third reported at least one episode of binge eating in the previous month (28.9%), over 2 in 10 (22.2%) reported a preoccupation with thinness and one in 20 (5.6%) reported vomiting to control their weight. Over 1 in 10 (12.2%) participants were considered at risk of an eating disorder. Participants from moderately and severely food-insecure households had higher odds of vomiting, binge eating, feeling preoccupied with thinness and being at risk for an eating disorder when compared to food-secure households. Marginally food-insecure households reported greater odds of binge eating compared to food-insecure households.

Conclusion: These results suggest that food insecurity and disordered eating/eating disorders have a significant graded association among young adults in Canadian cities, and greater attention should be paid to how proposed interventions and policies address this link.

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List of Abbreviations

HFSSM   Household Food Security Survey Module

FAO   Food and Agriculture Organization

CCHS   Canadian Community Health Survey

UBI   Universal Basic Income

BIG   Basic Income Guarantee

DSM-5   Diagnostic and Statistics Manual 5

CFS   Canada Food Study

ASA24   Automated Self-Administered 24-hour Dietary Assessment Tool

EAT-3   Eating Attitudes Test-3

EAT-26   Eating Attitudes Test-26

1.0 Introduction

1.1 Study Overview

Food insecurity and disordered eating each represent two complex and wide-reaching public health problems in Canada (1–4). Food insecurity is defined as inadequate or uncertain access to diverse or high-quality foods due to financial constraints (1,2), whereas disordered eating is defined as inappropriate compensatory behaviours or attitudes meant to control weight or shape (5,6). Both food insecurity and disordered eating are associated with long-standing negative health outcomes for individuals, families and society alike, including lower self-reported health, psychosocial stress, concurrent mental health conditions and an observed financial toll on the healthcare system (6,7,16,8–15). In particular, young and emerging adults are especially vulnerable to experiencing food insecurity and/or disordered eating, as this developmental period is often one of economic, educational and identity flux as people transition from adolescence to adulthood (6,15,17–19).

1.2 Study context and research objectives

Food insecurity and disordered eating are typically addressed with separate policies or interventions in higher income nations, such as food banks to alleviate the impacts of food insecurity (20) and school-based interventions intended to improve body image and combat disordered thoughts and eating patterns (21). However, there is growing evidence of a link between individual experiences of food insecurity and subsequent development of disordered eating (22–26). Both conditions are characterized, in part, by an individual preoccupation with food and cycles of food availability and unavailability (27), with externally imposed barriers to food access in the case of food insecurity and internally imposed barriers to food access in the case of disordered eating (28). Food restriction has been shown to lead to preoccupation with food and increased likelihood of binge eating (29), suggesting that individuals involuntarily experiencing food restriction as a result of their experiences of food insecurity may be more likely to engage in binge eating when food becomes available to them (27,30). Furthermore, cross-sectional studies have suggested a link between food insecurity and various compensatory behaviours (i.e., behaviours meant to counteract effects of eating or control weight) (26), as well as a link between self-reported eating disorder diagnoses, including binge eating disorder and bulimia (28,31).

A better understanding of the link between food insecurity and disordered eating has the potential to impact how these conditions are framed and addressed; not as independent of one another but rather as linked phenomena that require comprehensive and coordinated policies. Research on the hypothesized link between food insecurity and disordered eating has not yet been examined any Canadian populations or young adults in particular. Thus, the objectives of

this thesis are to: 1) characterize the prevalence of household food insecurity, risk of eating disorder and indicators of disordered eating and 2) examine the association between household food security status and risk of eating disorder, as well as indicators of risk (vomiting to lose weight, binge eating and preoccupation with thinness respectively) among young adults living in urban centers in Canada.

2.0 Background

2.1 Food Insecurity

2.1.1 Defining food security and food insecurity

Food security and food insecurity are complex phenomena and multiple definitions exist to conceptualize the range of experiences that characterize them (32). According to the Food and Agriculture Organization (FAO) of the United Nations' Rome Declaration at the 1996 World Food Summit, food security "exists when people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (33–35). FAO defines food insecurity as occurring when a person lacks "regular access to enough safe and nutritious food for normal growth and development and an active and healthy life" (36), which may be due to an unavailability of food, or lack of resources or money to acquire food (2,36). In Canada, food security is typically surveilled and measured at the household level using the Household Food Security Survey Module (HFSSM) (37–39). The HFSSM queries manifestations affecting adults and children to capture differential experiences (34,37).

Experiences associated with household food insecurity have been conceptualized in a number of ways, notably as being characterized by qualitative, quantitative, psychological and social dimensions (34,40). The qualitative dimension of food insecurity refers to sacrifices made in the quality of food available to households, such as purchasing food that is inferior or unsuitable in quality because that is the only affordable option (34). The quantitative dimension of food insecurity refers to depleted food supply, the most extreme manifestation of which is absolute food deprivation whereby adults and/or children go without food for a period of time (34). Psychological dimensions of household food insecurity are exemplified by feelings of uncertainty or anxiety over present and future intakes of food (40), with qualitative research characterizing feelings including a loss of control over their food situation, shame and deprivation and nutritional compromises (41,42). Evidence also suggests that broad preoccupation with or worry about food shapes decisions, emotions and interactions with others and can go as far as causing feelings of alienation, hindering individuals from being active participants in society (41,42). These feelings are emblematic of the social dimensions of household food insecurity, where food is acquired through socially unacceptable means (40), leading to social exclusion of food-insecure households (42).

Experience-based food insecurity scales, including the HFSSM used in Canadian surveillance (43), reflect the qualitative and quantitative manifestations associated with differing levels of severity of food insecurity. For example, the HFSSM includes items ranging from worrying about running out of food before getting more money, to sacrificing healthy foods or a sufficient variety of food, to skipping meals, and in extreme cases, going without food for a day or more due to the inability to afford food (1). The HFSSM includes one question regarding

worry but does not capture social exclusion or feelings of shame and embarrassment about the food situation.

2.1.2 Food insecurity in Canada

Based on the HFSSM, household food insecurity is prevalent in Canada, with the most recent nationally-representative estimates from the 2017-2018 Canadian Community Health Survey (CCHS) suggesting 13% of Canadian households (representing 4.4 million Canadians) experienced marginal, moderate or severe food insecurity over the previous 12 months (1). Marginal food insecurity is associated with worry over finances and subsequent food procurement, moderate food insecure is signified by compromises in food quality, and severe food insecurity is signified by compromises in food quantity (34). Over one in 20 (6%) Canadian households were moderately food insecure and 3% were severely food insecure, meaning that 1 in 4 households who experience food insecurity are severely food insecure (1).

Certain structurally excluded groups are more likely to experience food insecurity compared to other groups. For instance, in the 2017-2018 CCHS, households in which the respondent identified as Black or Indigenous were characterized as being food insecure at higher levels (28.9% and 28.2% respectively) compared to White households (11.2%) (1). Black and Indigenous households face disproportionately higher rates of food insecurity compared to White households due in part to the structural racism faced by both groups in Canada, although reasons as to why these disparities across race exist are complex and wide-ranging. Indigenous households within Canada face unique barriers to achieving food security, such as difficulty accessing traditional foods and traditional ways of food preparation and cooking (44,45). Structural racism negatively impacts the economic prospects and health outcomes of Black Canadians and Indigenous Peoples, and hugely shapes disparities in wealth and health while systematically excluding these groups from fully participating in society (44,46), leaving Black and Indigenous households predisposed to higher prevalence rates of food insecurity in Canada.

Research has also consistently found that women are more likely to experience food insecurity than men, likely due to women's socioeconomic disadvantage compared to men, with women generally being responsible for a greater share of the domestic duties including grocery shopping and cooking, and increasing number of single female-headed households (33,47). Women in married or cohabiting households are also more likely to report indications of household food insecurity compared to men in married households when both are presented with the same questions (47), which may be due to women being more aware of household food availability or women protecting members of their household from food insecurity by reducing their own intake (48).

Another group who may be uniquely vulnerable to food insecurity is post-secondary students, who are typically young (~18-25 years old), not yet a part of the full-time workforce

and are faced with high tuition and high cost of living expenses, including rising food costs (49). Changes in federal and provincial funding structures and inflation have increased the average debt load and overall financial precarity among Canadian post-secondary students, particularly among students from groups made marginalized in society and those from lower-income families (50,51). Post-secondary students are often left in a precarious position regarding their food security as a result of the multitude of factors outside their control. A systematic review of grey and academic literature examining cross-sectional convenience samples have placed prevalence of food insecurity among post-secondary students across the US and other countries as high as 42%, which suggests that post-secondary students may be disproportionately susceptible to food insecurity when compared to the general adult population (52).

2.1.3 Consequences of food insecurity

The consistently higher prevalence of household food insecurity in Canada over decades is concerning as food insecurity is associated with a host of negative health outcomes for individuals, households, and societies. For example, food insecurity is associated with poor diet quality (17) and nutritional inadequacies among adults and adolescents (8,10,53). Individuals in household experiencing food insecurity have been shown to experience instances of irregular eating patterns, food restriction and dietary compromises, all of which are theorized to be precursors to disordered eating or eating disorder pathology (28,54). Food insecurity is also associated with poor physical and mental health, including chronic health conditions, sleep disorders, mental health disorders and suicidal ideation (7,8,15,28,55,56). Among post-secondary students, food insecurity has been linked to poorer academic performance, decreased focus and higher levels of stress (49,57), in addition to the aforementioned outcomes. Because of the high number of associated negative health outcomes, individuals in households affected by food insecurity utilize healthcare resources more frequently compared to those in food-secure households, and thus exert a higher resource toll on the healthcare system (9,58).

2.1.4 Policy measures and interventions addressing food insecurity

Despite the high prevalence of food insecurity in Canada over the previous decades, there has been a dearth of adequate policy solutions implemented at the federal, provincial and/or municipal levels that target the causes rather than the symptoms of food insecurity (1). Evidence suggests current policies implemented to ameliorate food insecurity, such as food banks and collective kitchens, do not achieve the goal of providing the users with food security but rather can offer only partial solutions by way of temporarily providing access to food resources (59,60). Since household food insecurity is conceptualized as arising from a lack of financial resources, the necessary policy solution is often proposed as adequate financial income supports, not food-based interventions (20,60) and real-world evidence exists to support this notion. For instance,

food insecurity among Canadian households reliant on senior's income, such as pensions or dividends, has been shown to be lower than the national average, likely due to the guaranteed income supports offered to Canadian seniors (1). A study examining food insecurity rates among Canadian adults 55-74 years of age before and after qualification for publicly financed pensions, known as Old Age Security (OAS), found a lower rate of food insecurity among these adults once they qualified for OAS at age 65 (61). The reduction in food insecurity prevalence after the onset of OAS provides some evidence to support the notion that a broader guaranteed income would reduce the prevalence of food insecurity, particularly severe food insecurity, across the larger population. Guaranteed income pilot projects have been implemented previously in Canada, such as the MINCOME project in Dauphin, Manitoba (62) and the Ontario government's basic income project that was implemented in 2018 and discontinued in 2019 (63), although the projects' respective impacts on reducing food insecurity were not measured and is thus unknown. Universal Basic Income (UBI) or Basic Income Guarantee (BIG) programs propose providing a monthly cash grant to all people residing in a place as a means to ease economic precarity and has gained traction among academics and politicians in recent years as being an effective measure to reduce food insecurity and other health inequities (20,64).

2.2 Disordered eating and eating disorders

2.2.1 Defining disordered eating and eating disorders

Disordered eating refers to abnormal and inappropriate compensatory behaviours related to food and/or weight concern or control (65). Common compensatory behaviours associated with disordered eating include binge eating, vomiting, laxative abuse, caloric or macronutrient restriction and excessive exercising (6,65). Among non-clinical, community-based populations, disordered eating behaviours can be a precursor to a diagnosis of an eating disorder (11,66).

Eating disorders are complex psychiatric conditions characterized by preoccupations surrounding body image, weight and eating, as well as by disordered eating behaviours (3). Eating disorders specified in the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5) include anorexia nervosa, avoidant/restrictive food intake disorder, bulimia nervosa, binge eating disorder, pica, rumination disorder, other specified feeding or eating disorder and unspecified eating or feeding disorder (the latter two are broad diagnoses for a set of disordered eating behaviours and attitudes that do not align within the criteria for other diagnoses) (67).

To capture the differences between disordered eating behaviours and eating disorders in research, many measurement tools have been developed based on DSM-5 guidelines to characterize whether an individual is at risk for developing an eating disorder (66). Examples of psychometric eating disorder measurement tools include the Eating Disorder Examination Questionnaire, the Eating Attitudes Test-26 and the Eating Disorder Inventory subscales (68).

2.2.2 Disordered eating in Canada

While little research is available to characterize the breadth and depth of disordered eating and eating disorders in Canada, some research suggests it is relatively common among women, with one study reporting that 15% of a sample of Canadian women exhibited subthreshold eating disorder behaviours (3). Another study examining gender and age differences in eating attitudes among Canadian men and women found that 9% of the sample scored above the cut-off point for the Eating Attitudes Test-26 (a 26-item measure of eating disorder risk), indicative of a positive screening for an eating disorder (69). These studies suggest that disordered eating and eating disorders may be fairly prevalent among Canadian adults, which is concerning given the health implications of these conditions. In other Western economies, disordered eating has increased in prevalence among both men and women over previous decades (70,71), and is becoming increasingly common across genders and ethnicities and among individuals with varying socioeconomic status, as opposed to the common misconception that disordered eating is an affliction of primarily high-income young White women (72–74).

2.2.3 Consequences of disordered eating and eating disorders

Increases in rates of disordered eating are worrisome given that it is associated with adverse health outcomes, such as low self-rated quality of life (16) and poor dietary intake (75,76). Other psychiatric conditions have been associated with an eating disorder diagnosis, such as concurrent substance abuse (14), anxiety and depression (6) and psychological distress (6,11). Eating disorders have also been found to have one of the highest mortality rates among all mental illnesses (77,78).

Despite the difference in clinical significance between disordered eating and eating disorders, both conditions are characterized by similarities in eating attitudes, defined as beliefs, thoughts, feelings or behaviours towards food (5). People with eating disorders will experience disordered eating behaviours, but not everyone who experiences disordered eating behaviours will reach the clinical threshold for diagnosis of an eating disorder (5). However, it is important to note that disordered eating behaviours and attitudes can and do take a mental and physical toll on individuals, even if clinical thresholds for an eating disorder diagnosis are never formally met (5).

2.2.4 Policy measures and interventions addressing disordered eating

Despite the numerous adverse health outcomes associated with disordered eating, there is relatively little in the way of population-level prevention policies or strategies addressing disordered eating and/or eating disorder risk. Prevention programs have been implemented in elementary, secondary and post-secondary schools, with the intention of modifying specific risk

factors known to confer significant risk for disordered eating and eating disorders (21), such as thin-ideal internalization, negative body image and negative self-affect (21,79–81). Individuals in school-aged groups have been targeted in particular because they are likely to experience disordered eating and be at risk for developing eating disordered (65,82).

A majority of treatments for disordered eating and eating disorders focus on an individual's agency, as opposed to promoting changes in sociocultural structures that have large-scale influence on behaviours (83). One agentic example that has been examined for both prevention and treatment is intuitive eating (84–86). Intuitive eating describes a method of food consumption that promotes reliance on one's internal hunger and satiety cues to guide eating behaviours (85). Some evidence suggests that intuitive eating is positively associated with improved dietary intake and/or eating behaviours, as well as physiological health outcomes, which makes it a viable method of prevention as well as treatment for disordered eating (84,86). Other interventions for disordered eating and eating disorders include various types of therapy, such as dialectical behaviour therapy (87).

Recovery from eating disorders is often difficult, time-consuming and costly, if individuals are able or willing to access treatment at all (88). Evidence suggests that many people do not or cannot access adequate treatment for disordered eating or an eating disorder, or cannot access a primary care or family doctor, which raises concerns about equity, stigma, perceived need and eating disorder treatment (89). Inequitable access is a particular problem for those who do not meet the stereotypical eating disorder patient profile of wealthy, white, female or thin (88,90), as they or their health care providers might not recognize the symptoms when they present in someone who exists outside of the common conceptualization of eating disorders. For instance, individuals from a low socioeconomic background are disproportionately less likely to receive treatment compared to their wealthier counterparts (88). Thus, understanding potential upstream correlates of disordered eating and eating disorders, such as food insecurity, may inform effective population-level strategies that address structural determinants, as well as support individual agency in preventing and treating eating disorders.

2.3 The association between food insecurity and disordered eating

The individual experience of food insecurity is marked by a fixation on or preoccupation with food (34,91), as well as physical manifestations related to food deprivation (8,10,42). Like food insecurity, disordered eating is characterized by a preoccupation with food (3,74) and is related to poor physical and psychological well-being (11,16). While feelings of food preoccupation, shame and alienation, as well as experiences of binge eating among food-insecure populations run parallel to many experiences of disordered eating (6,92,93), they do not necessarily appear to be mediated by weight or shape concerns like disordered eating is posited to be. Food insecurity is externally motivated deprivation and would exist regardless of weight or

shape concerns as the societal forces that drive the existence of food insecurity are often times outside of the control of households and individuals. Nevertheless, the similarities between the manifestations of experiences of food insecurity and of disordered eating support a potential association between the two phenomena.

Emerging research suggests that the experience of food insecurity may be linked to behavioural displays similar to compensatory behaviours associated with disordered eating (25). Experiences of food insecurity have been linked to a cycle of restriction when resources are scarce, and binge eating when resources are available (23,28). Thus, individuals in food-insecure households may experience a "feast and famine" cycle, where food consumption aligns with the monthly allotment of food assistance or other income supports at the beginning of each month, and food deprivation coincides with the waning of those resources for food as the month progresses (23,28,94,95). Experiences of food restriction have been shown to lead to heightened emotional reactivity, preoccupation with food and a higher likelihood of binge eating once the period of food restriction has ended (29,30). Therefore, it stands to reason that regardless of whether food restriction is externally or internally imposed that the association with disordered eating would be similar. Furthermore, the hypothesized cycle of maladaptive behaviours may have longstanding implications for the relationship food-insecure individuals have with food, even if the threat of food insecurity abates.

3.0 Study Rationale and Research Objectives

3.1 Study Rationale

Examining a possible link between food insecurity and disordered eating or eating disorders is an area of interest that has gone largely unexplored within the disciplines of food insecurity and/or eating disorder research. While the potential association between food insecurity and eating disorders was identified as early as 1996 by Kendall, Olson and Frongillo (96), only recently has there been substantial attention paid to this association within the literature, with an early article of note describing a potential link being published in 2017 (23). Broadly, the existing literature has found and described associations between food insecurity and preoccupation with food (91), general eating disorder pathology (97), binge eating (28), compensatory behaviours (22,26) and self-reported eating disorder diagnoses (28,31), suggesting that food insecurity is associated with a range of behaviours and conditions that fall under the umbrella of disordered eating and eating disorders. Conversely, this hypothesized link suggests that disordered eating behaviours and eating disorder pathology can be influenced by other factors not as commonly understood and preventing food insecurity may help to mitigate disordered eating behaviours and lower risk of an eating disorder at a population level. However, much of the research is cross-sectional and focused on American adults (22–24,96), with a few studies focused on children and adolescents (12,26,98) or examining other countries. Further, the relationship between food insecurity and health outcomes has been demonstrated to be graded, with more severe food insecurity leading to more severe health outcomes (99), but evidence is inconclusive as to whether the relationship between food insecurity and disordered eating is graded as well (23).The nature of the association between food insecurity and disordered eating is not fully elucidated, which poses a barrier to understanding and addressing food insecurity as a possible modifiable risk factor for disordered eating, and for understanding the factors that may be associated with the development or perpetuation of eating disorders.

3.2 Research Objectives

The aim of this thesis is to explore the association between food insecurity and disordered eating, and risk of eating disorder among young adults living in urban centers in Canada. The specific objectives are to:

1. Characterize the prevalence of household food insecurity, risk of eating disorder and indicators of risk among young adults living in urban centers in Canada.

2. Examine associations between household food security status and risk of eating disorder, as well as indicators of eating disorders, including vomiting to lose weight, binge eating and preoccupation with thinness among young adults living in urban centers in Canada.

4.0 Methods

4.1 Dataset

Data were drawn from the 2016 wave (wave 1) of the Canada Food Study (CFS), a prospective cohort of approximately 3,000 adults aged 16-30 years at baseline, conducted to examine eating patterns and trends among Canadian youth and young adults (100). The survey included questions about dietary behaviours, weight management and dieting, nutrition knowledge, food security, perceived diet quality and health, and participation in or exposure to specific nutrition interventions, such as nutrition labelling (100). Socio-demographic and other health behaviour characteristics were also assessed (100). Respondents also completed up to two 24-hour dietary recalls using the Canadian version of the Automated Self-Administered 24-hour Dietary Assessment Tool (ASA24-Canada); the ASA24 data were not used in the present analyses. The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 21631).

4.2 Canada Food Study recruitment and sample

The sample was recruited from five major Canadian cities (Edmonton (AB), Halifax (NS), Montreal (QC), Vancouver (BC) and Toronto (ON)) from October to December 2016. Each city was stratified into regions based on neighbourhood boundaries, and each region contained two sites for participant recruitment (100). The recruitment sites were one of four pre-selected public areas, including parks, transit hubs, malls or other shopping districts (100). At each site, trained research assistants employed systematic sampling techniques, which consisted of approaching people who appeared to be within the study's target age range of 16 to 30 years of age and who passed a designated landmark with an invitation to participate in the study (100). Specifically, potential participants were asked if they were interested in enrolling in a panel for an online study about food choices being administered by the University of Waterloo. Respondents were informed they would receive $2 for enrolling in the study and a $20 Interac e-transfer after completing the main survey and the two ASA24 24-hour recalls (100). Individuals were eligible to participate if they were between the ages of 16 to 30 years at the time of recruitment; had internet access and access to a desktop computer, tablet or laptop; had not previously enrolled in the study panel and resided in one of the five recruitment cities (100). Recruitment was conducted simultaneously across the five cities every day of the week to avoid potential unintended time-related effects on data collection. Recruitment was conducted in English in all cities as well as in French in Montreal (100).

Participants recruited in-person were emailed a personalized link to the survey using SurveyGizmo one day after recruitment, with a maximum of four email reminders sent 2, 4, 7 and 10 days after the initial invite (100). Clicking the link directed participants to the main survey, which prompted them to complete the survey on a tablet, laptop or desktop computer,

although completing the survey via smartphone was not prohibited. Participants were then asked to re-confirm their eligibility. Overall, 6,720 participants were recruited and emailed invitations to the main survey and 3,234 (48.1%) accessed the survey link. Of the participants who accessed the survey link, 2,795 completed the survey (86.4%) and 439 partially completed the survey (13.6%). After exclusion of respondents whose data failed to meet the data quality standards (i.e. selected the wrong month when asked to select the current month from a list) (n=41) and two respondents for other concerns (i.e. suspicious or unusual answers), the final sample consisted of 3,000 participants (100).

For the present analyses, participants with missing data for vomiting to lose weight (n=107), binge eating (n=126), preoccupation with thinness (n=110) and current student status (n=4) were removed. The number of participants who provided a non-binary gender response was too small to provide reliable estimates (n=40) and these individuals were thus also removed from the sample, leaving individuals who identified as a man or a woman. The sum of participants with missing information who were deleted from each of the above variables is less than the sum of actual participants excluded from the analytic sample (n=169) because some participants with missing data for one variable also had missing data for another variable. The final analytic sample included 2831 respondents.

4.3 Measurement Tools

4.3.1 Household Food Insecurity Survey Module (HFSSM)

Household food security status was measured using a version of the 18-item HFSSM that was adapted by Health Canada for use in Canadian surveillance (37) (Table 1). The HFSSM was developed in the United States, where it has been administered yearly since 1995 (43). The HFSSM has been shown to have high validity in capturing experiences of household food insecurity in Canada and across diverse populations (43,101).

The HFSSM measures inadequate, insufficient or uncertain access to food resulting from limited financial resources at the household level (43). The survey module captures compromised or maladaptive food consumption or resource utilization behaviours, such as relying on low-cost food, as indicators of food insecurity (43). The questions range in severity, from worrying about food running out to adults and children not eating for a whole day (43). The HFSSM does not capture the individual experiences of all members of the household, but rather, evaluates indications of food insecurity among adults and among children <18 years in the household. Ten of the 18 questions capture adult experiences, whereas the remaining 8 questions capture the experiences of children (43), as reported by an adult. The questions are asked in three stages, with an affirmation to a question in one stage moving the respondent to the subsequent stage, reducing the burden for those who are not affected by food insecurity or by manifestations of severe food insecurity.

Typically, the HFSSM is administered to an adult who responds on behalf of all adults and children in the household. Although some CFS respondents were under the age of 18 years, the HFSSM was administered to all respondents. A food sufficiency question about their food situation during the previous year was first asked. Participants could answer that they 1) always had enough of the kinds of foods they wanted to eat; 2) had enough but not always the kinds of food they wanted to eat; 3) sometimes did not have enough to eat; or 4) often did not have enough to eat (39). The responses to this question did not directly contribute to determination of food security status, but respondents who answered 3) or 4) were administered the first and second stages of the HFSSM questions (i.e., they were automatically considered to be affected by at least marginal food insecurity) regardless of whether they affirmed a question in the first stage of the HFSSM (39).

Based on the number of affirmative responses, the HFSSM can be used to classify households into four categories; food secure, marginally food insecure, moderately food insecure and severely food insecure (37,39). Consistent with the Health Canada approach to coding responses to the HFSSM, food security was characterized by 0 affirmative responses, marginally food insecure was characterized by 1 affirmative response, moderately food insecure was characterized by 2 to 5 affirmative responses to the adult items and 2 to 4 affirmative responses to the child items, and severely food insecure was characterized by ≥ 6 affirmative responses to the adult items and ≥ 5 responses to the child items (39). The Health Canada coding approach is less conservative than the standard U.S. method (34,39), which means caution is warranted when comparing prevalence estimates across countries.

Table 1: Canada Food Study Food Security Questions (adapted from the CCHS Household Food Security Survey Module)

	Adult Food Security Scale	
	Question	**Reponses**
Food sufficiency question	Q1. Which of the following statements best describes the food eaten in your household in the past 12 months, that is since [current month] of last year?	-You and other household members always had enough of the kinds of foods you wanted to eat. -You and other household members had enough to eat, but not always the kinds of food you wanted. -Sometimes you and other household members did not have enough to eat. -Often you and other household members didn't have enough to eat.
	Now you will see several statements that may be used to describe the food situation	-Never true -Sometimes true

	for a household. Please indicate if the statement was often true, sometimes true, or never true for you and other household members IN THE PAST 12 MONTHS. Q2. You and other household members worried that food would run out before you got money to buy more.	-Often true
	Q3. The food that you and other household members bought just didn't last, and there wasn't any money to get more.	-Never true -Sometimes true -Often true
	Q4. You and other household members couldn't afford to eat balanced meals.	-Never true -Sometimes true -Often true
	Q5. In the past 12 months since last [current month] did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?	-Yes -No
	Q5b. [If yes to Q5] How often did this happen?	-Only 1 or 2 months -Some months but not every month -Almost every month
	Q6. In the past 12 months, did you (personally) ever eat less than you felt you should because there wasn't enough money to buy food?	-Yes -No
	Q7. In the past 12 months were you (personally) ever hungry but didn't eat because you couldn't afford enough food?	-Yes -No
	Q8. In the past 12 months, did you (personally) lose weight because you didn't have enough money for food?	-Yes -No
	Q9. In the past 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?	-Yes -No
	Q10. How often did this happen?	-Only 1 or 2 months -Some months but not every month -Almost every month
	Child Food Security Scale	
	Question	**Responses**
	The next statements may describe the food situation in the past 12 months for households with children.	-Never true -Sometimes true -Often true

	Q11. You or other adults in your household relied on only a few kinds of low-cost food to feed the child(ren) because you were running out of money to buy food.	
	Q12. You or other adults in your household couldn't afford to feed the child(ren) a balanced meal, because you couldn't afford it.	-Never true -Sometimes true -Often true
	Q13. The child(ren) were not eating enough because you and other adults members of the household just couldn't afford enough food.	-Never true -Sometimes true -Often true
	Q14. In the past 12 months, did you or other adults in your household ever cut the size of any of the children's meals because there wasn't enough money for food?	-Yes -No
	Q15. In the past 12 months, did any of the children ever skip meals because there wasn't enough money for food?	-Yes -No
	Q16. How often did this happen?	-Only 1 or 2 months -Some months but not every month -Almost every month
	Q17. In the past 12 months, were any of the children ever hungry but you just couldn't afford more food?	-Yes -No
	Q18. In the past 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food?	-Yes -No

4.3.2 Eating Attitudes Test-3 (EAT-3)

Indicators of disordered eating were measured using the EAT-3 (102). The EAT-3 tool was developed as a short form version of the EAT-26 (102), a commonly used instrument for measurement of disordered eating behaviours and attitudes to aid in diagnosis of eating disorders (103). The EAT-3 consists of three questions, two related to behaviours and one related to attitude (102). Participants were asked how often in the past three months they had gone on eating binges, defined as eating a large amount of food while feeling out of control, and how often they had vomited to control weight. They could respond to both queries with "Never", "Less than 1 time a month", "1 to 3 times a month", "Once a week", "2 to 6 times a week", "Once a day", "More than once a day", "Don't know", or "Refuse to answer". Participants were

also asked how frequently they felt preoccupied with a desire to be thinner and could respond on a scale from "Always", "Usually", "Often" "Sometimes", "Rarely", and "Never".

Dichotomous variables were developed for each of the behavioural items and attitudinal item, confirming whether a participant affirmed the item or did not affirm the item. Using the coding approach described by Haines et al. (102), men and women were considered to meet the cut-off for affirmative answers to the binge and vomit items if they responded with at least "1 to 3 times a month". Women met the cut-off for an affirmative answer for the preoccupation with thinness item if they responded "Always" or "Usually", whereas men met the cut-off for an affirmative answer if they answered "Always", "Usually" or "Often". Individuals who affirmed the attitudinal item and at least one of the behavioural items (i.e. vomit and preoccupation with thinness, binge and preoccupation with thinness, or all three) are considered to be at risk of an eating disorder (102), indicated by a dichotomous variable.

The EAT-3 tool has been shown to predict risk of developing an eating disorder with good sensitivity and specificity among young males and females (102). The behavioural items yielded high specificity and low sensitivity respectively, and the attitudinal item yielded both high specificity and high sensitivity, consistent with other research (102). Although the original study considered sex and not gender, the difference in the cut-point may reflect that men are not as likely to be as motivated by thinness as women when exhibiting disordered eating behaviours, and may instead be driven by muscularity (72,104,105). The sex difference in cut-points for the attitudinal item was determined by receiver operating characteristic analysis, which determined the optimal trade-off between specificity and sensitivity for predicting case status, measured by EAT-26 total score (case = EAT-26 score ≥ 20) (102).

4.4 Covariates

Covariates were determined based on previous research demonstrating their potential correlation with disordered eating and food insecurity (69,73,106). Age was ascertained with the question, "How old are you?" to assess study eligibility, and respondents were prompted to enter their numeric age in years. Age was included in the analyses as a categorial variable, derived into categories determined by the CFS study team. Gender was assessed with the question, "What is your current gender identity?" and respondents could answer "Man", "Woman", "Trans male/trans man", "Trans female/trans woman", "Genderqueer/Gender non-conforming" or a different identity in an open-ended response, as recommended by the Canadian Institute for Health Research (107). Any response other than "Man" or "Woman" was considered a non-binary identity and was excluded from the sample, as noted previously. Current student status was determined by the question, "Are you currently a student?" and participants could answer with "No", "Yes, full-time", "Yes, part-time" or select an option indicating "Don't know" or "Refuse to answer" (100).

Race/ethnicity was assessed with the statement, "People living in Canada come from many different cultural and racial backgrounds. Are you…", and participants were then prompted to select the racial or ethnic identities they identified as from a given list. Participants also had the option to self-identify as Indigenous, which included First Nations, Métis and Inuit. A variable derived by the study team was used in this study and included six categories; White only, Chinese only, South Asian only, Black only, Indigenous and Mixed/other/not stated/missing, a category encompassing all individuals whose answer fell outside of the previous five categories (100).

Perceived income adequacy was evaluated with the question, "Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?" and a Likert scale ranging from "Very difficult" to "Very easy". Another variable measuring income in dollars was available; however, the perceived income variable was selected as it evaluates the participants' experience with their income, which aligns with the experience-based nature of the HFSSM questions (101). A category capturing participants who responded with "Don't Know"/"Refuse to answer" or who did not provide a response for the question was also included in the analysis as income can be a sensitive question, and a missing response could be indicative of a participants' inadequate perception of their income or a desire to not disclose potentially sensitive information (108).

4.5 Statistical analyses

All analyses were conducted with SAS® Studio software (Copyright © 2021 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA).

Descriptive characteristics of the sample were calculated using the survey frequency procedure to account for the survey design. Covariates were stratified by gender to compare potential differences in prevalence between men and women respondents.

Multivariable logistic regression was used to assess the association between household food insecurity and each of the individual disordered eating behaviours: vomiting, bingeing and preoccupation with thinness. Multivariable logistic regression modeling was also used to assess the association between household food insecurity status and eating disorder risk. Models included adjustments for age, race/ethnicity, perceived income adequacy, student status and gender (22,67,109). Models were not stratified by gender due to a lack of statistical power as fewer men responded affirmatively to EAT-3 measures compared to women, particularly for the vomiting to lose weight item.

Each of the models has multiple adjusted effect estimates presented in a table, however the covariates were not interpreted as the primary effect was the association between household food insecurity and disordered eating behaviours and risk of eating disorder. The covariates were

included in each model as potential confounders for food insecurity and disordered eating, so it is considered inappropriate and misleading to interpret and present the odds ratios for these confounders as part of the results (110). For the sake of clarity and alignment with the a priori research objectives, only the main effects (household food insecurity vs. disordered eating behaviour/risk of eating disorder) were reported in the results.

To account for the complex survey design and resulting stratified nature of the data and avoid treating the data as a simple random sample drawn from an infinite population (111), survey procedures (i.e., PROC SURVEYFREQ, PROC SURVEYLOGISTIC) were used. The cities in which recruitment occurred were specified as the strata and post-stratification weights used. The post-stratification weights were created by the CFS study team, based on 2016 CANSIM postcensal tables population estimates from Statistics Canada (100). Weights were calculated as population proportion over sample proportion for each age by sex group, to ensure alignment between sample weights and known population proportion (100).

5.0 Results

5.1 Sample demographics

Approximately half of participants identified as a man (50.8%) and White only (46.9%). The majority of participants were between the ages of 26 to 30 years (35.2%), followed by 22 to 25 years (28.4%), 19 to 21 years (19.8%) and 16 to 18 years (16.6%). Over half identified as a full-time student (52.6%), followed by not a student (40.7%), while the remainder indicated being a part-time student (6.7%). In terms of income adequacy, over a third of participants reported it was neither easy nor difficult to make ends meet (37.7%), followed by very easy or easy (27.6%), very difficult or difficult (22.6%) while the remaining participants answered they did not know, refused to answer, or did not respond (12.1%).

Over half of participants lived in food-secure households (58.8%), while 1 in 5 (20.8%) lived in moderately-food insecure households, 1 in 10 (10.8%) lived in marginally food-insecure households and 1 in 10 (9.6%) lived in severely food-insecure households. A somewhat greater percentage of men lived in moderately food-insecure households (22.4%) compared to women (19.1%) and a greater share of women lived in severely food-insecure households (10.5%) compared to men (8.8%) (Table 2). A majority of both men (58.3%) and women (59.3%) did not report a sufficient number of affirmations for the HFSSM questions, and thus were considered to be food secure (Table 2).

In terms of disordered eating behaviours and attitudes, almost a third of the sample reported at least one episode of binge eating in the previous month (28.9%) and over 2 in 10 (22.2%) reported a preoccupation with thinness a majority of the time. A similar percentage of men reported binge eating (28.0%) compared to women (29.9%), and the share of women (22.9%) and men (21.6%) reporting being preoccupied with thinness a majority of the time was similar as well (Table 2). One in 20 (5.6%) reported vomiting to control their weight at least once in the previous month, although a somewhat larger share of women reported vomiting (7.3%) compared to men (4.1%). Altogether, more than 1 in 10 (12.2%) participants met the criteria for risk of an eating disorder according to the EAT-3 measure, with over 1 in 10 women (12.4%) and men (10.3%) meeting the respective cut-offs (Table 2).

Table 2: Household food security status, demographic characteristics, and indicators of disordered eating among young adults living in urban centres, Canada Food Study 2016, stratified by gender (n=2831)[a]

	Men (n=1438)	Women (n=1393)
Variable	n (%)	n (%)
Household Food Security Status		
Secure	838 (58.3)	826 (59.3)

Marginal	151 (10.5)	154 (11.1)
Moderate	323 (22.4)	266 (19.1)
Severe	126 (8.8)	147 (10.5)
Age (years)		
16 to 18	242 (16.8)	228 (16.3)
19 to 21	287 (19.9)	275 (19.7)
22 to 25	410 (28.5)	393 (28.3)
26 to 30	499 (34.7)	497 (35.7)
Student Status		
Not a student	597 (41.5)	557 (40.0)
Full-time student	762 (53.0)	726 (52.1)
Part-time student	79 (5.5)	110 (7.9)
Perceived Income Adequacy		
Neither easy nor difficult	525 (36.5)	543 (39.0)
Very difficult or difficult	332 (23.0)	308 (22.1)
Very easy or easy	395 (27.5)	387 (27.8)
Don't know/Refused/Missing	186 (13.0)	155 (11.1)
Race/Ethnicity		
White only	616 (42.9)	711 (51.1)
Chinese only	129 (9.0)	108 (7.8)
South Asian only	119 (8.2)	77 (5.5)
Black only	78 (5.4)	77 (5.5)
Indigenous	57 (4.0)	48 (3.4)
Mixed/Other/Not stated/Missing	439 (30.5)	372 (26.7)
Vomit to control weight		
Yes	59 (4.1)	102 (7.3)
No	1379 (95.9)	1291 (92.7)
Binge eating		
Yes	403 (28.0)	417 (29.9)
No	1035 (72.0)	976 (70.1)
Preoccupied with Thinness		
Yes	310 (21.6)	319 (22.9)
No	1128 (78.4)	1074 (77.1)
Risk of Eating Disorder (EAT-3)		
At risk	148 (10.3)	173 (12.4)
Not at risk	1290 (89.7)	1220 (87.6)

5.2 Models

5.2.1 Vomited to control weight

Heightened odds of engaging in vomiting to control weight were observed among those living in moderately food-insecure households (Adjusted Odds Ratio=2.76; 95% CI=1.75-4.35) or severely food-insecure households (AOR=4.52; 95% CI=2.45-8.33) compared to those living in food-secure households (Table 2). There was no difference in the odds of vomiting to control weight among those living in marginally food-secure households compared with those living in food-secure households.

Table 3: Adjusted odds ratio estimates for household food security status and odds of vomiting to control weight in the past three months, Canada Food Study 2016 (n=2831) [a][b]

Covariate	Adjusted odds ratio (95% CI)
Household Food Security Status	
Secure	1.00
Marginal	1.09 (0.54-2.18)
Moderate	**2.76 (1.75-4.35)**
Severe	**4.52 (2.45-8.33)**
Age (years)	
16 to 18	1.00
19 to 21	0.79 (0.51-1.23)
22 to 25	0.80 (0.47-1.36)
26 to 30	0.77 (0.42-1.41)
Student Status	
Not a student	1.00
Full-time student	1.49 (0.92-2.42)
Part-time student	2.03 (1.00-4.1)
Perceived Income Adequacy	
Neither easy nor difficult	1.00
Very difficult or difficult	0.72 (0.45-1.17)
Very easy or easy	1.01 (0.60-1.71)
Missing/Don't know/Not stated	1.22 (0.69-2.15)
Gender	
Man	1.00

Woman	1.85 (1.27-2.69)
Race/Ethnicity	
White only	1.00
Indigenous	1.16 (0.53-2.56)
Black only	0.85 (0.41-1.76)
Chinese only	1.13 (0.59-2.15)
South Asian only	1.29 (0.65-2.58)
Mixed/Other/Not Stated/Missing	0.78 (0.50-1.20)

[a]All estimates are weighted [b]Bolded values are significant based on 95% CI

5.2.2 Binge eating

Marginal household food insecurity (AOR=1.52; 95% CI 1.13-2.04), moderate household food insecurity (AOR=1.71; 95% CI=1.33-2.19) and severe household food insecurity (AOR=1.73; 95% CI=1.22-2.46) were all associated with significantly higher odds of engaging in binge eating compared to household food security (Table 3).

Table 4: Adjusted odds ratio estimates for household food security status and odds of binge eating in the past three months, Canada Food Study 2016 (n=2831) [ab]

Covariate	Adjusted odds ratio (95% CI)
Household Food Security Status	
Secure	1.00
Marginal	**1.52 (1.13-2.04)**
Moderate	**1.71 (1.33-2.19)**
Severe	**1.73 (1.22-2.46)**
Age (years)	
16 to 18	1.00
19 to 21	0.79 (0.62-1.01)
22 to 25	0.77 (0.59-1.01)
26 to 30	0.76 (0.56-1.07)
Student Status	
Not a student	1.00
Full-time student	1.00 (0.78-1.27)
Part-time student	0.94 (0.63-1.40)
Perceived Income Adequacy	
Neither easy nor difficult	1.00

Very difficult or difficult	1.17 (0.90-1.51)
Very easy or easy	0.94 (0.73-1.21)
Missing/Don't know/Not stated	0.98 (0.72-1.32)
Gender	
Man	1.00
Woman	1.14 (0.95-1.37)
Race/Ethnicity	
White only	1.00
Indigenous	1.40 (0.86-2.28)
Black only	1.00 (0.66-1.51)
Chinese only	1.05 (0.72-1.53)
South Asian only	1.80 (1.24-2.58)
Mixed/Other/Not Stated/Missing	1.18 (0.93-1.48)

[a]All estimates are weighted [b]Bolded values are significant based on 95% CI

5.2.3 Preoccupation with thinness

Increased odds of being preoccupied with thinness were observed among participants living in households affected by moderate household food insecurity (AOR=1.46; 95% CI=1.12-1.91) and severe food insecurity (AOR=1.59; 95% CI=1.07-2.36) compared to those in food-secure households (Table 4). Marginal household food insecurity, when compared to household food security, was not associated with preoccupation with thinness.

Table 5: Adjusted odds ratio estimates for household food security status and odds of feeling preoccupied with thinness always or most of the time, Canada Food Study 2016 (n=2831) [ab]

Covariate	Adjusted odds ratio (95% CI)
Household Food Security Status	
Secure	1.00
Marginal	1.04 (0.75-1.44)
Moderate	**1.46 (1.12-1.91)**
Severe	**1.59 (1.07-2.36)**
Age (years)	
16 to 18	1.00
19 to 21	0.92 (0.71-1.19)
22 to 25	0.77 (0.58-1.03)

26 to 30	0.77 (0.55-1.08)
Student Status	
Not a student	1.00
Full-time student	1.14 (0.88-1.48)
Part-time student	1.04 (0.67-1.64)
Perceived Income Adequacy	
Neither easy nor difficult	1.00
Very difficult or difficult	1.41 (1.06-1.87)
Very easy or easy	1.13 (0.86-1.48)
Missing/Don't know/Not stated	1.05 (0.76-1.46)
Gender	
Man	1.00
Woman	1.13 (0.93-1.39)
Race/Ethnicity	
White only	1.00
Indigenous	1.20 (0.71-2.04)
Black only	0.84 (0.53-1.32)
Chinese only	1.36 (0.94-1.95)
South Asian only	2.07 (1.40-3.07)
Mixed/Other/Not Stated/Missing	1.43 (1.12-1.85)

[a]All estimates are weighted [b]Bolded values are significant based on 95% CI

5.2.4 Risk of eating disorder

Risk of eating disorder, as determined by EAT-3 score, was associated with two levels of household food security when modelled using survey logistic regression. Moderate household food insecurity (AOR=1.53; 95% CI=1.07-2.17) and severe household food insecurity (AOR=2.05; 95% CI=1.24-3.37) were both associated with heightened odds of being at risk of an eating disorder when compared to respondents living in food-secure households (Table 5). Being in a marginally food-insecure household had no association with risk of eating disorder when compared to being in a food-secure household.

Table 6: Adjusted odds ratio estimates for household food security status and odds of being determined to be at risk of eating disorder, Canada Food Study 2016 (n=2831)[ab]

Covariates	Adjusted odds ratio (95% CI)
Household Food Security Status	

Secure	1.00
Marginal	1.43 (0.95-2.14)
Moderate	**1.53 (1.07-2.17)**
Severe	**2.05 (1.24-3.37)**
Age (years)	
16 to 18	1.00
19 to 21	0.89 (0.64-1.23)
22 to 25	0.84 (0.57-1.22)
26 to 30	0.98 (0.63-1.52)
Student Status	
Not a student	1.00
Full-time student	1.42 (0.99-2.04)
Part-time student	1.19 (0.67-2.11)
Perceived Income Adequacy	
Neither easy nor difficult	1.00
Very difficult or difficult	1.16 (0.81-1.68)
Very easy or easy	1.13 (0.79-1.61)
Missing/Don't know/Not stated	0.85 (0.54-1.33)
Gender	
Man	1.00
Woman	1.29 (0.99-1.69)
Race/Ethnicity	
White only	1.00
Indigenous	1.39 (0.70-2.76)
Black only	1.07 (0.60-1.90)
Chinese only	1.54 (0.97-2.46)
South Asian only	1.93 (1.19-3.13)
Mixed/Other/Not Stated/Missing	1.44 (1.04-2.01)

[a]All estimates are weighted [b]Bolded values are significant based on 95% CI

6.0 Discussion
6.1 Findings Relative to the Research Objectives

Almost half of the study participants were categorized as living in food-insecure households and more than 1 in 10 participants were found to be at risk of an eating disorder. Further, household food insecurity was associated with higher odds of all three indicators of disordered eating, as well as risk of an eating disorder. These results are worrisome given the numerous adverse health consequences associated with disordered eating behaviours and food insecurity (7,11,12,78,99), as well as the cumulative negative effects these conditions have at the population level and on larger systems, such as increased burden on the healthcare system (9,58). The potential link between food insecurity and disordered eating/risk of eating disorder challenges the idea that eating disorders are experienced only by people with higher socioeconomic status and raises concerns about who can access treatment for eating disorders and how effective existing treatments are at addressing the needs of communities (such as food-insecure households) pushed to the margins of society (112).

Evidence of a graded association between food insecurity and disordered eating and eating disorder risk in this sample is consistent with emerging literature, the vast majority of which examines American populations (27,30,54,65,91). Previous studies have looked at a variety of groups including children (98), adolescents (12,26), adults who access food banks (22,23,112) among others, and have measured associations including binge eating, various compensatory behaviours including vomiting, laxatives and excessive exercise and overall eating disorder pathology and risk (26,27,30,31,91,113). The current body of literature consists of studies primarily cross-sectional in nature, save for a qualitative study (98) and two longitudinal studies examining postpartum pregnant women at two time points and adolescents and young adults at two time points respectively (97,114). Despite these differences in study design, population and measures, results have consistently demonstrated that among adults, food insecurity is associated with higher odds of binge eating, compensatory behaviours and eating disorder pathology and diagnoses, and effects were calculated as being typically small to medium in size (30). The collective findings of previous studies align with the results of this thesis, which demonstrate that the observed associations may very well represent true associations and suggests that the same association may exist in Canada.

Nonetheless, there are differences in the experiences of Americans and Canadians that should be considered, largely shaped by the unique cultural and political landscapes. While previous American studies are relevant and largely comparable, they are not entirely applicable to or synonymous with the experiences of Canadians. For instance, the Supplemental Nutrition Assistance Program (SNAP), previously known as food stamps, is one of a large landscape of food assistance programs within the US meant to address food insecurity, with this approach shaping the American perspective and lexicon regarding food insecurity (95) and has been

hypothesized to exacerbate the binge/restrict disordered eating cycle by only providing a once-a-month payout to recipients (95,115). Thus, including a Canadian perspective is paramount to expanding the understanding of food insecurity and disordered eating and how populations in different countries may have differential associations and experiences.

The association between living in households affected by moderate or severe household food insecurity and vomiting to lose weight is consistent with prior work that has shown an elevated risk of bulimia-spectrum pathology among individuals who experience food insecurity (31). Vomiting to control weight is a compensatory behaviour used to either aid in weight loss or to counteract for overeating (23), and bulimia is an eating disorder diagnosed when a patient presents symptoms of binge eating and purging, typically vomiting (67). The link between food insecurity and vomiting to lose weight may relate to the previously hypothesized externally imposed binge/purge cycle that may characterize experiences of food insecurity (22,28,112). This hypothesized cycle also supports the results of this thesis on all levels of household food insecurity and increased odds of bingeing, as bingeing and purging behaviours are associated as part of eating disorder pathology and align with previous research on food insecurity and disordered eating (23,28). The externally-imposed dietary restriction on food-insecure households that may drive binge eating and compensatory behaviours differs from intentional dietary restraint where individuals are driven to binge eat and compensatory behaviours by a weight/shape/thinness motivation (22). While the results demonstrating significant associations between food insecurity and vomiting and binge eating support the previous literature, more longitudinal research should be done to establish the potential causal and/or cyclical nature of the association.

Moderate household food insecurity and severe household food insecurity were associated with higher odds of being preoccupied with thinness in this sample. It is generally understood that thinness preoccupation can be a driver of eating disorders (116), but the relationship between thinness preoccupation and food insecurity, and where/if thinness preoccupation lies along the hypothesized causal pathway between food insecurity and eating disorders, is less understood. Previous literature posits that people in food-insecure households who experience dietary restraint are not doing so because of weight or shape concerns but for alternative reasons such as sacrificing their own food to provide for other members of the household (22,23). It appears likely that the association between food insecurity and thinness preoccupation may be mediated by another unknown variable in this model. More research is needed to explain the mechanism of food insecurity and thinness preoccupation, and how potential confounders or mediators may modulate the association.

Almost half of the young adults and adolescents sampled were categorized as living in food-insecure households, which is drastically higher than the most recent estimate of household food insecurity of 12.7% in the 2017-18 CCHS (1). Among youth aged 12-24 years in the 2017-

18 CCHS, one in seven (14.8%) were determined to be living in a food-insecure household (117), which is higher than the prevalence of household food insecurity among the full population as well, but lower than the estimate from this study. The high rate in this sample could be because younger Canadians are more susceptible to household food insecurity due to the higher likelihood of having more precarious income sources, less time spent at maximum earning potential in a full-time job position, and limited access to social services that provide adequate support (56,118). Further, evidence suggests post-secondary students experience an elevated risk of food insecurity compared to the general population (49,52,57). Nearly half (48.2%) of study participants were between the ages of 19 to 26 years, and over half (52.6%) reported being full-time students, which means a large percentage of the CFS population were likely full-time post-secondary students and therefore at higher risk of experiencing household food insecurity based on previous evidence (52).

As previously mentioned, American studies that use the HFSSM tend to use different cut-offs than the coding approach applied in Canada, which is less conservative in evaluating food insecurity as it incorporates a lower threshold to account for marginal household food insecurity (one affirmative answer on the HFSSM) (37). Marginal food insecurity captures worry about having enough food, with the findings of this study consistent with others in suggesting that worry about food alone may be sufficient enough to be associated with an increased risk of poor health outcomes (58). By not including a separate category, marginally food-insecure households may be erroneously classified as food secure despite evidence to suggest marginal should be a distinct consideration (119). The potential for misclassification has ramifications for how household food insecurity is measured in research and could potentially bias results towards the null (119,120).

More than 1 in 10 participants were found to be at risk of an eating disorder in this sample. This prevalence poses a concern as eating disorders have some of the most severe consequences of all mental health conditions, including associations with various other comorbidities (14,121,122) and a high mortality rate (77,78). There is very little available data on the prevalence of eating disorder risk among young adults across Canada; however, some recent research provides evidence that 15% of women and 8% of men aged 15 to 71 in Alberta were found to experience clinically significant eating disorder pathology based on the Eating Disorder Examination Questionnaire (EDE-Q) (123). Some evidence from studies in other countries has placed the eating disorder risk prevalence at different rates than reported in this thesis. For instance, a study of adolescents aged 10-18 years in Austria using the SCOFF questionnaire found that 31% of girls and 15% of boys screened positive for risk of an eating disorder (124), and another study of undergraduate and postgraduate students at an American university found that 17% of women and 6% of men were at risk of an eating disorder when measured with the EDE-Q (65). It is difficult to know whether the rates of eating disorder risk

among this study population are generalizable when so little Canadian data is available as a comparison; however, looking to other countries suggest that eating disorder risk rates vary based on population and measurement tool used. More research is needed to draw a stronger conclusion about the prevalence of eating disorder risk among adolescents and young adults in Canada.

The EAT-3 tool is a brief form of the EAT-26, which offers a more in-depth look at disordered eating behaviours and comprehensive eating disorder risk assessment. It stands to reason that the different measures are not 1:1 comparable across studies, and a brief measure of eating disorder risk likely might not capture the entire spectrum of disordered eating behaviours. A brief measure may have also underestimated the risk of eating disorder among the sample population, leading to potentially and unknowingly biased results that do not represent the true scope of eating disorder risk or the association with food insecurity. However, there is a lack of information available from Canadian sample populations regarding eating disorder risk and minimal information detailing the prevalence of eating disorders across Canada (3,14,123). It is not possible to fully evaluate how accurately the EAT-3 tool assessed the prevalence of eating disorder risk in Canada when so little Canadian data exists but based on findings from other countries showing a higher prevalence of risk in adolescent and emerging adult populations (65,124), the overall estimate in this thesis may be a undercalculation.

Considering that household food insecurity is likelier to effect lower-income households, and eating disorders are typically thought to impact higher-income individuals, evidence for their potential association has implications for how we frame food insecurity and eating disorders. What was previously thought to be known about the correlates of food insecurity and disordered eating implicitly suggested that both conditions were diametrically opposite in affected demographic groups but linking the two together alters that assumption. Lower-income households and other groups marginalized by society may experience disordered eating as a possible result of food insecurity, which has numerous implications for how these conditions should be framed by researchers and addressed by policymakers and clinicians. Policies and treatments for food insecurity and eating disorders should be mindful and adopt a social justice lens to create more equitable access to interventions and better outcomes across all groups.

Some emerging research has posited that both disordered eating behaviours and food insecurity have increased in prevalence during the 2020 COVID-19 pandemic. Statistics Canada reported that food insecurity impacted one in 7 households (14.6%) in May 2020 (125,126), and other evidence suggested that individuals who lost their jobs due to pandemic related disruptions were more likely to face food insecurity (126). Evidence also suggested that living in a food-insecure household increased the likelihood of reporting poor or fair mental health, as well as moderate or severe anxiety symptoms when compared to food-secure households (125) suggesting that COVID-19-triggered food insecurity could impact mental health. Indeed, during

the same time period, as social activities and general movement were restricted and individuals were encouraged to stay home, disordered eating behaviours and attitudes increased as well (127,128). There are many possible reasons for the suspected increase in disordered eating such as increased risk due to social isolation, disruption of daily activities, modifications in exercise or sleeping patterns, media exposure and fear of contagion (128). Alongside the risk increase, many individuals also experienced a decrease in protective capacity against eating disorders including limited access to social supports or treatments and reduced emotional regulation that made them more susceptible to the risk factors of eating disorders (128). Evidence suggests that the COVID-19 pandemic could have tangentially increased the rate of food insecurity and disordered eating due to the shared risk factors brought about by political and economic responses to the pandemic (129). Research examining how food insecurity and disordered eating interact within the broader context of a global pandemic that has, among other serious consequences, caused harmful disruptions to health, income, food security and relationships with food, would be valuable for creating holistic policies and interventions that address short- and long-term consequences (129).

6.2 Limitations

There are many strengths of this study that allow for robust results and interpretation, such as the use of a comprehensive validated measure for household food insecurity that allowed for consideration of marginal food insecurity, and the use of population weights in analysis to allow for results more representative of the general Canadian population. However, there are some limitations present in the research that required mitigation and consideration.

The cross-sectional design did not allow for an analysis of temporality and precludes causal inferences. Thus, the direction of the association should be studied in cohorts using longitudinal analysis techniques. In any study where participants can self-select to participate, there may be selection bias based on who is more likely to participate in research. While population-specific weights were calculated to make the analyses more representative of the general Canadian young adult population, participants were only sampled from urban centres and thus this data may not be an adequate representation of Canadians living in rural or remote areas.

The HFSSM is designed for use by adults 18 years or older (130) but some study participants were under the age 18 years when they responded to the HFSSM questions. Correspondingly, the responses from people under 18 may not be entirely valid within the context of the study. However, some research has suggested that children under 18 years of age are aware of the food security status of the households they live in (131), so the results may be more accurate that previously understood.

The EAT-3 tool is a brief screening tool and may not be sensitive enough to detect every participant at risk for an eating disorder or capture people who are at risk for eating disorders but do not experience the disordered symptoms that inform the EAT-3. For instance, there is

evidence to suggest men are likelier to experience a drive for muscularity rather than a preoccupation with thinness, yet still be at risk for an eating disorder (72,104,132). People who do not identify as having a preoccupation with thinness in particular, but still experience a general preoccupation with body shape would likely be considered at risk of an eating disorder when displaying other disordered eating behaviours, but this distinction would not necessarily be captured by the EAT-3 tool.

The race/ethnicity variable collapses multiple survey responses down into six categories for the purpose of analysis, so this variable does not accurately represent the spread of diverse racial/ethnic identities that exist in Canada. Perceived income adequacy has a significant amount of missing data which is to be expected as it is a more sensitive question prone to non-response and biased estimates like other income-related variables (133). Higher income is typically associated with a missing response on income-related questions, so the amount of missing data could have implications on how accurately the perceived income adequacy variable adjusted the models. A category representing the missing data was included in the model in an attempt to account for the potential impact of the missing data on the association between the exposure and outcome variables.

6.3 Policy implications

The prevalence of both household food insecurity and disordered eating behaviours and risk of eating disorder among young adults in Canada highlights the need for interventions at the population level that emphasizes the need for systems thinking to inform effective programs and policies. The association between these conditions also suggests that lower cost eating disorder treatments are needed to address noted inequities in treatment access.

For instance, many academics who study food insecurity are proponents of universal basic income (UBI) as a policy solution that would address the posited root cause of household food insecurity as a lack of financial resources (20). There is some evidence to suggest guaranteed income supports such as OAS or the Canada Child Benefit, are protective against food insecurity (61,134) so it stands to reason that a universal income support would lead to decreases in household food insecurity, and thus lead to a decrease in the prevalence of disordered eating behaviours and risk of eating disorders across the population. A population level strategy such as UBI would also have implications for how eating disorders are treated, as such a broad strategy would likely see a decrease in eating disorders among those affected by the externally imposed binge and restrict cycle that may follow from experiences of food insecurity.

To have the greatest impact on household food insecurity and disordered eating/risk of eating disorder from a policy standpoint, universal basic income should be considered as part of a network of policies that adequately addresses food insecurity, disordered eating and their supposed link. For instance, a majority of Canadian households affected by food insecurity are

reliant on employment for a wage or salary according to the most recent CCHS data (1), which suggests minimum wage and/or labour laws do not provide a number of households with adequate financial resources to achieve and maintain food security. There is also evidence that approximately 60% of Canadians households who access social services, like social assistance and disability supports, experience food insecurity (1), which suggests benefit levels are not adequate. The implementation of a universal basic income would help households achieve food security and possibly prevent disordered eating behaviours, but it would not solve the problems of labour exploitation or inequitable welfare systems that lead to such financial precarity in the first place.

In a similar vein, while implementing UBI may solve one upstream determinant of disordered eating, many studies have suggested that disordered eating behaviours and eating disorders are influenced by other upstream systems, such as the billion-dollar diet and weight-loss industry and dominant cultural ideals of thinness (135) that implementing a UBI program would not be able to fully address. Additionally, some governing bodies may see UBI/BIG programs as a justification to reduce the social safety net by redistributing the money that would have been spent on social welfare programs to providing a basic income (136). Social services programs are not sufficient enough to keep many households out of poverty, therefore it stands to reason that reducing social services to fund a BIG or UBI program would still allow poverty, food insecurity and health inequities to exist (136). Thus, to achieve the most success at eradicating household food insecurity and disordered eating, a variety of policy measures should be implemented alongside UBI. Minimum wages should be continuously adjusted alongside inflation and cost of living estimates, instead of being determined by partisan politics, to be sustainable and provide households with the necessary financial resources to have a reasonable standard of living. Stricter regulations on the dieting industry and advertising standards should be enforced so as to attempt to disentangle the tightly woven relationship between capitalism and thinness preoccupation, perpetuating weight stigma, insidious promotion of disordered eating behaviours and setting unrealistic and dangerous cultural standards for body image. Financial barriers to eating disorder treatments should be eradicated so low-income individuals can access necessary treatments, and clinicians such as family doctors or psychiatrists should be trained in how to recognize symptoms of eating disorders and disordered eating behaviours in patients who fall outside of the expected or stereotypical eating disorder patient. Policies such as the aforementioned examples working in tandem could be impactful at reducing the prevalence of food insecurity and disordered eating across the population.

Despite the likely positive effects of stringent regulations, so long as neoliberal politics and free market capitalism dominate Western society, the effects of household food insecurity and disordered eating will never be fully negated. Powerful businesses and organizations with strong financial incentives will continue to exist and keep food inaccessible to maintain value

and profit, and the diet and weight-loss industry will continue to create and feed into demand for life-long dieting behaviours and weight cycling. Solutions outside of a capitalist and/or neoliberal framework may be part of the long-term response to these problems, and indeed some researchers have been looking at solutions beyond the current capitalistic framework to target food insecurity and disordered eating. Research examining food security through other avenues such as Indigenous food sovereignty (137) offers an alternative pathway to achieving food security, and should be considered when examining potential interventions to address food insecurity.

6.4 Future directions for research

This study suggests that the link between household food security status and disordered eating observed in US studies also exists among young adults living in Canadian urban centers. Future longitudinal research is needed to help establish the directionality of the relationship, as well as explore causality. More research is needed to explicate the causal pathway between food insecurity and disordered eating, including examining potential confounder, mediator and collider variables. The mechanism between food insecurity and disordered eating should be further elucidated through qualitative and mixed methods research, to understand lived experiences and inform the interpretation of population level associations.

Future research should examine the role race and ethnicity may play in moderating the association between food insecurity and disordered eating. A persistent problem in disordered eating research is not appropriately accounting for multiple categories for race or ethnicity, and consequently, little is known about the nature of the probable association between race and disordered eating. Some race categories can lack power due to low numbers and thus have to be dropped or combined into fewer categories. The solution to this would be to oversample non-White racial identities in Canada or the United States so categories can be significantly powered. The practice of oversampling is becoming more common; for example, a number of nationally administered surveys in the United States have begun to oversample historically underrepresented racial groups in order to achieve more equitable analysis and results (138).

Both body mass index (BMI) and weight stigma were evaluated in the CFS sample; however, these variables were ultimately excluded from this analysis due to the unclear nature of the true association of these covariates with the exposure and outcome variables of interest. Body mass index (BMI) has been included as a model covariate in previous studies examining food insecurity and disordered eating; however, some evidence suggests BMI may be a collider variable in this instance (30). Collider variables are independent outcomes caused by the exposure and outcome variables individually and therefore lie outside of the causal pathway. It is inappropriate to control for a collider variable in a model as a collider can look as though the exposure and outcome are significantly association, but in actuality represents a spurious

association brought on by controlling the collider (139). Similarly, some preliminary exploration of the relationship between weight stigma and food insecurity has been conducted (140), but more is needed to determine the nature of the association. Most research points towards a bi-directional relationship between weight stigma and disordered eating (i.e., weight stigma influences risk of eating disorder, and disorder eating behaviours influence weight stigma) (24,93), but it is not yet clear how weight stigma interacts with both food insecurity and disordered eating. Weight stigma may exist on the causal pathway between food insecurity and disordered eating, or it could confound the relationship or may be a collider variable in a similar way to BMI (30,140). To understand whether weight stigma, for example, is a potentially useful variable upon which to intervene, its position in the causal pathway must be more clearly understood. In the future, the relationship between the covariates and main effects should be explored in greater detail using longitudinal methods to determine potential for causality or confounding.

7.0 Conclusion

In conclusion, this study presents evidence for a potential association between household food insecurity and disordered eating behaviours, as well as risk of eating disorder, among young adults living in urban centers in Canada. Policy makers, researchers, clinicians and other stakeholders should consider this potential interrelationship when addressing one or both of these concerns, potentially through approaches informed by systems thinking that considers the unintended outcomes and ripple effects. Future longitudinal analyses should explore the potential causal and bidirectional relationship between food insecurity and disordered eating. Additionally, qualitative and mixed methods research would be valuable to characterize lived experiences and help inform an understanding of the mechanisms that underly the potential association. Future research should also focus on examining the possible role of BMI and/or weight stigma in mediating, confounding or colliding upon the association between food insecurity and disordered eating. Overall, food insecurity and disordered eating and risk of eating disorder represent significant public health concerns, especially among young adults living in Canada, and a potential interrelationship between the two has multiple implications for how interventions should more effectively address these conditions.

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