

Household Food Insecurity in Canada Before and During the COVID-19 Pandemic: Findings
from the International Food Policy Study 2018-2020

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 refers to constrained food access due to inadequate financial resources. Those living in food-insecure households are at risk for compromised nutrition, including inadequate nutrient intakes. Furthermore, food insecurity is linked to numerous diet-related non-communicable diseases, including poor mental health, diabetes, and cardiovascular diseases. Reducing food insecurity is thus an important population health goal to improve nutritional status and reduce non-communicable disease risk. There are numerous sociodemographic factors, such as income, racial identity, and region, that are associated with food insecurity in Canada. Food bank use is considered an indicator of food insecurity, especially in short-term situations, yet the suitability of food bank use as a measure for food insecurity is questionable. The COVID-19 pandemic may have impacted the prevalence of food insecurity in Canada due to reduced income. Examining the relationship between household food insecurity and sociodemographic factors, including how the COVID-19 pandemic may have differential impacts on certain sociodemographic groups, could shed unique insights into effective interventions to ameliorate food insecurity.

Research Questions: The study addressed four primary research questions: (1) What proportion of adults in the IFPS lived in food-insecure households in 2018, 2019, and 2020, and how has the prevalence of household food insecurity changed over time? (2) Are there significant differences in the proportion of respondents who live in food-insecure households among certain sociodemographic groups before and during the COVID-19 pandemic? (3) What proportion of respondents who live in food-insecure households also report preparing or consuming food collected from a food bank in the past week, and how does the sociodemographic profile of those who did prepare or consume food from a food bank differ from those who didn't? and (4) What proportion of adults self-reported that the COVID-19 pandemic impacted whether their household had enough food to eat?

Methods: Repeat cross-sectional data were drawn from the International Food Policy Study. Data were collected via self-completed web-based surveys conducted in November-December 2018, 2019, and 2020. Respondents included adults aged 18 to 100 years residing in Canada at the time of the survey. Respondents were recruited using nonprobability-based sampling from the Nielsen Global Panel. Food insecurity was assessed using the Household Food Security Survey Module. Respondents were also asked if they prepared or consumed food that was collected from a food bank in the past week and if COVID-19 had an impact on whether their household had enough food to eat and on their ability to meet their financial obligations in 2020. In model 1, a multinomial regression tested the associations between sociodemographic characteristics and household food insecurity (0=*Food secure*, 1=*Moderate food insecurity*, 2=*Severe food insecurity*), and 2-way interactions with survey year were assessed to examine patterns over time. In model 2, a binary logistic regression examined the associations between sociodemographic characteristics and preparing or consuming food collected from a food bank within the past seven days (0=*No*, 1=*Yes*), and 2-way interactions between sociodemographic characteristics and survey year and household food security status were analyzed. In model 3, a multinomial regression tested the associations between sociodemographic characteristics and the

self-reported impact of COVID-19 on whether households had enough food to eat in 2020 only (0=*Not at all*, 1=*A little*, 2=*A lot*).

Results: Approximately one-third of respondents lived in moderately or severely food insecure households between 2018 and 2020. The prevalence of living in severely food-insecure households was higher in 2019 compared to 2018 (OR:1.28; CI:1.061-1.540), and higher in 2019 compared to 2020 (OR: 1.17; CI: 0.97-1.41). Similarly, the proportion of respondents who reported preparing or consuming food collected from a food bank was greater in 2019 compared to 2018 (OR:1.49; CI:1.05-2.12) and greater in 2019 compared to 2020 (OR:1.13; CI:0.78-1.64). As hypothesized, respondents who were younger and who reported lower perceived income adequacy, lower levels of education, having a child under 18 years old, and who identified as Indigenous or Black had higher odds of living in food-insecure households. The associations between sociodemographics and household food insecurity were consistent over time, except for education and having a child. Respondents who had a child were less likely to live in a severely food-insecure household in 2019 (compared to 2018 and 2020), while those who did not have a child were more likely to live in a severely food-insecure household in 2019 (compared to 2018 and 2020). Respondents who had a university degree were more likely to live in moderately and severely food-insecure households in 2020 compared to 2019, while all other education groups had lower household food insecurity levels in 2020. When asked about the impact of the COVID-19 pandemic, about one-third of respondents self-reported that it had "a little" or "a lot" of impact on whether their household had enough food to eat. Low perceived income adequacy and self-reported financial impact of the pandemic were associated with self-reporting that the COVID-19 pandemic affected whether their household had enough food to eat.

Conclusion: The COVID-19 pandemic has been hypothesized as a potential contributor to food insecurity as it has altered the daily life and financial stability of many households in Canada. However, the findings suggest that household food insecurity decreased in 2020 following an increase in 2019. This research adds to the body of literature on household food insecurity during the first year of the COVID-19 pandemic. Future research should be conducted to examine how the prevalence of food insecurity continues to be impacted by the COVID-19 pandemic over time, especially as financial assistance programs created during the pandemic have ended, potentially impacting the income adequacy of households in Canada.

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LIST OF ABBREVIATIONS

CCB	Canada Child Benefit
CCHS	Canadian Community Health Survey
CERB	Canada Emergency Response Benefit
CESB	Canada Emergency Student Benefit
CIHR	Canadian Institutes of Health Research
COVID-19	Coronavirus Disease 2019
CPSS2	Canadian Perspectives Survey Series 2
EBS	Experience-Based Scales
HFSSM	Household Food Security Survey Module
IFPS	International Food Policy Study
NLSCY	National Longitudinal Survey of Children and Youth
POU	Prevalence of Undernourishment
SDG	Sustainable Development Goals
US	United States

1.0 Background

1.1 Food Insecurity

Health Canada defines food insecurity as "the inability to acquire or consume an adequate diet quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so" [1]. Food insecurity is often described as constrained food access due to inadequate financial resources since food insecurity is more of a problem of financial deprivation than solely a lack of food [2]. There are numerous indicators of food insecurity at the population, household, and individual levels.

Measurement of food insecurity generally falls into two categories: the prevalence of undernourishment (POU) and experience-based scales (EBS) of food insecurity [3]. POU is used as an indicator to measure food insecurity by the World Food Programme to assess progress toward the Sustainable Development Goal (SDG) to eradicate hunger [3]. POU measures used in the SDG monitoring include the prevalence of undernourished people and children under 5 years who meet the criteria for underweight or stunting, which reflect insufficient food supplies and chronic undernourishment [3,4]. Measuring POU may be best suited to countries with high levels of undernourishment and stunting, yet less informative for high-income countries such as Canada [5]. Only examining POU falls short of fully describing the problem of food insecurity [6]. Food insecurity is not only a function of the amount of food (e.g., calories) but the quality, variety, and nutrient density of the foods consumed that lead to a healthy dietary pattern. In contrast to POU, EBS are designed to encompass a broader understanding of food insecurity, as they capture food insecurity across the spectrum of severity and not only when food intake is reduced [3]. For example, ethnographic studies in the United States have described the experience of food insecurity as a process starting with worry about getting enough food, which can progress to reduced quality and then reduced quantity of foods consumed [7]. It was this theoretical understanding of food insecurity that led to the creation of the Household Food Security Survey Module (HFSSM) and other EBS [3]. The HFSSM detects "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" [8]. Since the HFSSM is a household measure, it can be used to categorize the food security status of adults and children living together as a household, but not the personal food security status of each member of the group [8].

1.2 Implications of Food Insecurity for Nutrition and Health

Food insecurity has important implications for diet and health-related outcomes. Healthy foods provide energy and nutrients that allow us to develop, grow, and maintain a healthy active lifestyle. In addition to promoting overall health, being well-nourished prevents many acute and chronic diseases [9–11]. Healthy dietary patterns include the type and quantity of food, and other social factors, such as cooking and eating with others. Healthy foods of sufficient quality and variety, and which meet cultural norms, are imperative to a healthy lifestyle [12]. Adults living in food-insecure households are at risk for compromised nutrition, including inadequate nutrient intakes [13,14].

Furthermore, food insecurity is linked to numerous diet-related chronic diseases, including diabetes and cardiovascular diseases [15–17]. Food insecurity has negative impacts on

health independent of other measures of low socioeconomic status, such as education and income [2]. Those experiencing food insecurity have been found to have poorer mental health, psychological distress, anxiety, and depression [18,19]. Food insecurity and poor mental health may be bidirectional, as poorer mental health has been found to precede the shift from being food secure to food insecure and vice versa [20]. Therefore, reducing food insecurity is an important population health goal to improve nutritional status and reduce non-communicable disease risk.

1.3 Food Insecurity Monitoring and Prevalence

National population surveys have estimated levels of household food insecurity in Canada. Beginning in 1994, the National Longitudinal Survey of Children and Youth (NLSCY) estimated that children in 1.2% of families in Canada experience child hunger [21,22]. However, the survey captured only child hunger as a proxy for food insecurity [22], characterizing only extreme experiences and thus, likely vastly underestimating the true prevalence. Similarly, in the 1996/1997 National Population Health Survey, food insecurity was measured only as the household running out of money for food and lacking enough food to eat (e.g., "*sometimes not enough food to eat*" or "*often not enough food to eat*") [21]. The next NLSCY wave in 1998/1999 was the first to include worry about a lack of food as an indicator of household food insecurity [21,23]. It was estimated that 10% of Canadian households were food insecure in this survey, which is a large jump from 4% in 1996/1997 [21,23]. The indicator of worrying about running out of food likely captured more people than a lack of food or child hunger. Systematic food insecurity monitoring began when the Household Food Security Survey Module (HFSSM), adapted from the U.S. Food Security Survey Module, was added to the Canadian Community Health Survey (CCHS) in 2005 [24]. The HFSSM is currently the primary standardized and validated tool in Canada to assess inadequate or insecure food access due to financial constraints [25]. The HFSSM uses 18 questions that can be employed to categorize the presence of food insecurity into three categories depending on severity [26]. *Marginal food insecurity* includes worrying about having too little food or having reduced food selection due to a lack of financial resources [27]. *Moderate food insecurity* includes a compromise in the quality or quantity of food due to a lack of financial resources [27]. Lastly, *severe food insecurity* includes reduced intake (e.g., missed meals or entire days without food) due to a lack of financial resources [27]. The HFSSM captures household food insecurity, so it measures the food security status of the household as a group and not individual people within the household [24].

The HFSSM has been assessed in several waves of the Canadian Community Health Survey (CCHS) [28]. Analyses of data from the 2017/2018 CCHS estimated that 12.7% of households were food insecure over the previous 12 months, with 4.0% experiencing marginal food insecurity, 5.7% experiencing moderate food insecurity and 3.0% experiencing severe food insecurity [29]. That equates to 4.4 million Canadians, including 1.2 million children under the age of 18, living in food-insecure households [29]. The prevalence of food insecurity varies across Canada, with the highest percentage of households experiencing food insecurity residing in the territories [29]. Food insecurity is most prevalent in Nunavut and least prevalent in Quebec, with 57.0% and 11.1% of households experiencing food insecurity, respectively [29]. Nunavut also had the highest prevalence of children living in food-insecure households at 78.7%, with the lowest prevalence in British Columbia at 15.1% [29]. Quebec was the only province that saw a statistically significant decrease in the prevalence of food insecurity from 2015/2016 to

2017/2018: 12.7% to 11.1% [29]. The prairies and British Columbia saw slight increases in food insecurity, whereas the Maritime provinces saw no changes [29].

In a global context, Canada is similar to other high-income countries in relation to the prevalence of food insecurity. In 2019, the US Department of Agriculture's Economic Research Service found that 10.5% of US households were food-insecure, with 4.1% having very-low food security (i.e., severely food insecure) [30]. However, the more conservative thresholds used to yield estimates for the US do not allow for direct comparisons to estimates for Canada [25]. According to Health Canada coding, households that affirm one or more responses on the HFSSM are classified as food insecure by the CCHS, whereas three or more affirmative responses are required to be considered food insecure in the US [25]. A 2019 study using data from a nationally-representative UK sample found that 14.2% of respondents experienced some degree of food insecurity [31]. Similarly, the 2016 Food and You survey comprised of adults in England, Wales and Northern Ireland found that 80% of respondents lived in food-secure households, 10% in marginally food-insecure households, and 10% in moderately or severely food-insecure households [32]. Although food insecurity is not regularly measured at the population level in Australia, it is estimated that between 4-13% of Australians experience food insecurity, with 22-31% of the Indigenous population experiencing food insecurity [33]. Overall, there are relatively few direct comparisons in the prevalence of food insecurity across countries to date.

1.4 Sociodemographic Correlates of Food Insecurity

Besides province or territory of residence, food insecurity is more common among those who rely on social assistance programs, those without a degree from a university, those with children, those without a spouse or partner, those who rent their home, lone parents, and those who self identify as Aboriginal or Black [26,34]. In contrast, in 2011/2012 households with immigration status and those in rural areas were less likely to experience severe food insecurity when compared to Canadian-born residents and households living in an urban area [2].

Food insecurity is closely related to income. Higher income is associated with less food insecurity: there is a higher risk of food insecurity among households that rely on social assistance, employment insurance, and workers' compensation [26]. In 2011/2012, Tarasuk et al. found that a gradient in the severity of food insecurity can be seen when moving from low to high income in Canada, with every thousand dollars in income (pre-tax) associated with a 2%, 4%, and 5% lower odds of being marginally, moderately, or severely food insecure, respectively [2]. Despite the creation of cash transfer programs to aid in the welfare of households, the relationship between social assistance programs and food insecurity is possibly due to low benefit levels [2]. The level of food insecurity in households receiving social assistance dropped by a factor of five after adjustment for income and sociodemographic characteristics in 2011/2012, suggesting that the low level of income and shared characteristics (e.g., likelihood of renting) [2]. Importantly, although overall food insecurity rose in British Columbia between 2005 and 2012, food insecurity declined among those who rely on social assistance following an increase in social assistance benefits and the introduction of the Rental Assistance Program [35]. Similarly, the federal government of Canada replaced the Child Tax Benefit and Universal Child Care Benefit with the Canada Child Benefit (CCB) in 2016 [36]. The CCB provided families

with an average of \$6800, which is \$2300 more than the previous programs [36]. A cross-sectional study of food insecurity before and after implementation of the CCB found that households with children saw decreased food insecurity across the income spectrum, with those at lower income levels seeing the most substantial decline in food insecurity [37]. Similar protection against food insecurity is seen with Canada's old age security pension provided to those 65 years and older [38]. Using data from 2007-2013, adults in Canada over 65 had half the prevalence of food insecurity as low-income adults under 65, which may be because those over 65 can take advantage of both the old age security pension and an additional income supplement provided to low-income seniors [38].

Food insecurity is higher among those who rent compared to those who own homes [39]. Homeownership is a protective factor against food insecurity during times of inflation and momentary income losses [40]. A recent study found that market renters in Canada had higher odds of being food insecure compared to homeowners, even with adjusting for after-tax income and other sociodemographic factors [41]. Research suggests that about 71% of the increased prevalence of food insecurity in renters is due to sociodemographic variables, leaving 29% as an unexplained protective factor of home ownership [40].

Racial identity is associated with food insecurity in Canada. Most food-insecure households in Canada are White, though the prevalence of food insecurity is highest among households in which the respondent identifies as Indigenous (First Nations, Métis, or Inuk) or Black [29]. Although racial identity is associated with food insecurity, several sociodemographic variables, such as income and education, act as mediators in the relationship [29]. When mediators are taken into consideration, there remains a greater likelihood of food insecurity among Indigenous and Black households [29,42]. Data from 2017/2018 showed that while 28.9% of Black and 28.2% of Aboriginal households experienced food insecurity, only 11.1% of white households did [29]. A study using CCHS data from 2004 found that Indigenous households living off-reserve had 2.6 times the odds of living in food-insecure households compared to non-Aboriginal households, after adjusting for sociodemographic variables [43].

1.5 Food Insecurity and Food Bank Use

Community and organization-level food programs, such as food banks and soup kitchens, are common in high-income countries. The use of these programs serves as an indicator of food insecurity, yet they do not stop the cycle of food insecurity because they do not address the root cause of the problem (i.e., inadequate finances) [5,44]. For example, food bank users in Toronto maintained a high rate (70%) of severe food insecurity despite attending food banks regularly, with 57% of users still reporting hunger in the past 30 days [45]. Food banks may provide some temporary assistance, but they are inadequate to lift households out of a state of food insecurity [46,47].

In the absence of regular monitoring surveys, food banks are often used as immediate indicators of food insecurity within the community [48]. However, most individuals who experience food insecurity do not seek help from community food programs [44]. For example, only one in five respondents experiencing severe food insecurity from the 2008 Canadian Household Panel Survey Pilot accessed a food bank in the past 12 months [47]. Reluctance to

use a food bank may also reflect the stigma surrounding the use of food banks and other programs that provide free food to households [5,44]. Households experiencing food insecurity were more likely to seek financial help from family or friends, ask for help from an organization, or suffer financial costs such as missing rent or mortgage payments rather than use a food bank [47]. There is little research in Canada that examines the characteristics of food bank users and non-users. A study of sociodemographic characteristics of food bank users and non-users in 1998 found that food banks were primarily visited by young, educated, healthy adults who use social assistance [49]. In contrast, a 2018 study of food bank use in Vancouver over the past 25 years found that health challenges, older age, and larger family size were positively associated with frequent and long durations of food bank use [50]. There is a research gap in exploring the sociodemographic profile of those who experience food insecurity and choose to use food banks and those who do not. Although food bank use is known as a poor indicator of food insecurity due to low rates of use, large shifts in food bank attendance can reflect potential changes in food security status [47]. For example, food bank use in Canada rose substantially in the first wave of the pandemic, with a popular food bank in Toronto seeing a 53% increase in demand [48]. Understanding the use of food banks among individuals experiencing food insecurity may help to identify the extent to which food bank usage serves as a reliable indicator of food insecurity in the broader population.

1.6 The COVID-19 Pandemic's Potential Impact on Food Insecurity

There are numerous reasons to suspect that the COVID-19 pandemic affected food insecurity in Canada. The pandemic brought changes to daily life, financial instability, and stress for many Canadian households [51,52]. By the end of March 2020, provinces and territories closed schools, universities, and non-essential businesses. Social distancing (not gathering outside the household) and travel restrictions were some of the first measures implemented to slow the spread of COVID-19 in Canada [52]. Some provinces and territories (e.g., the Maritime provinces) mandated a 14-day isolation when entering even if the person was already within Canada [52]. Social distancing and isolation requirements impacted households' ability to connect with others, access services, and carry out school and work commitments. For example, some food banks closed temporarily, and schools were not open to provide students with breakfast or lunch programs [53].

The initial impact of COVID-19 on the labour market had the potential to increase the risk of food insecurity, with those most affected being young workers, those paid hourly, and those not unionized [54]. Canada saw a decline of 32% in aggregate weekly work hours among those aged 20-64 years, as well as a 15% decline in employment between February and April 2020 [54]. Furthermore, approximately half of the jobs lost were among workers in the bottom quartile of income [54]. The most dramatic reduction in employment occurred between April and May of 2020, and although many who initially lost work have found new employment, Canada is still below the baseline level of employment before the pandemic began [55]. The loss of work in Canada in the service sector was especially affected by COVID-19, with food services and accommodation sectors being at just 55% of baseline in June 2020 [56]. Loss of employment or working hours can lead to unanticipated lost income and financial stress, as well as dealing with the stress of a pandemic and altered living arrangements. In April 2020, 80% of Canadians

surveyed stated that the COVID-19 pandemic had a negative impact on their mental health, with the most common concern being financial impact [57]. Those who were younger and those with children were more likely to report a negative impact on mental health [57]. In April 2021, the same survey shows that the overall score for the mental health of Canadians was close to the level of the most distressed 1% of the population before the pandemic [58].

COVID-19 was hypothesized by experts to increase food insecurity in Canada due to reduced household income [59]. Pandemics may alter food affordability and accessibility through increased prices/inflation, and reduced spending capacity [51]. Although food price inflation was predicted, data from the first year of the pandemic suggest that the changes in month-to-month food prices showed greater food price inflation from 2018 to 2019 than from 2019 to 2020 in Canada [55]. Similarly, the Government of Canada aimed to provide up to \$27 billion to Canadian workers and businesses as part of the COVID-19 Economic Response Plan [60]. One of the most successful policies for alleviating financial stress was the Canadian Emergency Response Benefit (CERB) [55,61]. CERB provided \$2000 per four-week period to eligible employed Canadians who lost income due to COVID-19 [61]. In fact, government financial aid provided enough funds to Canadians to raise disposable income in the second and third quarters of 2020, with the youngest and lowest-income workers gaining the most [62]. Therefore, policy decisions from the government played a role in maintaining the general food supply chain and providing funds to households.

Few studies have examined food insecurity during the pandemic in Canada. The most recent data released from the CCHS (collected Sept-Dec 2020) estimated that 9.6% of people in Canada were living in food-insecure households over the previous 12 months, which is lower than the previous estimate of 12.6% from 2017/2018 [63]. However, it is important to note that there was only a 24.6% response rate in 2020 compared to 60.8% in 2017/2018[63]. In May 2020, the cross-sectional Canadian Perspectives Survey Series 2 (CPSS2) measured household food insecurity among those in Canada aged 15 and older with a short-form version of the HFSSM [64]. Of the 4481 respondents, 14.6% lived in households that experienced some food insecurity in the past 30 days, which shows a 39% relative increase from 2017/2018 data (10.5%) [64]. Of those who lived in food-insecure households, 9.3% obtained food from a community organization, such as a food bank [64]. This reflects the fact that many see food banks and other free food options as a last resort only [46]. Over one fifth of respondents rated their mental health as fair or poor; however, those who lived in food-insecure households had nearly three times the odds of fair or poor mental health, and moderate or severe anxiety compared to those in food-secure households [64].

1.7 Summary

Food insecurity has important implications for diet quality and health more generally. National estimates from before the pandemic suggested that approximately 1 in 8 households experience food insecurity, and food insecurity is highest among the most vulnerable populations, including those with low income, education, and reliance on social assistance programs [27]. The CCHS is the premier national health survey in Canada and measures household food insecurity at regular intervals. Given the current awareness of the importance of

reproducibility in science, it is valuable to analyze the association between sociodemographic factors and food insecurity in Canada using a novel data source to illuminate similarities and differences to previous studies [65]. As well, there are inconsistent conclusions in Canada in regards to changes in food insecurity during the COVID-19 pandemic; the CCHS found a decrease in household food insecurity in 2020 compared to 2017/2018 data, while the CPSS2 found an increase [63,64]. There is also a lack of current research on the characteristics of food bank users in Canada and the impact of COVID-19 on the decision of individuals living in food-insecure households to make use of food banks. Overall, there is a need for examination of food insecurity before and during the COVID-19 pandemic to discern how best to help households move to food security in the new normal.

2.0 Specific Aims

The objectives of this study were to (a) assess changes in the magnitude and severity of household food insecurity in Canada between 2018-2020, (b) examine associations between food insecurity and sociodemographic factors before and during the pandemic, (c), examine the proportion and sociodemographic profile of respondents living in food-insecure households who reported preparing food collected from a food bank in the past week, and (d) to assess the self-reported effect of the COVID-19 pandemic on food insecurity in 2020.

The study examined four primary research questions, presented below with the corresponding hypotheses:

- 1. What proportion of adults in the IFPS lived in food-insecure households in 2018, 2019, and 2020, and how has the prevalence of household food insecurity changed over time?**
 - a. The proportion of respondents who lived in food-insecure households will be approximately 15%, similar to the CPSS2 survey in 2020 (H1a).
 - b. The prevalence of food insecurity will be higher in 2019 versus 2018, as well as 2020 versus 2019 (H1b).

- 2. Are there significant differences in the proportion of respondents who live in food-insecure households among certain sociodemographic groups before and during the COVID-19 pandemic?**
 - a. Younger age, lower income, and lower education will be significantly positively associated with food insecurity in 2020 (H2a).

- 3. What proportion of respondents who live in food-insecure households also report preparing or consuming food collected from a food bank in the past week, and how does the sociodemographic profile of those who did prepare or consume food from a food bank differ from those who didn't?**
 - a. Approximately 10% of those who live in a food-insecure household will also report preparing or consuming food collected from a food bank in the past week in 2018, 2019, and 2020 (H3a).
 - b. The sociodemographic correlates for food bank usage will be different than household food insecurity, such that having children will be associated with preparing or consuming food collected from a food bank (H3b).

- 4. What proportion of adults self-reported that the COVID-19 pandemic impacted whether their household had enough food to eat?**
 - a. Approximately 20% of 2020 respondents will report that the COVID-19 pandemic has had an impact on whether the household had enough food to eat (H4a).

3.0 Methods

3.1 Data Sources

The analysis used data from the 2018, 2019, and 2020 cycles of the International Food Policy Study (IFPS), an annual repeat cross-sectional survey conducted in Australia, Canada, Mexico, the United Kingdom, and the United States. Only data from the Canadian arm were used in data analysis for this thesis. The Canadian sample does not include the territories. The IFPS will be employed as a unique data set to explore the study questions and to add to the body of research of previous CCHS findings on food insecurity and related sociodemographic variables in Canada. Using a different dataset to explore similar questions (e.g., replicability) helps to increase the confidence in study findings [65].

IFPS data were collected via self-completed web-based surveys in November-December 2018, 2019, and 2020 with adults aged 18 to 100 years. Respondents were recruited using nonprobability-based sampling through Nielsen Consumer Insights Global Panel and their partners' panels. Email invitations with unique survey access links were sent to a random sample of panellists within each country after targeting for demographics; panellists known to be ineligible were not invited. Potential respondents were screened for eligibility, with quota requirements based on age and sex. Surveys were conducted in English or French in Canada. Members of the research team who were native of the French language reviewed the French translations independently.

Respondents provided consent prior to survey completion. Respondents received remuneration in accordance with their panel's usual incentive structure (e.g., points-based or monetary rewards, chances to win prizes). The study was reviewed by and received ethics clearance through the University of Waterloo Research Ethics Committee (ORE# 30829). A full description of the study methods can be found in the International Food Policy Study: Technical Reports for Waves 2, 3, and 4 [66–68].

3.2 Measures

3.2.1 Dependent Variable – Household Food Security Status

The food security status of households will be determined from the HFSSM, a validated 18-question survey of uncertain, insufficient, or inadequate food access due to financial constraints [8]. The HFSSM has been validated in previous research, in that the questions asked reflect the experiences of marginal, moderate, and severe food insecurity, and that those who affirm questions of the HFSSM can be linked to the appropriate severity of food insecurity [3]. Small changes were made in the wording of survey questions for use in the IFPS study to allow for a better experience using an online survey format instead of a live interview (e.g., altering directives such as “I’m going to read you several statements...”). The HFSSM asks respondents several statements based on experiences in the previous 12 months. Ten of the eighteen questions refer to the experience of household food security for adults, while the other eight refer to the experiences of children [24]. Questions were asked in a tiered design to screen for household food insecurity. If the respondent did not affirm any of the first three questions, no further questions were asked to reduce the respondent burden. If the respondent indicated potential food insecurity, follow-up questions were asked for adults and, if present in the household, children. In cases with missing answers to the HFSSM, missing answers were imputed when there were

enough valid responses. There is no specific threshold of a number of acceptable missing answers to allow for imputation; the imputation of missing answers relies on an adequate existing pattern of valid answers [69]. As per the USDA Guide to Measuring Food Security, “yes” was imputed to a missing item when the respondent had an affirmative response to at least one item more severe than the missing item and only affirmative answers to items less severe than the missing item [69]. All other missing items were imputed as “no.”

Food insecurity was categorized using Health Canada thresholds [70]. To be considered *Food Secure*, the respondent must answer “no” to all questions [70]. No more than one affirmative response in either adult or child scales indicates *Marginal Food Insecurity* [70]. Between two to five and two to four affirmative responses indicate *Moderate Food Insecurity*, for the adult and child scales, respectively [70]. Six or more and five or more affirmative responses indicate *Severe Food Insecurity*, for the adult and child scales, respectively [70]. If either children or adults are severely food insecure, the household is considered severely food insecure [26]. If either children or adults, or both, were moderately food insecure, but neither were severely food insecure, then the household is considered moderately food insecure [26]. HFSSM categories were condensed into a three-level outcome, combining those who lived in marginally food-insecure households with those who lived in food-secure households. This was chosen to simplify data analysis while allowing for differences to be examined across levels of food insecurity.

3.2.2 *Dependent Variable – Preparing or Consuming Food Collected from a Food Bank*

As a related indicator of potential food insecurity, preparing or consuming food collected from a food bank in the past seven days was included in the analysis as a proxy measure for food bank use. Analyzing food-insecure households' food bank use and the relation to sociodemographic variables provides additional information on the relationship between food bank use and food insecurity. Respondents were asked “Please think about the food you ate that was prepared at home during the past 7 days. Where was it PURCHASED?” with one response option being “food bank”. The variable was analyzed as a dichotomous outcome (0=Did not prepare food from a food bank in the past week 1=Prepared food from a food bank in the past week). For the analysis, those who did not prepare any food at home—which was used in the survey structure to ask about food bank usage— were included in the “No” category. No other response options were analyzed.

3.2.3 *Dependent Variable – Self-Reported Impact of COVID-19 on Food Security Status*

In the 2020 data collection, IFPS respondents were asked questions pertaining to COVID-19 and their experiences with food insecurity. These questions were used to bolster confidence that the potential changes in the prevalence of household food insecurity were due to the pandemic. Respondents were asked “Has the COVID-19 pandemic affected whether your household has had enough food to eat?” and “Is the COVID-19 pandemic currently affecting whether your household has enough food to eat?”. Responses for both questions were categorized as “not at all”, “a little”, and “a lot”. If respondents said yes to the first question, they were asked a follow-up question about the reasons for food insecurity. Respondents could select “I/we did not have enough money for food”, “I/we could not access enough food because shops did not have the supplies”, “I/we could not access enough food because we could not go out and

did not have any other way to get the food we needed", "Other", "Don't know", or "Refuse to answer".

3.2.4 Independent Variables – Sociodemographic

Self-reported demographic variables included sex, age, race, region, perceived income adequacy, education, occupation, and having a child. All sociodemographic variables are known to be associated with food insecurity from previous research [29,34,39]. Sex at birth was used instead of gender since 99.1% of respondents in the sample assigned male at birth identified as men and 98.8% of respondents assigned female at birth identified as women. Age groupings of 18-34, 35-44, 45-64, and 65+ were formed based on the CCHS [71]. The question on racial identity was taken from the Ontario Data Standards for the Collection of Personal Information [72]. Racial groupings used were "White only", "East/Southeast Asian only", "South Asian only", "Black only", "Indigenous inclusive", and "Mixed/Other/Not stated/Missing". Region was reported as the province where the respondent resides, with Nova Scotia, New Brunswick, Newfoundland and Labrador, and Prince Edward Island being combined into one "Atlantic Provinces" category due to low respondent counts in these provinces. Perceived income adequacy was ascertained by asking "Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?". Responses were classified as "Very difficult", "Difficult", "Neither easy nor difficult", "Easy", "Very easy". Education was collected as the highest level of formal education the respondent had achieved, categorized as "Less than high school", "High school diploma or equivalent", "Trade certificate, diploma from a technical/vocational school or apprenticeship, or some university, or university certificate/diploma below the bachelor's level", or "University degree". Occupation was collected using the question "What was your main activity in the past week?". Responses were categorized as "Employed", "Unemployed", "Caregiver/Homemaker", "Student", "Illness/Disability", "Retired", or "Other". Only living with a child was considered for family composition. The variable was analyzed as a dichotomous outcome (0=does not live with children under 18, 1=lives with children under 18). No other response options were analyzed.

3.2.5 Independent Variable – Self-Reported Impact of COVID-19 on Food Security Status

Concerning financial impact, respondents were asked "Has the COVID-19 pandemic affected your ability to meet financial obligations or essential needs, such as rent or mortgage payments, utilities and groceries?". Responses were categorized as "Major impact", "Moderate impact", "Minor impact", "No impact", and "Too soon to tell".

3.3 Data Analysis

Respondents were excluded for the following reasons: the region was missing, ineligible or had an inadequate sample size (i.e., Canadian territories); invalid response to a data quality question; survey completion time under 15 minutes; and/or invalid responses to at least three of 20 open-ended measures. The analytic sample included n=4,397, n=4,107, and n=4,309 respondents from 2018, 2019, and 2020 respectively (n=12,813 total). Respondents were excluded for selecting "Don't know" or "Refuse to answer" for the following variables: preparing or consuming food from a food bank in the past week (n=85), self-reported impact of COVID-19 on food security (n=58), self-reported impact of COVID-19 on finances (n=68), education (n=58), occupation (n=89), and perceived income adequacy (n=135). Respondents were also

excluded if there were too many missing answers to the HFSSM to impute a missing answer. Respondents in households with children missing nine of eighteen questions, in households without children missing five of ten questions, or in any household missing all four household food security questions were excluded (n=68). There were 12,537 respondents included in the analysis after removing those who had missing data.

Data were weighted using post-stratification sample weights constructed using a raking algorithm with population estimates from the census in Canada based on age, sex, region, and education. Weights were rescaled to the sample size for each model. Estimates reported were weighted unless otherwise specified. All models were adjusted for sex, age group, race, education, occupation, having a child, and perceived income adequacy. Analyses were conducted using SAS® 9.4. We reported exact p values and odd ratios with 95% confidence intervals. Efforts were made to avoid an arbitrary threshold for determining statistical differences, with a focus on reporting the exact p-level [73]. Similarly, there was no adjustment for multiple comparisons as exact values were reported instead of a threshold of statistical significance.

Univariate descriptive statistics (means, standard deviations, frequencies) examined the distribution of all outcomes and variables included in the model. Regression models were used to examine changes over time and sociodemographic correlates for each of the three primary outcomes, as described below.

3.3.1 Model 1: Changes in Food Insecurity Over Time

A multinomial regression model was conducted, in which the level of food insecurity served as the dependent variable using the HFSSM: 0=Food secure, 1=Moderate food insecurity, 2=Severe food insecurity. The following variables were analyzed for associations with food insecurity: sex, age group, race, education, occupation, having a child, and perceived income adequacy. An indicator variable for the survey year was entered in the model (where 0=2018, 1=2019, and 2=2020) to examine changes in food security over time. Since income adequacy is a potential mediator for the effect of the COVID-19 pandemic on food security status (i.e., the pandemic may have reduced perceived income adequacy through job loss, which could then increase the risk of food insecurity), a sensitivity analysis was conducted where perceived income adequacy was removed from the model to examine if adjusting for perceived income adequacy was obscuring the association between year and food security status. Model 1 was conducted in two steps. In Step 1, only the main effects were included. In Step 2, two-way interactions were added to the model between the survey year and each of the sociodemographic variables (i.e., sex, age group, race, region, education, occupation, having a child, and perceived income adequacy). Each two-way interaction was added to the model in a separate step, and all significant ($p < 0.05$) two-way interactions were reported. Model 1 was used to examine Hypotheses 1 and 2, described above.

3.3.2 Model 2: Comparison of Sociodemographic Correlates of Food Insecurity and Preparing or Consuming Food Collected from a Food Bank in the Past Week

A binary logistic regression was conducted where the preparing or consuming food collected from a food bank over the past seven days was the dependent variable (0=No, 1=Yes). The following variables were analyzed for associations with preparing or consuming food collected from a food bank: sex, age group, race, education, occupation, having a child,

perceived income adequacy, and food security status. An indicator variable for the survey year was also entered in the model (where 0=2018, 1=2019, and 2=2020) to examine changes in preparing or consuming food collected from a food bank between years. Income adequacy may act as a mediator in the relationship between the pandemic and food bank use; therefore, a sensitivity analysis was conducted where perceived income adequacy was removed from the model to examine if adjusting for perceived income adequacy obscured the relationships between year and food bank use. A second sensitivity analysis was conducted where perceived income adequacy was removed from the model to examine if adjusting for perceived income adequacy suppressed the relationships between sociodemographic variables and food bank use. Food security status is a potential mediator in the relationship between sociodemographic variables and food bank use. Therefore, another sensitivity analysis was conducted where food security status was removed from the model to examine if adjusting for food security status suppressed the association between sociodemographic variables and food security status. Model 2 was used to examine Hypothesis 3, described above.

3.3.3 Model 3: Self-Reported Impact of COVID-19 on Food Insecurity

A multinomial regression model was conducted to discern the degree to which the COVID-19 pandemic affected whether households had enough to eat: 0=*Not at all*, 1=*A little*, 2=*A lot*. The following variables were analyzed for associations with self-reported impact of COVID-19 on food security: sex, age group, race, education, occupation, having a child, perceived income adequacy, and perceived financial impact of the COVID-19 pandemic. Due to the nature of this question, this model only included 2020 data. A sensitivity analysis was conducted where perceived income adequacy was removed from the model to examine if adjusting for perceived income adequacy was suppressing the association between sociodemographics and self-reported impact of the pandemic on food security.

3.4 Power calculation

Sample size calculations were estimated for the primary outcome in Model 1, changes in food insecurity over time. Based on food insecurity estimates of 3% for severe food insecurity and 5.7% for moderate food insecurity at baseline in 2018 (CCHS data), sample sizes of approximately 4000 at each wave provide 80% power to detect a 1.17% change in severe household food insecurity and a 1.55% change in moderate household food insecurity between each wave over time (assuming a two-tailed test where $\alpha=0.05$). Adjusting for sociodemographic covariates in the model increases power. Overall, the study has the appropriate power to detect ‘small’ effect sizes for the primary outcome.

4.0 Results

4.1 Study Sample Respondent Characteristics

Table 1 shows the profile of the study sample for each year and overall. Most respondents identified as White only (78.2%) and there were similar proportions of males (49.4%) and females (50.6%).

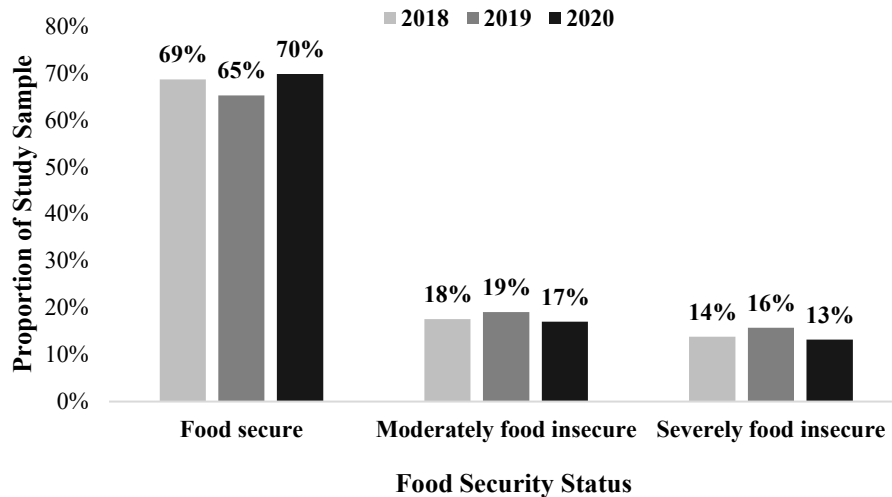
Table 1. Weighted descriptive statistics of study respondents (n=12,537).

Sociodemographic Characteristic	2018 (n=4,317)	2019 (n=4,046)	2020 (n=4,174)	Total (n=12,537)
Sex				
Male	49.5%	49.3%	49.3%	49.4%
Female	50.5%	50.7%	50.7%	50.6%
Age				
18-34 years	25.9%	27.1%	26.9%	26.6%
35-44 years	18.1%	17.5%	16.5%	17.4%
45-64 years	35.9%	34.9%	35.3%	35.4%
65+ years	20.1%	20.5%	21.2%	20.6%
Ethnicity				
White only	77.0%	79.5%	78.1%	78.2%
East/Southeast Asian only	5.4%	7.1%	8.2%	6.9%
South Asian only	2.0%	2.6%	4.3%	3.0%
Black only	1.7%	2.3%	1.9%	2.0%
Indigenous inclusive	4.0%	3.4%	2.5%	3.3%
Mixed/other/not stated/missing	9.9%	5.1%	4.9%	6.7%
Region				
Alberta	9.9%	10.8%	10.3%	10.3%
Atlantic Canada	6.7%	6.6%	6.7%	6.7%
British Columbia	13.9%	14.0%	14.1%	14.0%
Manitoba	4.9%	4.3%	4.2%	4.5%
Ontario	38.9%	39.1%	38.8%	38.9%
Quebec	22.8%	22.6%	22.8%	22.7%
Saskatchewan	2.9%	2.5%	3.1%	2.8%
Perceived Income Adequacy				
Very difficult	8.9%	9.0%	7.1%	8.3%
Difficult	19.5%	20.6%	17.8%	19.3%
Neither easy nor difficult	37.1%	38.1 %	40.7%	38.6%
Easy	22.2%	22.3%	21.9%	22.1%
Very easy	12.4%	10.0%	12.5%	11.6%
Education				
Less than high school diploma	16.2%	16.3%	15.9%	16.1%
High school	26.0%	25.8%	25.8%	25.9%
Trade certificate, diploma, or some university	33.3%	33.5%	33.7%	33.5%
University degree	24.5%	24.5%	24.6%	24.5%
Occupation				
Employed	47.0%	47.0%	44.8%	46.2%
Unemployed	5.4%	5.0%	7.4%	5.9%
Caregiver/Homemaker	10.8%	11.8%	11.3%	11.3%
Student	4.4%	5.3%	4.9%	4.8%
Illness/Disability	5.2%	4.7%	4.6%	4.8%
Retired	24.4%	23.4%	24.9%	24.2%
Other	2.9%	2.8%	2.1%	2.6%
Lives with a child				
Yes	82.2%	81.9%	82.3%	82.1%
No	17.8%	18.1%	17.7%	17.9%

4.2 Changes in Household Food Insecurity, 2018-2020 (Research Question 1)

As Figure 1 shows, approximately two-thirds of respondents were classified as living in food-secure households between 2018 and 2020. After adjusting for sociodemographic variables in a multinomial regression model, there was moderate evidence of differences in household food insecurity across the years of study ($F=2.32$, $p=0.0546$). There was evidence that the proportion of respondents living in severely food-insecure households increased in 2019 compared to 2018 (OR:1.28; CI:1.061-1.540), and modest evidence that the proportion of respondents living in moderately food-insecure households changed during the same time period (OR: 1.15; CI:1.00-1.34). There was also evidence that the proportion of respondents living in households experiencing severe (OR: 1.17; CI: 0.97-1.41) and moderate (OR: 1.16; CI:1.00-1.34) household food insecurity was higher in 2019 than in 2020. Thus, the levels of household food insecurity in 2020 were similar to those seen in 2018.

Figure 1: Weighted proportion of the sample living in households with varying degrees of food security in Canada in 2018, 2019, and 2020 (n=12,537).



A sensitivity analysis was conducted to examine the effect of adjusting for perceived income adequacy on household food insecurity over time. Income adequacy is a potential mediator in the effect of the pandemic on food insecurity since COVID-19 may have a direct effect on income adequacy [62,63]; therefore, adjusting for perceived income adequacy across years has the potential to suppress the contribution of the survey year in the model. When the multinomial regression model was re-run excluding the perceived income adequacy variable, there was stronger evidence of the effect of year on household food insecurity ($F=4.80$, $p=0.0007$). The proportions of respondents who lived in moderately food-insecure households (OR=1.17; CI:1.01, 1.35) and severely food-insecure households (OR=1.28; CI:1.08, 1.51) were higher in 2019 than in 2018. As well, there was evidence that the proportion of respondents who lived in moderately food-insecure households (OR:1.24; CI:1.08-1.43) and severely food-insecure households (OR:1.32; CI:1.12-1.55) were higher in 2019 than in 2020.

4.3 Sample Characteristics Associated with Household Food Insecurity (Research Question 2)

Table 2 shows the proportion of respondents' household food security status by sample characteristics. In the main effects multinomial regression model described above, all variables except region ($p=0.0905$) were associated with household food insecurity. As shown in Table 2, those who reported greater difficulty meeting their financial needs had greater odds of living in moderately and severely food-insecure households. Compared to those who reported it was "neither easy nor difficult" to meet their financial needs, those who reported it was "very difficult" to meet their needs had 50 times greater odds of experiencing severe household food insecurity (OR=52.33; CI:38.84, 70.50). Compared to those who reported it was "very easy" to meet their needs, those who reported it was "very difficult" had 113 times greater odds of living in a severely food-insecure household (OR=113.59; CI:73.49, 175.56). Higher levels of education of the respondent were associated with less moderate and severe household food insecurity. Respondents with less than high school education were more likely to live in severely food-insecure households than those with a university degree (OR=2.91; CI:2.12, 4.00). Respondents who were caregivers/homemakers were modestly more likely than those who were employed to live in a severely food-insecure household (OR=1.38; CI:1.08, 1.76). Those with children under 18 years in the home experienced more moderate and severe household food insecurity than those without children. Those with children had almost twice the odds of experiencing severe household food insecurity (OR=1.86; CI:1.53, 2.25). Younger age groups were more likely to live in households that were moderately and severely food insecure. Those who were 18-34 had about twice the odds (OR=1.92; CI:1.51, 2.38) of living in a severely food-insecure household than 35-44-year-olds and eight times the odds (OR=8.33; CI:5.55, 12.5) of living in a severely food-insecure household than those 65+. Respondents who identified as East/Southeast Asian only, South Asian only, Black only, Indigenous, or mixed/other/not stated had higher odds of living in moderately food-insecure households than those who identify as White only. For severe household food insecurity, a similar relationship was observed only for respondents who identified as Black (OR=2.20; CI:1.41, 3.43), Indigenous (OR=2.39; CI:1.62, 3.55), and mixed/other/not stated (OR=1.98; CI:1.49, 2.63).

Table 2. Weighted the proportion of the sample living in households with varying degrees of food security by sample characteristics in 2018, 2019, and 2020 (n=12,537).

	2018 (n=4317)			2019 (n=4046)			2020 (n=4174)		
	Secure	Moderate	Severe	Secure	Moderate	Severe	Secure	Moderate	Severe
Overall	68.6%	17.6%	13.8%	65.2%	19.1%	15.7%	69.8%	17.0%	13.2%
Sex									
Male	70.8%	15.9%	13.3%	66.3%	18.8%	14.9%	70.2%	17.3%	12.5%
Female	66.4%	19.3%	14.3%	64.1%	19.4%	16.4%	69.4%	16.6%	14.0%
Age									
18-34 years	58.1%	23.0%	18.9%	49.0%	28.5%	22.5%	53.2%	25.8%	20.9%
35-44 years	59.9%	22.5%	17.6%	61.6%	20.4%	18.0%	62.9%	21.4%	15.7%
45-64 years	70.9%	15.7%	13.4%	68.5%	15.9%	15.6%	73.4%	12.5%	12.1%
65+ years	85.9%	9.6%	4.5%	83.9%	11.1%	5.0%	90.3%	6.4%	3.3%
Ethnicity									
White only	71.3%	16.4%	12.3%	66.8%	17.9%	15.3%	72.9%	14.9%	12.2%
East/Southeast Asian only	74.0%	16.6%	9.4%	74.7%	17.4%	7.9%	68.2%	23.1%	8.7%
South Asian only	65.1%	26.3%	8.6%	59.1%	28.4%	12.5%	57.4%	24.8%	17.8%
Black only	52.7%	24.3%	22.9%	45.6%	33.2%	21.1%	50.6%	32.8%	16.6%
Indigenous inclusive	44.2%	24.7%	31.0%	40.0%	28.9%	31.1%	46.4%	23.6%	29.9%
Mixed/other/not stated/missing	58.3%	21.8%	19.9%	55.1%	23.4%	21.4%	54.2%	23.0%	22.8%
Region									
Alberta	70.4%	14.7%	14.9%	62.5%	22.4%	15.0%	68.3%	17.7%	13.9%
Atlantic Canada	68.3%	14.6%	17.1%	60.1%	20.0%	19.9%	68.8%	18.8%	12.3%
British Columbia	68.1%	16.3%	15.5%	66.2%	18.3%	15.5%	68.2%	18.8%	12.9%
Manitoba	74.7%	13.1%	12.2%	67.0%	15.8%	17.2%	69.9%	15.4%	14.7%
Ontario	69.4%	18.4%	12.5%	67.8%	16.8%	15.4%	68.7%	17.3%	14.0%
Quebec	66.0%	20.6%	13.4%	62.4%	22.6%	15.0%	74.7%	14.3%	11.0%
Saskatchewan	64.5%	18.3%	17.2%	66.5%	17.6%	15.9%	62.0%	19.5%	18.5%
Perceived Income Adequacy									
Very difficult	17.0%	25.1%	57.9%	12.0%	24.0%	64.0%	15.3%	22.6%	62.0%
Difficult	39.9%	33.2%	26.9%	37.2%	34.0%	28.8%	41.1%	32.4%	26.5%
Neither easy nor difficult	76.5%	17.9%	5.5%	73.5%	19.4%	7.1%	74.4%	18.3%	7.3%
Easy	88.4%	7.1%	4.5%	85.9%	10.0%	4.1%	88.4%	7.7%	3.9%
Very easy	91.6%	5.5%	2.9%	92.7%	3.6%	3.7%	94.0%	3.7%	2.3%
Education									
Less than high school diploma	56.3%	24.0%	19.7%	48.4%	26.3%	25.3%	54.2%	22.0%	23.7%
High school	64.7%	18.3%	17.0%	58.9%	21.3%	19.8%	68.7%	17.7%	13.6%
Trade certificate, diploma, or some university	71.0%	16.5%	12.4%	68.6%	17.9%	13.5%	74.2%	15.6%	10.2%
University degree	77.5%	14.2%	8.3%	78.3%	13.7%	8.0%	75.0%	14.7%	10.3%
Occupation									
Employed	68.8%	18.3%	12.9%	66.9%	19.2%	13.8%	70.0%	18.0%	12.0%
Unemployed	42.8%	27.1%	30.1%	39.2%	29.1%	31.7%	46.4%	25.9%	27.7%
Caregiver/Homemaker	59.3%	19.9%	20.8%	52.2%	21.7%	26.1%	57.0%	22.0%	21.0%
Student	60.0%	27.3%	12.7%	61.3%	26.1%	12.6%	66.2%	24.1%	9.7%
Illness/Disability	47.2%	24.8%	28.0%	39.8%	26.4%	33.8%	49.3%	20.3%	30.4%
Retired	84.2%	9.6%	6.2%	82.0%	11.6%	6.4%	87.8%	7.2%	5.0%
Other	67.8%	20.0%	12.2%	47.6%	25.5%	26.8%	58.2%	27.4%	14.4%
Lives with a child									
No	70.1%	16.9%	13.0%	66.5%	19.2%	14.3%	72.1%	16.1%	11.8%
Yes	61.5%	20.9%	17.6%	59.2%	18.7%	22.1%	59.3%	20.8%	19.9%

Table 3. Adjusted estimates from a multinomial regression model examining the proportion of the sample living in households with varying degrees of food security between 2018, 2019, and 2020 (n=12,537)

	Level of food insecurity	
	Moderate (vs Severe)* OR, 95%CI (p value)	Severe (vs Secure)** OR, 95%CI (p value)
Year		
2018 vs. 2019	1.15, 0.99-1.34 (p=0.0648)	1.28, 1.06-1.54 (p=0.0098)
2019 vs. 2020	1.16, 1.00-1.34 (p=0.0575)	1.17, 0.97-1.41 (p=0.1069)
2018 vs. 2020	1.00, 0.85-1.17 (p=0.9761)	1.10, 0.90-1.34 (p=0.3694)
Sex		
Male	Ref	
Female	0.92, 0.81-1.04 (p=0.1930)	0.76, 0.65-0.89 (p=0.0009)
Age		
18-34 years	Ref	
35-44 years	0.65, 0.54-0.78 (p<0.0001)	0.52, 0.42-0.66 (p<0.0001)
45-64 years	0.39, 0.33-0.46 (p<0.0001)	0.32, 0.26-0.40 (p<0.0001)
65+ years	0.25, 0.19, 0.33 (p<0.0001)	0.12, 0.08-0.18 (p<0.0001)
Ethnicity		
White only	Ref	
East/Southeast Asian only	1.27, 1.02-1.59 (p=0.0331)	0.94, 0.67-1.32 (p=0.7237)
South Asian only	1.62, 1.14-2.29 (p=0.0068)	1.05, 0.62-1.77 (p=0.8596)
Black only	2.44, 1.69-3.53 (p<0.0001)	2.20, 1.41-3.43 (p=0.0005)
Indigenous inclusive	1.86, 1.24-2.78 (p=0.0025)	2.39, 1.62-3.55 (p<0.0001)
Mixed/other/not stated/missing	1.52, 1.20-1.93 (p=0.0004)	1.98, 1.49-2.63 (p<0.0001)
Region		
Alberta	0.91, 0.73-1.13 (p=0.3747)	0.88, 0.68-1.16 (p=0.3689)
Atlantic Canada	1.13, 0.87-1.46 (p=0.3450)	1.27, 0.96-1.70 (p=0.0970)
British Columbia	1.01, 0.82-1.25 (p=0.9034)	1.05, 0.81-1.35 (p=0.7290)
Manitoba	0.79, 0.56-1.11 (p=0.1779)	0.95, 0.66-1.35 (p=0.7658)
Ontario	Ref	
Quebec	1.27, 1.08-1.50 (p=0.0040)	1.08, 0.88-1.34 (p=0.4499)
Saskatchewan	1.07, 0.71-1.61 (p=0.7362)	1.08, 0.63-1.87 (p=0.7713)
Perceived Income Adequacy		
Very difficult	7.31, 5.43-9.85 (p<0.0001)	52.33, 38.84-70.50 (p<0.0001)
Difficult	3.66, 3.12-4.29 (p<0.0001)	8.20, 6.72-10.01 (p<0.0001)
Neither easy nor difficult	Ref	
Easy	0.39, 0.32-0.46 (p<0.0001)	0.54, 0.42-0.70 (p<0.0001)
Very easy	0.24, 0.17, 0.34 (p<0.0001)	0.46, 0.31-0.67 (p<0.0001)
Education		
Less than high school diploma	Ref	
High school	0.60, 0.47-0.78 (p<0.0001)	0.57, 0.43-0.77 (p=0.0002)
Trade certificate, diploma, or some university	0.48, 0.37-0.62 (p<0.0001)	0.39, 0.29-0.52 (p<0.0001)
University degree	0.42, 0.32-0.55 (p<0.0001)	0.34, 0.25-0.47 (p<0.0001)
Occupation		
Employed	Ref	
Unemployed	1.14, 0.87-1.50 (p=0.3499)	1.29, 0.94-1.78 (p=0.1188)
Caregiver/Homemaker	1.07, 0.86-1.33 (p=0.5271)	1.37, 1.08-1.76 (p=0.0111)
Student	0.74, 0.55-1.00 (p=0.0473)	0.48, 0.33-0.71 (p=0.0002)
Illness/Disability	1.01, 0.72-1.41 (p=0.9635)	1.27, 0.90-1.80 (p=0.1712)
Retired	0.81, 0.64-1.02 (p=0.0706)	1.00, 0.71-1.39 (p=0.9835)
Other	1.54, 1.00-2.39 (p=0.0518)	1.50, 0.88-2.56 (p=0.1328)
Lives with a child		
No	Ref	
Yes	1.24, 1.05-1.46 (p=0.0098)	1.86, 1.53-2.25 (p<0.0001)

All odds ratios are adjusted for all other variables in the table

*Odds of moderate and secure food insecurity in reference to food secure

To examine if adjusting for perceived income adequacy suppressed the relationship between sociodemographic predictors of household food insecurity and food security status, a sensitivity analysis was conducted. When only perceived income adequacy was removed from the model, there were similar associations between sociodemographic variables and household food insecurity. However, there were notable differences concerning sex and occupation. When perceived income adequacy was removed from the model, there was no evidence of an association between the sex of the respondent and household food insecurity. Compared to respondents who were employed, those who were unemployed and who were ill or on disability were more likely to live in moderately and severely food-insecure households. There were about three times the odds of someone who was ill or on disability living in a severely food insecure household compared to those who were employed (OR=3.03; CI:2.23, 4.12).

4.3. Interaction Effects with Year

To test for potential differences in household food insecurity status over time depending on sociodemographic groups, interaction terms between year and sociodemographic variables were added to the main effects multinomial model. There were significant interaction effects between year and education ($F=2.31$, $p=0.0061$) and living with a child ($F=2.58$, $p=0.0355$). Overall, having a child was associated with lower severe household food insecurity in 2019 (compared to 2018 and 2020), while the opposite was true for not having a child. Respondents with a university degree were more likely to live in a moderately or severely food-insecure household in 2020 compared to 2019, while all other education groups had lower household food insecurity levels in 2020. See Figure 1 for a visual representation of the interaction effects.

Figure 2. Interaction effects between year and education, and year and having a child under 18 years old, from an adjusted multinomial model. Graphs show the weighted proportion of respondents who lived in moderately and severely food-insecure households* (n=12,537).

Figure 2a: Interaction effect between having a child and the year of study on moderate household food insecurity.

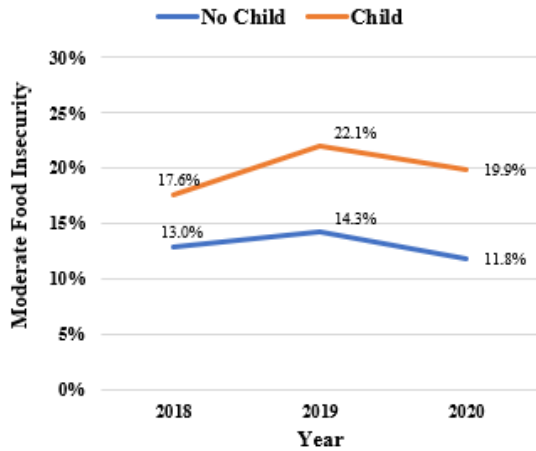


Figure 2b: Interaction effect between having a child and the year of study on severe household food insecurity.

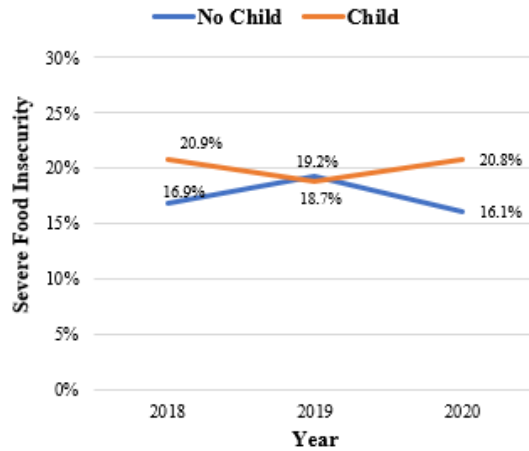


Figure 2c: Interaction effect between education and the year of study on moderate household food insecurity.

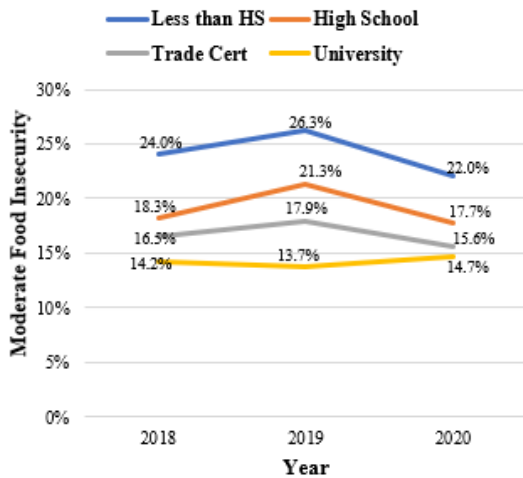
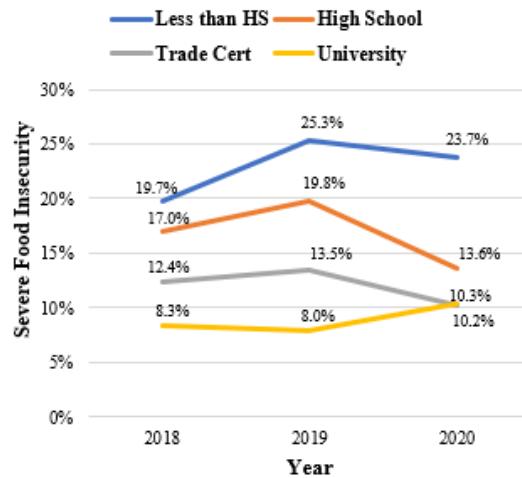


Figure 2d: Interaction effect between education and the year of study on severe household food insecurity.



4.4 Food Bank Use in Relation to Household Food Insecurity (Research Question 3)

As shown in Figure 3, the percentage of respondents who reported preparing or consuming food collected from a food bank in the past week was 1.8% in 2018, 2.8% in 2019, and 2.2% in 2020.

Figure 3. Weighted proportion of respondents who reported preparing or consuming food that was collected from a food bank in the past week in Canada in 2018, 2019, and 2020 (n=12488).

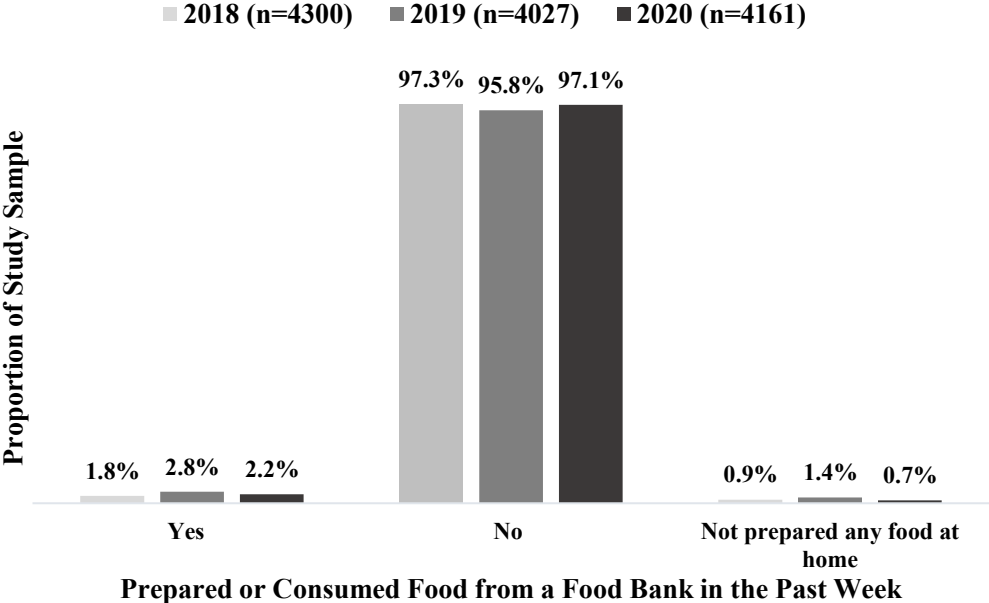


Table 4. Weighted proportion of respondents who prepared or consumed food from a food bank in the past week in Canada by sample characteristics in 2018, 2019, and 2020 (n=12,488).

	2018 (n=4,300)	2019 (n=4,027)	2020 (n=4,161)
Sample Characteristic	Yes	Yes	Yes
Overall	1.8%	2.8%	2.2%
Sex			
Male	1.9%	3.0%	2.0%
Female	1.8%	2.7%	2.4%
Age			
18-34 years	2.2%	4.1%	2.9%
35-44 years	2.4%	3.3%	3.0%
45-64 years	2.1%	2.6%	1.9%
65+ years	0.2%	1.1%	1.3%
Ethnicity			
White only	1.7%	2.7%	1.9%
East/Southeast Asian only	0.3%	1.8%	2.2%
South Asian only	2.3%	2.8%	1.8%
Black only	1.8%	8.4%	1.1%
Indigenous inclusive	3.9%	2.4%	10.6%
Mixed/other/not stated/missing	2.6%	4.3%	4.1%
Region			
Alberta	1.8%	2.5%	1.2%
Atlantic Canada	3.3%	7.8%	2.7%
British Columbia	2.3%	2.5%	2.5%
Manitoba	1.7%	3.7%	1.4%
Ontario	1.2%	2.2%	2.3%
Quebec	2.4%	2.9%	2.5%
Saskatchewan	0.0%	1.3%	0.5%
Perceived Income Adequacy			
Very difficult	6.7%	8.4%	10.0%
Difficult	3.5%	4.3%	3.9%
Neither easy nor difficult	0.9%	2.0%	1.5%
Easy	0.7%	1.9%	0.6%
Very easy	0.6%	0.2%	0.4%
Education			
Less than high school diploma	0.8%	4.0%	3.8%
High school	2.8%	3.6%	2.7%
Trade certificate, diploma, or some university	2.0%	2.5%	1.6%
University degree	1.2%	1.7	1.6%
Occupation			
Employed	1.2%	1.6%	1.3%
Unemployed	3.5%	10.0%	5.5%
Caregiver/Homemaker	3.1%	3.6%	4.7%
Student	1.5%	4.0%	2.3%
Illness/Disability	5.8%	9.4%	4.9%
Retired	1.2%	1.5%	1.0%
Other	3.6%	5.3%	4.8%
Lives with a child			
No	1.7%	2.9%	2.0%
Yes	2.5%	2.6%	3.4%
Food security status			
Food secure	0.5%	0.7%	0.4%
Moderately food insecure	3.3%	4.8%	4.2%
Severely food insecure	6.8%	9.2%	9.2%

4.4.1 Preparing or Consuming Food Collected from a Food Bank Over Time

After adjusting for sociodemographic variables in a logistic regression model, there was moderate evidence of a change in preparing or consuming food collected from a food bank in the past week across the years of study ($F=2.56$, $p=0.0772$). There was moderate evidence that the proportion of respondents who prepared or consumed food from a food bank in the past week was higher in 2019 compared to 2018 (OR:1.49; CI:1.05-2.12). There were no other differences when comparing 2019 to 2020 and 2018 to 2020.

A sensitivity analysis was conducted to examine if adjusting for perceived income adequacy suppressed the contribution of year in the model. When perceived income adequacy was removed from the model, the effect of year on the proportion of respondents who prepared or consumed food from a food bank in the past week was similar ($F=2.50$, $p=0.0819$).

4.4.2 Sample Characteristics Associated with Preparing or Consuming Food Collected from a Food Bank in the Past Week

In the main effects logistic regression model described above, food security status, occupation, and region were associated with preparing or consuming food collected from a food bank (see Table 5). Compared to those who lived in food-secure households, the odds of preparing or consuming food collected from a food bank was substantially higher among respondents who lived in moderately food-insecure households (OR=6.10; CI:3.37, 11.03) and severely food-insecure households (OR=10.37; CI:5.55, 19.34). Compared to those who were employed, preparing or consuming food collected from a food bank was more likely among respondents who were unemployed (OR=2.83; CI:1.67, 4.82), caregivers/homemakers (OR=2.42; CI:1.49, 3.94), and those who were ill or on disability (OR=3.25; CI:1.66, 6.39). Compared to those in Ontario, respondents who resided in Quebec (OR=1.58; CI:1.05, 2.28) and the Atlantic provinces (OR=2.48; CI:1.39, 4.41) were more likely to have reported preparing or consuming food collected from a food bank.

Table 5. Adjusted estimates from a logistic regression of respondents preparing or consuming food collected from a food bank in the past week in Canada with combined data from 2018, 2019, and 2020 (n=12,488)

	Food bank use (vs None)
	OR, 95%CI (p value)
Year	
2018 vs. 2019	1.49, 1.05-2.12 (p=0.0263)
2019 vs. 2020	1.13, 0.77-1.64 (p=0.5359)
2018 vs. 2020	1.32, 0.90-1.94 (p=0.1501)
Sex	
Male	Ref
Female	0.81, 0.59-1.09 (p=0.1665)
Age	
18-34 years	Ref
35-44 years	1.10, 0.70-1.74 (p=0.6662)
45-64 years	0.96, 0.63-1.45 (p=0.8436)
65+ years	0.64, 0.26-1.58 (p=0.3349)
Ethnicity	
White only	Ref
East/Southeast Asian only	1.02, 0.54-1.92 (p=0.9520)
South Asian only	0.97, 0.45-2.11 (p=0.9480)
Black only	1.52, 0.56-4.12 (p=0.4136)
Indigenous inclusive	1.41, 0.74-2.68 (p=0.3004)
Mixed/other/not stated/missing	1.40, 0.81-2.42 (p=0.2274)
Region	
Alberta	0.89, 0.49-1.61 (p=0.6973)
Atlantic Canada	2.48, 1.39-4.41 (p=0.0020)
British Columbia	1.29, 0.81-2.05 (p=0.2882)
Manitoba	1.12, 0.53-2.36 (p=0.7694)
Ontario	Ref
Quebec	1.55, 1.05-2.28 (p=0.0265)
Saskatchewan	0.23, 0.05-1.07 (p=0.0615)
Perceived Income Adequacy	
Very difficult	1.72, 1.08-2.74 (p=0.0222)
Difficult	1.27, 0.81-1.99 (p=0.2948)
Neither easy nor difficult	Ref
Easy	1.08, 0.61-1.92 (p=0.7944)
Very easy	0.56, 0.22-1.42 (p=0.2232)
Education	
Less than high school diploma	Ref
High school	1.63, 0.93-2.87 (p=0.0896)
Trade certificate, diploma, or some university	1.47, 0.83-2.60 (p=0.1869)
University degree	1.58, 0.83, 3.00 (p=0.1601)
Occupation	
Employed	Ref
Unemployed	2.83, 1.67-4.82 (p=0.0001)
Caregiver/Homemaker	2.42, 1.49-3.94 (p=0.0004)
Student	1.88, 0.93-3.81 (p=0.0790)
Illness/Disability	3.25, 1.80-5.88 (p<0.0001)
Retired	1.98, 0.98-3.99 (p=0.0571)
Other	3.26, 1.66-6.39 (p=0.0006)
Lives with a child	
No	Ref
Yes	1.15, 0.78-1.69 (p=0.4690)
Food security status	
Food secure	Ref
Moderately food insecure	6.10, 3.37-11.03 (p<0.0001)
Severely food insecure	10.37, 5.55-19.38 (p<0.0001)

*All odds ratios are adjusted for all other variables in the table

*Odds of food bank use in reference to no food bank use

A sensitivity analysis was conducted to examine if adjusting for perceived income adequacy suppressed the associations between sociodemographic variables and food bank use. When only perceived income adequacy was removed from the model, there were similar

associations between sociodemographic variables and preparing or consuming food collected from a food bank. A second sensitivity analysis was conducted to examine if adjusting for food security status suppressed the relationship between sociodemographics and preparing or consuming food collected from a food bank in the past week. Food insecurity is a strong mediator between sociodemographic variables and food bank use. COVID-19 is hypothesized to alter food insecurity; thus, including food security status in the model may shroud other associations with food bank use. When food security status was removed from the model, perceived income adequacy was associated with preparing or consuming food collected from a food bank in the past week. Compared to those who reported it was "neither easy nor difficult" to meet their financial needs, those who reported it was "very difficult" to meet their needs had almost five times greater odds of preparing or consuming food collected from a food bank in the past week (OR=4.81; CI:3.16, 7.33). Compared to those who reported it was "very easy" to meet their needs, those who reported it was "very difficult" had almost thirteen times greater odds of preparing or consuming food collected from a food bank in the past week (OR=12.83; CI:5.00, 32.91).

4.4.3 Interaction Effects Between Year and Food Insecurity on Preparing or Consuming Food Collected from a Food Bank in the Past Week

Interaction terms between year and sociodemographic variables were added to the main effects logistic regression model to examine the potential for differential reports of preparing or consuming food collected from a food bank over time by sample characteristics. Only region had a significant interaction with year ($F=17.00$, $p<0.0001$). To test for differences in preparing or consuming food collected from a food bank across sociodemographic groups with the same household food security status, interaction terms between household food security status and sociodemographic variables were tested for significance. There was evidence of interactions between household food security status and perceived income adequacy ($F=108.14$, $p<0.0001$), occupation ($F=1.99$, $p=0.0211$), region ($F=16.85$, $p<0.0001$), and age ($F=3.32$, $p=0.0029$). There was a steep increase in reports of preparing or consuming food collected from a food bank in the Atlantic provinces in 2019, followed by a decrease in 2020; a similar change with a smaller difference across years was seen in Alberta, Manitoba, and Saskatchewan. In contrast, there was very little change across years in Quebec, BC, and Ontario. Having a more severe level of household food insecurity was associated with respondents preparing or consuming food collected from a food bank across perceived income levels, except for those who reported it was "easy" to meet their needs, who had similar levels of preparing or consuming food collected from a food bank at moderate and severe household food insecurity. Our findings show that students in severely food-insecure households had disproportionately low reports of preparing or consuming food collected from a food bank (compared to students in moderately food-insecure households), while respondents who were retired had higher reports of preparing or consuming food collected from a food bank in severely food-insecure households, compared to other occupations. There was a steeper increase in reports of preparing or consuming food collected from a food bank from moderate to severe household food insecurity in Manitoba compared to other regions. Respondents 65+ were more likely to report preparing or consuming food collected from a food bank when living in moderately food-insecure households than other age groups. See Figures 4 and 5 for a visual representation of the interaction effects.

Figure 4. Interaction effects between year and region on preparing or consuming food collected from a food bank. The graph shows the weighted proportion of respondents who prepared or consumed food from a food bank in the past week in 2018, 2019, and 2020 (n=12,488).

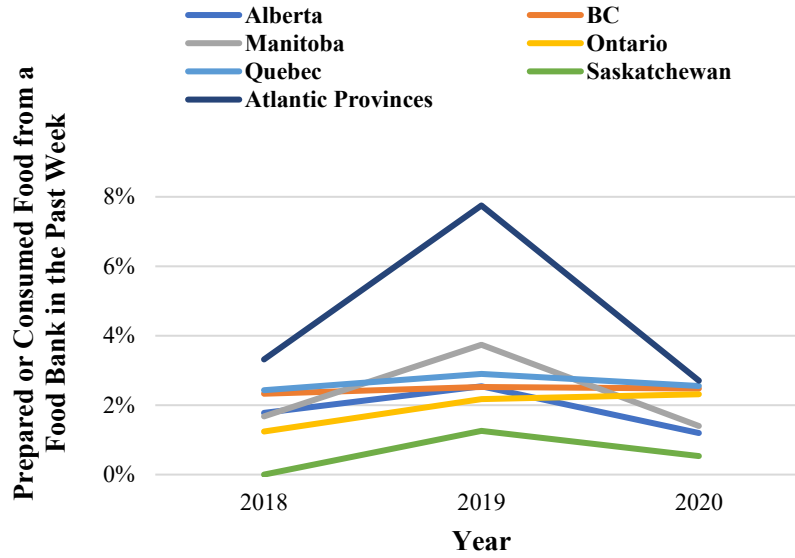


Figure 5: Interaction effects between household food security status and perceived income adequacy, education, region, and age group. Graphs show the weighted proportion of respondents who prepared or consumed food from a food bank in the past week with combined data from 2018, 2019, and 2020 (n=12,488).

Figure 5a: Interaction effect between household food security status and perceived income adequacy on preparing or consuming food from a food bank.

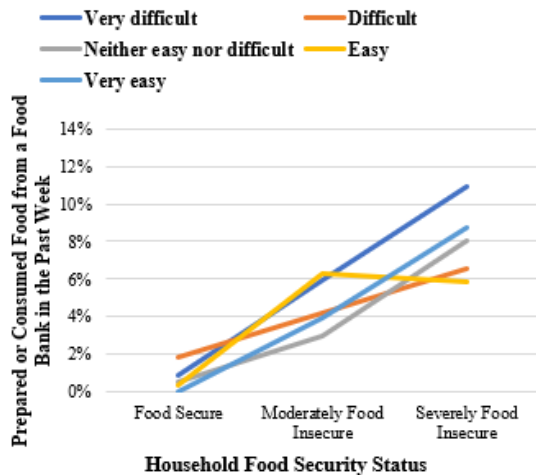


Figure 5b: Interaction effect between household food security status and education on preparing or consuming food from a food bank.

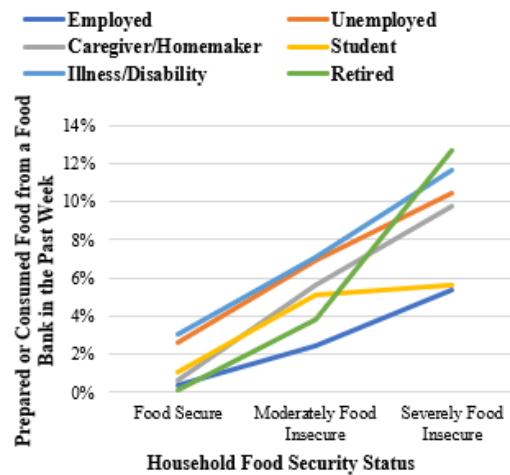


Figure 5c: Interaction effect between household food security status and region on preparing or consuming food from a food bank.

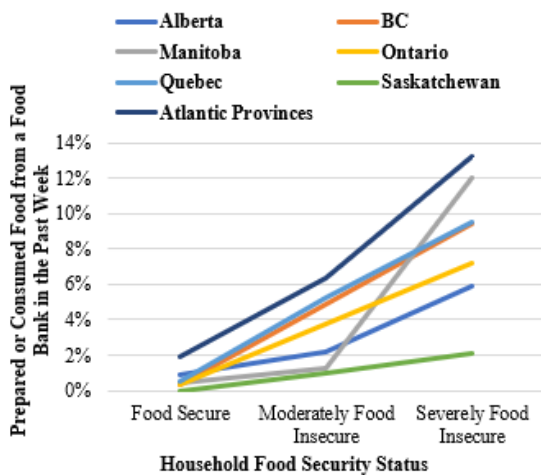
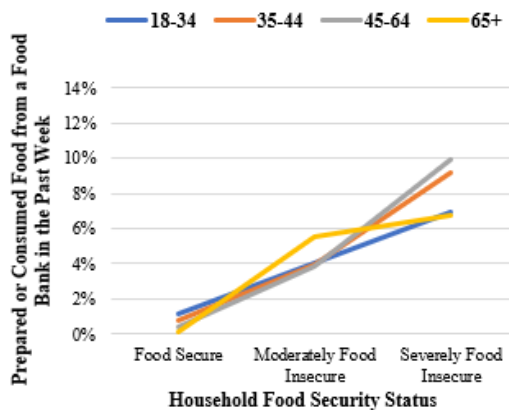


Figure 5d: Interaction effect between household food security status and age group on preparing or consuming food from a food bank.



4.5 Self-Reported Impact of COVID-19 on Household Food Insecurity (Research Question 4)

As shown in Table 6, 5.6% of respondents self-reported the COVID-19 pandemic had affected whether the household had enough to eat "a lot", 23.5% "a little", and 70.9% "not at all". Respondents who self-reported that COVID-19 had impacted whether their household had enough to eat, were then asked if the impacts of COVID-19 were 'currently' having an effect. Among these respondents, 58.7% self-reported that COVID-19 impacted whether their household 'currently' had enough to eat "a little", and 15.1% "a lot". In addition, 44% of

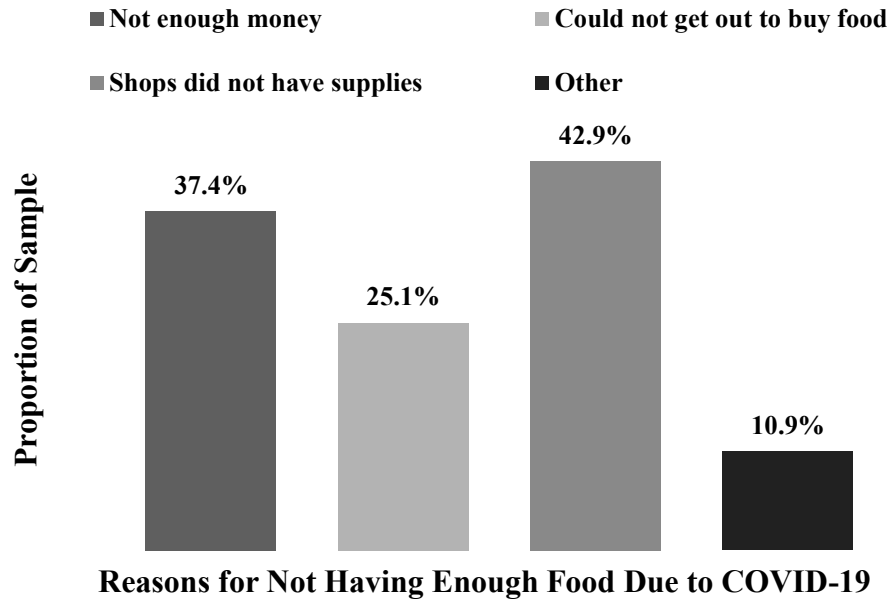
respondents self-reported that COVID-19 had at least a ‘minor impact’ on their ability to meet financial obligations or essential needs

Table 6. Weighted proportion of respondents' self-reported impact of the COVID-19 pandemic, 2020 (n=4,177).

Has the COVID-19 pandemic affected whether your household has had enough food to eat? (n=4,177)	
Not at all	70.9%
A little	23.5%
A lot	5.6%
Is the COVID-19 pandemic currently affecting whether your household has enough food to eat? (n=4,177)	
Not at all	7.6%
A little	17.1%
A lot	4.4%
Has the COVID-19 pandemic affected your ability to meet financial obligations or essential needs, such as rent or mortgage payments, utilities and groceries? (n=4,177)	
Major impact	7.3%
Moderate impact	14.6%
Minor impact	22.1%
No impact	53.0%
Too soon to tell	2.9%

As shown in Figure 6, most of those who reported that COVID-19 impacted whether their household had enough to eat by "a little" or "a lot" stated that it was due to shops not having enough supplies or the household not having enough money. The question posed allowed respondents to "select all" responses; therefore, the responses above are not mutually exclusive.

Figure 6: Weighted proportion of respondents' reasons for their household not having enough food to eat because of the COVID-19 pandemic, 2020 (n=1,256)



*Only those who self-reported that the COVID-19 pandemic affected whether their household has had enough food to eat

**Those who selected "don't know" and "refuse to answer" are not shown above but account for 3.4% and 0.5%, respectively

4.5.1 Sample Characteristics Associated with Self-Reported Impact of COVID-19 on Household Food Insecurity

In the main effects multinomial regression model described above, perceived income adequacy, self-reported impact of COVID-19 on finances, age group, living with a child, and race were associated with the self-reported impact of COVID-19 on whether households had enough food to eat. Perceived income adequacy and the self-reported financial impact of the pandemic were strongly associated with the self-reported impact of COVID-19 on household food security. Those who reported that it was "very difficult" to meet their financial needs had higher odds (OR=9.67; CI:4.98, 18.79) of self-reporting COVID-19 had "a lot" of impact on their household having enough food to eat, compared to those who said it was "neither easy nor difficult". Those who self-reported that COVID-19 affected their ability to meet financial obligations minorly (OR=2.89; CI:1.54, 5.45), moderately (OR=9.99; CI:6.31, 15.83), and majorly (OR=38.23; CI:19.83, 73.70) were more likely than respondents who self-reported COVID-19 had no impact on finances to self-report that COVID-19 had "a lot" of impact on whether their household had enough to eat. Compared to child-free households, those who lived with a child under 18 years old had over twice the odds (OR=2.51; CI:1.58, 3.99) of self-reporting COVID-19 had "a lot" of impact on whether their household had enough to eat. Respondents in younger age groups were more likely to self-report "a little" impact of COVID-19 on household food insecurity, but there was no difference across age groups for "a lot" of

impact. Those who were 18-34 had about twice the odds of self-reporting COVID-19 had "a little" impact on whether their household had enough to eat (OR=2.58; CI:1.65, 4.05) than those 65+. Compared to respondents who identified as White only, those who identified as South Asian only, Black only, and Mixed/not stated were at greater odds of self-reporting "a little" impact of COVID-19 on whether their household had enough to eat.

Table 7. Weighted proportion of respondents' self-reported impact of COVID-19 on whether their household had enough to eat by sample characteristics, 2020 (n=4,177)

Sample Characteristic	Total (n=4177)		
	Not at all	A little	A lot
Overall	70.9%	23.5%	5.6%
Sex			
Male	71.4%	22.7%	5.9%
Female	70.3%	24.3%	5.4%
Age			
18-34 years	54.9%	37.4%	7.7%
35-44 years	65.8%	27.2%	7.0%
45-64 years	74.9%	19.8%	5.4%
65+ years	88.4%	9.1%	2.4%
Ethnicity			
White only	74.6%	20.4%	4.9%
East/Southeast Asian only	65.3%	27.6%	7.1%
South Asian only	46.0%	41.2%	12.8%
Black only	53.8%	39.4%	6.8%
Indigenous inclusive	59.1%	35.3%	5.6%
Mixed/other/not stated/missing	54.2%	37.3%	8.5%
Region			
Alberta	62.2%	30.5%	7.3%
Atlantic Canada	78.6%	16.5%	4.9%
British Columbia	67.2%	26.2%	6.6%
Manitoba	71.3%	20.5%	8.2%
Ontario	70.0%	25.1%	4.9%
Quebec	75.9%	18.9%	5.2%
Saskatchewan	78.6%	16.5%	4.9%
Perceived Income Adequacy			
Very difficult	21.3%	47.1%	31.6%
Difficult	46.9%	45.6%	7.4%
Neither easy nor difficult	73.6%	23.1%	3.3%
Easy	87.2%	10.3%	2.5%
Very easy	95.5%	2.9%	1.5%
Education			
Less than high school diploma	61.8%	28.5%	9.6%
High school	70.9%	24.9%	4.2%
Trade certificate, diploma, or some university	73.8%	21.0%	5.2%
University degree	72.6%	22.1%	5.2%
Occupation			
Employed	69.2%	25.0%	5.8%
Unemployed	46.4%	44.4%	9.2%
Caregiver/Homemaker	67.2%	25.5%	7.3%
Student	61.7%	33.2%	5.1%
Illness/Disability	56.4%	34.6%	9.0%
Retired	87.5%	9.7%	2.8%
Other	69.0%	21.3%	9.7%
Lives with a child			
No	72.7%	22.6%	4.7%
Yes	62.4%	27.6%	10.0%

Table 8. Adjusted estimates from a multinomial regression of respondents' self-reported impact of COVID-19 on whether their household had enough to eat by sample characteristics, 2020 (n=4,177)

	“A little” (vs “No impact”)* OR, 95%CI (p value)	“A lot” (vs “No impact”)* OR, 95%CI (p value)
Sex		
Male	Ref	
Female	0.99, 0.80-1.22 (p=0.9021)	0.68, 0.47-1.00 (p=0.0507)
Age		
18-34 years	Ref	
35-44 years	0.60, 0.45-0.79 (p=0.0004)	0.73, 0.42-1.26 (p=0.2569)
45-64 years	0.48, 0.37-0.62 (p<0.0001)	0.68, 0.40-1.15 (p=0.1479)
65+ years	0.39, 0.25-0.61 (p<0.0001)	0.52, 0.19-1.46 (p=0.2161)
Ethnicity		
White only	Ref	
East/Southeast Asian only	1.13, 0.81-1.58 (p=0.4730)	1.78, 0.91-3.47 (p=0.0891)
South Asian only	2.10, 1.34-3.29 (p=0.0013)	3.12, 1.52-6.42 (p=0.0020)
Black only	2.28, 1.25-4.17 (p=0.0073)	2.26, 0.61-8.29 (p=0.2193)
Indigenous inclusive	1.53, 0.78-2.97 (p=0.2129)	1.04, 0.36-3.04 (p=0.9351)
Mixed/other/not stated/missing	1.64, 1.05-2.57 (p=0.0286)	1.25, 0.54-2.90 (p=0.6027)
Region		
Alberta	1.26, 0.89-1.77 (p=0.1864)	1.74, 0.92-3.27 (p=0.0860)
Atlantic Canada	0.58, 0.34-0.99 (p=0.0444)	1.19, 0.55-2.57 (p=0.6496)
British Columbia	1.14, 0.82-1.58 (p=0.4229)	1.37, 0.76-2.47 (p=0.3010)
Manitoba	0.78, 0.44-1.40 (p=0.4080)	1.45, 0.58-3.64 (p=0.4281)
Ontario	Ref	
Quebec	0.93, 0.70-1.22 (p=0.5895)	1.32, 0.74-2.33 (p=0.3446)
Saskatchewan	0.57, 0.31-1.04 (p=0.0660)	0.62, 0.21-1.86 (p=0.3960)
Perceived Income Adequacy		
Very difficult	3.79, 2.36-6.08 (p<0.0001)	9.67, 4.98-18.79 (p<0.0001)
Difficult	1.66, 1.26-2.18 (p=0.0003)	1.36, 0.75-2.46 (p=0.3174)
Neither easy nor difficult	Ref	
Easy	0.54, 0.41-0.71 (p<0.0001)	0.83, 0.45-1.55 (p=0.5602)
Very easy	0.23, 0.14-0.40 (p<0.0001)	0.73, 0.31-1.73 (p=0.4810)
Education		
Less than high school diploma	Ref	
High school	0.77, 0.51-1.17 (p=0.2258)	0.34, 0.17-0.70 (p=0.0033)
Trade certificate, diploma, or some university	0.62, 0.41-0.93 (p=0.0197)	0.38, 0.19-0.74 (p=0.0042)
University degree	0.68, 0.44-1.04 (p=0.0744)	0.38, 0.18-0.80 (p=0.0104)
Occupation		
Employed	Ref	
Unemployed	1.20, 0.84-1.71 (p=0.3188)	0.71, 0.37-1.38 (p=0.3107)
Caregiver/Homemaker	0.69, 0.47-0.99 (p=0.0467)	0.79, 0.40-1.54 (p=0.4844)
Student	0.72, 0.44-1.17 (p=0.1883)	0.71, 0.31-1.65 (p=0.4253)
Illness/Disability	1.35, 0.81-2.25 (p=0.2467)	1.45, 0.57-3.69 (p=0.4377)
Retired	0.86, 0.59-1.25 (p=0.4224)	1.31, 0.52-3.27 (p=0.5638)
Other	0.68, 0.31-1.53 (p=0.3574)	1.40, 0.61-3.19 (p=0.4272)
Lives with a child		
No	Ref	
Yes	1.19, 0.92-1.54 (p=0.1809)	2.51, 1.58-3.99 (p<0.0001)
COVID-19 impact on finances		
No impact	Ref	
Minor impact	5.82, 4.39-7.71 (p<0.0001)	2.89, 1.54-5.45 (p=0.0010)
Moderate impact	9.89, 7.17-13.64 (p<0.0001)	11.20, 1.09-20.58 (p<0.0001)
Major impact	9.99, 6.31-15.83 (p<0.0001)	38.23, 19.83-73.70 (p<0.0001)
Too soon to tell	2.92, 1.55-5.49 (p=0.0009)	0.75, 0.13-4.35 (p=0.7516)

All odds ratios are adjusted for all other variables in the table

*Odds of "a little" impact in reference to "no impact"

**Odds of "a lot" of impact in reference to "no impact"

To understand if adjusting for perceived income adequacy suppressed the relationship between sociodemographic characteristics and the self-reported impact of COVID-19 on whether

their household had enough to eat, a sensitivity analysis was conducted. When only perceived income adequacy was removed from the model, there were similar associations between sociodemographic variables and the self-reported impact of COVID-19 on whether households had enough to eat, with several of these magnified. For example, when perceived income adequacy was removed from the model, those who self-reported that COVID-19 had a major impact on their finances had about 94 times the odds of self-reporting that COVID-19 had "a lot" of impact on whether their household had enough food to eat (OR=93.88; CI: 52.26, 168.65).

5.0 Discussion

The current study is among the few to examine changes in food security at the national level before and during the pandemic in Canada. Overall, the study has four primary findings. First, the proportion of respondents who lived in households that were food insecure was higher in 2019 than 2018, but in 2020, was similar to 2018 levels. Second, there were notable differences in household food insecurity across sociodemographic groups; however, most of these associations appeared to be consistent across years, except for education and having a child. Third, respondents who had lower perceived income adequacy and reported greater financial impact from the pandemic were more likely to self-report that the COVID-19 pandemic affected whether their household had enough food to eat. Finally, household food insecurity was strongly associated with preparing or consuming food collected from a food bank in the past week, following similar changes as household food insecurity over time. These findings are discussed in the following paragraphs.

The proportion of respondents who lived in a food-insecure household increased a moderate amount from 2018 to 2019 before decreasing to 2018 levels in 2020. It was hypothesized that household food insecurity would be highest in 2020, due to increased financial stress from the COVID-19 pandemic. Instead, household food insecurity was highest in the year preceding the pandemic's onset and decreased after the start of the COVID-19 pandemic to 2018 levels. CCHS data from 2020 similarly suggest a decrease in the proportion of Canadians living in food-insecure households, from 12.6% in 2017/2018 to 9.6% in September-December 2020 [63]. Data from the current study and CCHS were collected in fall 2020, which was approximately six to nine months into the pandemic. In contrast, the CPSS2 found a higher proportion of respondents living in food-insecure households in May 2020 (14.6%) compared to 2017/2018 (10.5%) [59,64]. The mixed findings on the impact of the COVID-19 pandemic on household food insecurity may reflect the specific time of data collection and the government assistance available. It is possible that the hardships of lost work seen in the first wave of the pandemic were mitigated by government financial aid, or that they were temporary until people regained employment. The federal government provided substantial financial assistance to Canadians, such as the Canada Emergency Response Benefit (CERB)—available between March and Oct 2020—which provided funds to those who lost work or were working reduced hours due to the pandemic [61]. In addition, the Canada Emergency Student Benefit (CESB) provided funds to post-secondary students and recent graduates in the summer months of 2020 [74]. After the end of CERB, the government provided other financial assistance, such as the Canada Recovery Caregiving Benefit (CRCB), the Canada Recovery Sickness Benefit (CRSB), and the Canada Recovery Benefit (CRB). The CRB, which closed on Dec 23, 2021, provided income to individuals who lost employment or had their income reduced by half due to the COVID-19 pandemic [75]. The CRCB provided \$500 each week, up to a maximum of 44 weeks between Sept 27, 2020 and May 7, 2022 for employed individuals who must miss work to take care of a child or a family member who needs care, or because they are sick or self-isolating [76]. The CRSB provided \$500 each week, up to a maximum of 6 weeks between Sept 27, 2020 and May 7, 2022 for individuals who must miss work due to being sick or needing to isolate because of COVID-19 [77]. Early research indicates that support from the government was likely a

contributing factor in reducing financial hardships seen in COVID-19, with 28.3% of adults of working age in Canada reporting receiving financial aid [78,79]. Since low income is strongly associated with food insecurity, it is plausible that increased cash flow from the government reduced the prevalence of household food insecurity. The findings add to the body of research that suggests a relationship between government assistance and reduced food insecurity, which could inform policy decisions and government action to best address ongoing food insecurity [35,53,63]. Future research should examine any potential changes in household food insecurity in Canada following the end of emergency financial aid, such as the CRCB and the CRSB in May 2022.

Several studies have examined the relationship between the COVID-19 pandemic and food insecurity in other countries. In the US, a population-level survey in Vermont from March 29 to April 12, 2020 found a 32.3% increase in household food insecurity among the 3219 respondents [80]. Of the food-insecure households, 35.5% were classified as newly food insecure [80]. Respondents who had a job loss or job disruption were at higher odds of living in food-insecure households [80]. However, data collected in Nov-Dec 2020 as part of the USDA Economic Research Service showed that 10.5% of respondents were food insecure, which was unchanged from 2019 estimates [81]. In Australia, the US HFSSM short form was employed by Kent et al. in May-June 2020; researchers found that 26% of 1170 Australian households surveyed were food-insecure and that the odds of experiencing household food insecurity doubled if household income dropped by more than 25% [82]. In the UK, the Food Foundation commissioned seven nationally representative surveys using an adapted version of the HFSSM to take place between March 2020 and January 2021 to analyze the impact of COVID-19 on food insecurity [83]. They found that household food insecurity spiked in the first two weeks of lockdown in March-April 2020 at 15.6%, and has since come back down to 7.4% in January 2021 [83]. Overall, it appears that household food insecurity rose in several countries following the beginning of the pandemic but has since decreased to pre-pandemic levels. In comparison, the current findings suggest that household food insecurity levels in 2020 were similar to those in 2018.

The findings highlight the marked differences in household food security across socioeconomic groups. As expected, respondents with lower perceived income adequacy were at substantially greater risk of living in food-insecure households. Food insecurity is one facet of material deprivation, which is highly associated with inadequate income and limited assets [29]. A state of low income and limited assets reduces a household's ability to cover expenses when income falls or budget costs (e.g., rent) increase [84]. Since food is not a fixed expenditure, disruptions to income adequacy can result in a lack of money for food being a recurring situation [84]. Viewing household food insecurity as a consequence of a lack of income and not solely a lack of food should be considered for policymakers working to reduce the prevalence of food insecurity in Canada. Increasing the income adequacy of households with universal basic income is a potential solution to stop the cycle of food insecurity because the government would provide all adult citizens with a regular sum of money.

As anticipated, respondents with lower levels of education were more likely to live in moderately and severely food-insecure households. The findings mirror other research in Canada

which shows that households with at least one member with a university degree or other post-secondary education are less likely to experience household food insecurity than those who have completed high school or are yet to finish high school [29]. However, there was an interaction with the year of study and education, where respondents who had only finished high school saw a steep decline in severe household food insecurity from 2019 to 2020, while those who had university degrees saw a slight increase.

Racial differences related to food insecurity remained consistent across years of study. Although the majority of respondents who lived in food-insecure households identified as White only, those who identified as Black only, Indigenous, and mixed/other/not stated had approximately twice the odds of living in moderately and severely food-insecure households—an association which remained unchanged over the three years of study. Similarly, data from the CCHS 2017/2018 collection period indicated that households where the respondent identified as Black or Indigenous were more likely to be food insecure [29]. A recent study was conducted using pooled data from the 2005-2014 CCHS cycles to examine the differential vulnerability to food insecurity of Black households in Canada [42]. Dhunna and Tarasuk found that being racialized as Black was a determining factor of household food security status after adjustment for sociodemographic characteristics, such that Black respondents had twice the odds of experiencing household food insecurity when compared to White respondents [42]. When Indigenous food insecurity was evaluated by the First Nations Food, Nutrition, and Environment Study, they found that an astonishing 47.9% of respondents' households were food insecure, with higher rates in households in rural communities and households with children [85]. The current study found that 53.5% of respondents who identified as Indigenous lived in moderately or severely food-insecure households. These findings highlight the importance of eliminating systemic racism and racial factors in food insecurity and other inequalities. Households with children are more at risk of food insecurity due to increased financial obligations, with those headed by a single mother most at risk [86]. Respondents who lived with children under 18 years were at greater risk of living in moderately and severely food-insecure households, as hypothesized. Similarly, CCHS data from 2017/2018 showed that 16.2% of households with a child or children were food insecure, in comparison to 11.4% of child-free households [29]. The current study indicates an interaction effect between having children and the year of study, where respondents with children had a dip in the likelihood of living in a severely food-insecure household in 2019, while those without children saw a peak. The levels of household food insecurity for respondents that had children were similar in 2018 and 2020. In contrast, CCHS data collected in the fall of 2020 found that households with children had lower food insecurity than in 2017/2018 [63]. It is unlikely that the level of food insecurity for households with children maintained similar levels in 2020 as in 2018 due to financial aid from the government, since there was only a one-time supplement to the Canada Child Benefit during May 2020 [63]. Alongside the analysis of food insecurity with the HFSSM, the self-reported question on COVID-19 impacting whether the household had enough food to eat provides a complementary approach to understanding the extent to which Canadians perceived the impact of the pandemic. Fewer than one-third of respondents self-reported that the COVID-19 pandemic affected whether their household had enough food to eat. Of those who reported that COVID-19 affected whether their household had enough to eat, the two most popular reasons stated were due to shops not

having enough supplies (42.9%) or the household not having enough money for food (37.4%). Although not having physical access to food does broadly fit under the definition of food insecurity, the HFSSM only captures household food insecurity due to a lack of money and may be less likely to capture other reasons related to access (i.e., shops not having enough supplies) [8]. This may indicate some discrepancy between the lived experience of adults living in Canada during the pandemic with the validated scale used to evaluate food insecurity. However, the majority of disruptions to the food supply chain in Canada, including grocery store shortages, were neither long-lasting nor exhaustive [55,87]. Grocery stores did not run out of food entirely, though certain products (e.g., dry pasta, pasta sauce, frozen fruits and vegetables) could sometimes have been cleared from shelves before being restocked [87]. A survey conducted between April-August 2020 in BC found that respondents reported it was relatively easy to access food during the COVID-19 pandemic, with those who had children and those who identified as Indigenous reporting more difficulty in accessing food [88]. Additionally, it is important to note that the question posed to respondents did not ask whether the pandemic improved or worsened their ability to have enough to eat. However, the two most common reasons given by respondents suggest that many experienced a negative impact on their food security status. Since this question was posed concerning any time during the pandemic, it is possible that the worsened food insecurity occurred at the start of the pandemic before government assistance was distributed. This would be similar to other findings which found that food insecurity was higher at the start of the pandemic and then dropped to below 2017/2018 levels as time went on [59,63].

As expected, respondents with low perceived income adequacy were more likely to self-report that COVID-19 impacted whether their household had enough to eat. A similar relationship was seen with respondents self-reporting that the pandemic had an impact on the household's ability to meet financial obligations. The pandemic brought economic hardship to many households in Canada with unemployment and reduced work hours, especially to those at lower income levels [54]. Despite the protective effect of government financial assistance, several groups would have fallen through the cracks, such as those who were already out of the workforce at the start of the pandemic [61]. This points to the importance of comprehensive social safety nets, to provide needed financial aid to people with a wide variety of experiences.

Several sociodemographic factors were associated with the self-reported impact of COVID-19 on household food insecurity, such as having a child under 18 years old, being in a younger age group, and identifying as South Asian only, Black only, and mixed/not stated. Interestingly, the associations for age group and race were only evident when comparing "a little" impact to "none at all". This might be due to low perceived income adequacy or a self-reported major impact on finances overriding other associations, as both were strongly associated with self-reporting COVID-19 had "a lot" of impact on whether the household had enough food to eat. As expected, respondents in high-risk groups for household food insecurity as measured by the HFSSM were also more likely to self-report that the pandemic affected whether their household had enough to eat. It is of importance to understand how to mitigate the effects of the pandemic and rising costs of living on household food insecurity as we continue into the second year of life with COVID-19. Government financial aid which maintains a household's ability to

afford essentials can not be a temporary emergency solution but long-term preventative measure to alleviate health inequalities.

Changes in the proportion of respondents who reported preparing or consuming food collected from a food bank mirrored changes in household food insecurity over time: increasing in 2019 and with 2020 similar 2018 levels. In contrast, data from Food Banks Canada points to a dip in food bank use from March to May 2020, followed by higher use in the fall than baseline [53]. At the start of the COVID-19 pandemic, Food Banks Canada found that there was a rise in use for 52% of food banks, with a quarter of food banks seeing an increase in use greater than 25% [89]. However, as the months progressed, food bank use declined, which was attributed to government financial aid (e.g., CERB), restrictions on travel, and temporary food support initiatives [89]. From June 2020 into the fall, food banks once again saw increases in use as pandemic unemployment and cost of living remained high [53].

On average, 0.5% of respondents who lived in food-secure households, 4.1% of respondents who lived in moderately food-insecure households, and 8.4% of respondents who lived in severely food-insecure households prepared or consumed food collected from a food bank in the past week. As predicted, the proportion of respondents who prepared or consumed food collected from a food bank was lower than 10%, even among those who lived in severely food-insecure households. Our findings are similar to those from the CPSS2, which found that 9.3% of respondents who lived in food-insecure households in May 2020 reported accessing free food [64]. The findings are also consistent with previous studies indicating that food bank use is regarded to be the last resort by many people who live in food-insecure households [46]. Previous research has found that those who live in food-insecure households are more likely to ask family and friends for financial help or to miss bill payments than to access food from a food bank [47]. Data from the Hunger Count 2021 points to the cost of food, social assistance being too low, cost of housing, and unemployment as the top four reasons people accessed a food bank [53]. Although food banks and other community food programs (e.g., soup kitchens) are not the answer to solving food insecurity, they play a role in the temporary relief of hunger.

The predictors for preparing or consuming food collected from a food bank in the past week were similar to those of household food insecurity. Most sociodemographic groups were more likely to prepare or consume food collected from a food bank when living in severely food insecure households. In contrast, students had similar proportions of respondents who prepared or consumed food from a food bank when living in moderately and severely food-insecure households. Respondents who were unemployed, caregivers/homemakers, and ill or on disability were more likely to prepare or consume food collected from a food bank regardless of the food security status of their household. It was expected that preparing or consuming food collected from a food bank would be associated with not being employed as food bank use has been previously associated with government assistance [49].

5.5 Strengths and Limitations

The study has several strengths including the large sample size and recruitment of adults across provinces in Canada. In addition, the IFPS has annual survey waves using the same methodology before and after the COVID-19 pandemic. However, this study is subject to

limitations common to survey research. Respondents were recruited using nonprobability-based sampling; therefore, the findings do not provide nationally representative estimates. Although data have been weighted for age, sex, education, and region, the sample included in the analysis may differ from the Canadian population in other important ways (e.g., racial identity). As well, Canadians living in less populous areas (i.e., the territories) were not included in the analysis, which limits generalizability to these regions. The study is repeat cross-sectional, which means that it does not provide prospective cohort data and, therefore, cannot examine changes within individuals over time, which limits causal inferences about the impact of sociodemographic variables and food insecurity. However, repeat cross-sectional designs are superior for estimating prevalence changes at the population level.

The IFPS estimates of household food insecurity are higher than other nationally representative surveys in Canada. In 2020, the current study found that 8.9% of respondents lived in marginally food-insecure households, 17.0% in moderately food-insecure households, and 13.2% in severely food-insecure households. In comparison, results from the CCHS 2020 data collection showed that 3.3% of respondents lived in households that were marginally food-insecure, 5.8% in households that were moderately food-insecure, and 1.7% in households that were severely food-insecure [63]. Data collected from the CPSS2 found slightly higher estimates, such that 5.8% of respondents lived in households that were marginally food-insecure, 6.8% in households that were moderately food-insecure, and 2.0% in households that were severely food-insecure [64]. There are several possible reasons for these discrepancies. First, the surveys used different modes. IFPS and CPSS2 used online surveys, whereas CCHS interviews were conducted over the telephone. The survey mode may affect the results obtained due to the "mode effect". In a study to test the effect of survey mode, the Pew Research Centre randomly assigned respondents to complete the same survey on the phone or the web [90]. Both groups were weighted independently to be representative of the US population and the same measures were completed to ensure that the only difference was in the mode of the survey [90]. Interestingly, more survey respondents using the web (28%) than those using the phone (20%) indicated that they did not have enough money to buy food for their family [90]. It is possible that respondents felt less social desirability bias when reporting food insecurity in an internet-based survey than when speaking to a live person. Respondents may under report food insecurity, especially that which impacts children, to appear more socially desirable [91]. Second, the surveys have a different sampling method. The IFPS uses nonprobability-based sampling while the CCHS uses a two-step procedure to randomly sample dwellings and then randomly assign a respondent of the household, which would provide more representative estimates than IFPS [92]. There may be differences in the characteristics of the IFPS sample and that of CCHS which leads to higher estimates of food insecurity in our sample. For example, IFPS had high proportions of respondents in our sample report living with a child under 18 years (over 80%) compared to the Canadian census in 2016 which found over half of households were either as couples without children or one-person households [93]. Third, the surveys were conducted at different time periods in 2020. The IFPS data was collected in Nov-Dec 2020, the CCHS in Sept-Dec 2020, and the CPSS2 in early May 2020 [63,64]. Other studies have found that household food insecurity increased earlier in the pandemic (March-April 2020), but then came down to pre-pandemic levels in late 2020/2021 [80,81,83].

The question used as a proxy measure for food bank use only captures whether the respondent prepared food at home that was collected from a food bank in the past seven days. That is a small window and may not reflect the true use of food banks by those who are food insecure; therefore, the proportion of respondents who said "yes" to the proxy measure of food bank use likely underrepresented the true proportion of the sample who make use of food banks. As well, the survey measure does not consider other ways people may access free food, such as from a 'soup kitchen' or other community-based services.

Although odds ratios are common in public health research, there is confusion around their interpretation [94]. When the odds ratio is small, it is more similar to the relative risk; when the odds ratio is large, it is prone to misinterpretation and overestimation of benefit or risk [95]. For example, the two largest odds ratios were manually converted to relative risk (RR) to disclose the notable difference. Compared to those who reported it was "neither easy nor difficult" to meet their financial needs, those who reported it was "very difficult" to meet their needs had almost fourteen times the risk (RR=13.96) or 50 times the odds (OR=52.33; CI:38.84, 70.50) of living in a severely food-insecure household. Compared to those who reported it was "very easy" to meet their needs, those who reported it was "very difficult" had 27 times the risk (RR=26.83) or 113 times greater odds (OR=113.59; CI:73.49, 175.56) of living in a severely food-insecure household.

5.6 Conclusion

The first waves of the COVID-19 pandemic radically altered work and daily life in Canada; thus, the pandemic had the potential to contribute to household food insecurity via reduced income and limited access to assistance programs. In the current study, substantial proportions of adults living in Canada self-reported that the pandemic affected whether their household had enough to eat, particularly those with lower socioeconomic status. However, overall proportions of respondents who lived in food-insecure households and prepared or consumed food collected from a food bank in the past week were highest in 2019, with 2020 levels similar to 2018. The findings, along with other research in Canada, suggest that governmental financial assistance may have been effective in moderating the impact of the pandemic on income adequacy and, consequently, household food insecurity during the first months of the pandemic. As emergency response benefits ease and the cost-of-living increases, it is vital for policymakers to recognize that an adequate income is needed to improve food insecurity and its related health disparities.

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APPENDIX

Table 9. Weighted proportion of the sample living in households with varying degrees of food security in Canada in 2018, 2019, and 2020 (12,537).

Level of Food Insecurity	2018 (n=4,317)	2019 (n=4,046)	2020 (n=4,174)	Total (12,537)
Food Insecure	40.5%	43.5%	39.1%	41.0%
Marginal	9.1%	8.7%	8.9%	8.9%
Moderate	17.6%	19.1%	17.0%	17.9%
Severe	13.8%	15.7%	13.2%	14.2%
Food Secure	59.5%	56.5%	60.9%	59.0%