



# Food insecurity among Canadian youth and young adults: insights from the Canada Food Study

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## Abstract

**Objective** This study explored associations between socio-demographic characteristics, self-reported health, and household food security among young adults.

**Methods** National cohort study participants from Toronto, Montreal, Vancouver, Edmonton, and Halifax, Canada, aged 16–30 years ( $n = 2149$ ) completed online surveys. Multinomial logistic regression, weighted to reflect age and sex proportions from the 2016 census, was conducted to examine associations between food security status and covariates.

**Results** Almost 30% of respondents lived in food-insecure households, with 19% in “moderately” food-insecure and 10% in “severely” food-insecure households. Respondents identifying as Black or Indigenous were more likely to live in moderately (AOR = 1.96, CI: 1.10, 3.50; AOR = 3.15, CI: 1.60, 6.20) and severely (AOR = 4.25, CI: 2.07, 8.74; AOR = 6.34, CI: 2.81, 14.30) food-insecure households compared with those identifying as mixed/other ethnicity. Respondents who found it “very difficult” to make ends meet were more likely to be moderately (AOR = 20.37, CI: 11.07, 37.46) and severely (AOR = 101.33, CI: 41.11, 249.77) food insecure. Respondents classified as “normal” weight (AOR = 0.64, CI: 0.43, 0.96) or overweight (AOR = 0.53, CI: 0.34, 0.83) were less likely to be moderately food insecure compared with those affected by obesity. Compared with “very good or excellent,” “poor” health, diet quality, and mental health were each positively associated with severe food insecurity (AOR = 7.09, CI: 2.44, 20.61; AOR = 2.63, CI: 1.08, 6.41; AOR = 2.09, CI: 1.03, 4.23, respectively).

**Conclusion** The high prevalence of correlates of food insecurity among young adults suggests the need for policies that consider the unique challenges (e.g., precarious income) and vulnerability associated with this life stage.

## Résumé

**Objectif** Explorer les associations entre le profil sociodémographique, l'état de santé autodéclaré et la sécurité alimentaire du ménage chez les jeunes adultes.

**Méthode** Des participants d'une étude de cohorte nationale de Toronto, Montréal, Vancouver, Edmonton et Halifax (Canada) âgés de 16 à 30 ans ( $n = 2\ 149$ ) ont répondu à des sondages en ligne. Nous avons procédé à une régression logistique multinomiale, pondérée selon les proportions d'âge et de sexe dans le recensement de 2016, pour examiner les associations entre l'état de sécurité alimentaire et ses covariables.

**Résultats** Près de 30 % des répondants vivaient dans des ménages aux prises avec l'insécurité alimentaire, dont 19 % dans des ménages « modérément » exposés à l'insécurité alimentaire et 10 % dans des ménages en situation d'insécurité alimentaire « grave ». Les répondants s'étant identifiés comme étant noirs ou autochtones étaient plus susceptibles de vivre dans des ménages en situation d'insécurité alimentaire modérée (RCa = 1,96, IC : 1,10, 3,50; RCa = 3,15, IC : 1,60, 6,20) et grave (RCa = 4,25, IC : 2,07, 8,74; RCa = 6,34, IC : 2,81, 14,30) que les répondants s'étant identifiés comme étant d'ethnicité mixte/autre. Les répondants qui trouvaient « très difficile » de joindre les deux bouts étaient plus susceptibles d'être en situation d'insécurité alimentaire modérée (RCa = 20,37, IC : 11,07, 37,46) et grave (RCa = 101,33, IC : 41,11, 249,77). Les répondants classés comme étant de poids « normal » (RCa = 0,64,

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IC : 0,43, 0,96) ou en surpoids (RCa = 0,53, IC : 0,34, 0,83) étaient moins susceptibles d'être en situation d'insécurité alimentaire modérée que les répondants touchés par l'obésité. Comparativement aux réponses « très bonne ou excellente », la santé, la qualité du régime ou la santé mentale « mauvaise » était associée positivement à l'insécurité alimentaire grave (RCa = 7,09, IC : 2,44, 20,61; RCa = 2,63, IC : 1,08, 6,41; RCa = 2,09, IC : 1,03, 4,23, respectivement).

**Conclusion** La forte prévalence des corrélats de l'insécurité alimentaire chez les jeunes adultes indique qu'il faut des politiques qui tiennent compte des difficultés uniques (p. ex. le revenu précaire) et de la vulnérabilité associées à ce stade de la vie.

**Keywords** Food insecurity · Youth · Young adult · Canada

**Mots-clés** Insécurité alimentaire · jeunes · jeune adulte · Canada

## Introduction

Food insecurity is recognized as a serious public health concern in Canada and other countries worldwide (FAO, 2018). In high-income countries, food insecurity is often conceptualized as constrained access to adequate food due to financial shortages, with manifestations ranging from worry and anxiety about accessing sufficient food, to compromises in diet quality and quantity (FAO, 2018; PROOF, 2014; Statistics Canada, 2014a). Food insecurity has been associated with a myriad of health problems, with longitudinal studies pointing to increased risk for noncommunicable conditions such as mental health issues and chronic disease (i.e., type 2 diabetes) (Bruening et al., 2017; PROOF, 2014). In Canada, the latest nationally representative data suggest that food insecurity affects over one in ten households, representing 4 million Canadians, including 1.15 million children (PROOF, 2014).

The underlying causes of food insecurity are multifactorial and complex (FAO, 2018; Statistics Canada, 2010). Economic and social factors, including income and income sources, housing circumstances, and household composition (i.e., role and number of people residing in a household), are among the key determinants of food security status, with some population subgroups experiencing greater vulnerability to food insecurity than others (FAO, 2018; Statistics Canada, 2010). In Canada, the most vulnerable groups identified by analyses of national surveillance data include households with children under 18 years (approximately 16% food insecure compared to 10% without children), lone-parent families headed by women (33.5%), households in Northern Territories, e.g., Nunavut (60%), those who rent rather than own their dwellings (25%), households reliant on social assistance (58%), and households with incomes below the low-income measure (29%) (PROOF, 2014; Statistics Canada, 2015a).

Youth and young adults, hereafter referred to as young adults, may be particularly vulnerable to food insecurity, as they are at a critical transition phase often characterized by social, economic, and physical changes (PHAC, 2014). Indeed, studies have found an inverse relationship between age and the likelihood of household food insecurity, as young

adults are more likely than other age groups to experience insufficient food access or unaffordability (Baer et al., 2015; Kirkpatrick & Tarasuk, 2008). In Canada, unemployment rates are higher among young adults aged 15–24 years compared with other age groups, thereby putting them at greater risk for food insecurity (Dietitians of Canada, 2016; Statistics Canada, 2018a). Indications of high vulnerability to food insecurity among young adults are especially worrisome given deleterious implications for their physical and mental health (Baer et al., 2015; Bruening et al., 2017; Dietitians of Canada, 2016; PROOF, 2014). Despite indications of high vulnerability, young adults are understudied compared to other at-risk groups. Thus, this paper explores the relationship between food security status, socio-demographic characteristics, and perceived health among this sensitive life stage using cross-sectional data from a national cohort study of Canadian young adults.

## Methods

### Study design

The Canada Food Study is a 3-year prospective cohort study conducted in five Canadian cities (Edmonton, Alberta; Vancouver, British Columbia; Halifax, Nova Scotia; Toronto, Ontario; and Montreal, Québec). These sites were selected as they are major cities in Canada, and population-level nutrition interventions are implemented at the municipal level. Each city also serves as a proxy for evaluating provincial-level policies implemented in Alberta, British Columbia, Nova Scotia, Ontario, and Québec. The multi-city data collection and quasi-experimental design enable examination of eating patterns and trends among youth and young adults in Canada. This study used cross-sectional data from the 2016 wave of the Canada Food Study.

### Sampling and data collection

Participants were recruited between October and December 2016 using a face-to-face intercept sampling method, stratified

by region and type of location (e.g., mall, transit hub, park, other shopping district) in each city. Recruitment from public spaces facilitated a more heterogeneous sample compared with other studies among youth and young adults based in post-secondary settings. Eligible individuals were between 16 and 30 years of age, were fluent in English or French, resided in one of the five cities, and reported internet access on a laptop, desktop computer, or tablet. Participants ( $n = 3000$ ) completed web-based surveys between October and December 2016, which included a main survey on dietary behaviours, including food shopping patterns, food security, and meal planning, as well as two Automated Self-Administered 24-hour (ASA24) dietary assessments. All participants were shown the survey in English, by default, but they had the option to change the language to French by clicking a button at the top of the screen. The survey was created using Survey Gizmo, an online platform which enabled survey administration via desktops, laptops, and tablets. Respondents were discouraged from attempting to complete the survey via smartphones, but were not restricted from doing so. One survey question was displayed on the screen at a time, and respondents had the option of using the back button to return to earlier questions if necessary. The response rate was 48.1%, among whom 86.4% and 13.6% fully or partially completed the survey, respectively. The median time to complete the main survey was 53 minutes. Respondents received a \$2 cash incentive upon initial recruitment and a \$20 *Interac* e-transfer after completing the study. Consent was provided electronically prior to survey completion. The study was reviewed and received ethics clearance through a University of Waterloo research ethics committee (ORE #21631). A full description of the study methods can be found in the technical report (Hammond, White & Reid, 2019).

Of the total 3000 respondents who completed the 2016 Canada Food Study survey, a subsample of 2149 respondents were included in the current study after excluding those with missing data for household food security and the covariates of interest. Approximately 19% of the sample did not provide responses to questions on height and weight, constituting the bulk of the missing data.

## Measures

### Household food security status

The Household Food Security Survey Module (HFSSM) was used to ascertain household food security status (Government of Canada, 2012a; Statistics Canada, 2015b). The HFSSM was developed by the United States (US) Department of Agriculture (USDA, 2013) and is widely used, including in the Canadian Community Health Survey (CCHS) (Statistics Canada, 2010). The HFSSM includes 18 items, with the number of affirmative responses used to classify individuals based

on household food security status. In this study, coding developed by Health Canada was applied to categorize individuals who were living in households characterized as food secure, or moderately or severely food insecure (Government of Canada, 2012b). According to Health Canada, households were food secure if they “had access, at all times throughout the previous year, to enough food for an active, healthy life for all household members” (Government of Canada, 2012b). Moderate food insecurity indicates a “compromise in quality and/or quantity of food consumed,” and severe food insecurity reflects “reduced food intake and disrupted eating patterns” over the past year (Government of Canada, 2012b). Within the full HFSSM, 10 items are referenced to adults (i.e., Adult Scale), whereas 8 items are child-referenced (i.e., Child Scale); the latter are completed only in households including children < 18 years of age. Based on the number of affirmative items (i.e., “yes,” “often,” “sometimes,” “almost every month,” “some months but not every month”) for each scale, adult and child food security status were determined separately. In households without children, adult food security status is consistent with household food security status. In households with children, indications of food insecurity at either the adult or child level are indicative of household food insecurity. Households classified as food secure provided none or one affirmative response (Government of Canada, 2012b).

### Socio-demographic and health measures

Potential correlates of food insecurity were identified based on a review of previous literature in Canada (Dietitians of Canada, 2016; Kirkpatrick & Tarasuk, 2008; PHAC, 2014; PROOF, 2014; Statistics Canada, 2010; Statistics Canada, 2015a, Statistics Canada, 2015b). The literature points to differences in prevalence and experience of food insecurity by age, sex, race/ethnicity, parental status, education/employment status, and income (Dietitians of Canada, 2016; FAO, 2018; PROOF, 2014; Statistics Canada, 2015b). Age groups were classified as 16–18, 19–21, 22–25, and 26–30 years to allow for comparisons with national estimates and across phases of youth, adolescence, and emerging adulthood (Hammond, White, & Reid, 2019). Sex was determined by asking, “What sex were you assigned at birth, meaning on your original birth certificate?” with response options “male” and “female.” Race/ethnicity was derived from 2014 CCHS survey questions that asked participants to select all applicable racial or ethnic groups from a list of 12 options (White, Chinese, South Asian [e.g., East Indian, Pakistani, Sri Lankan], Black, Filipino, Latin American, Southeast Asian [e.g., Cambodian, Indonesian, Laotian, Vietnamese], Arab, West Asian [e.g., Afghan, Iranian], Japanese, Korean, Aboriginal [First Nations, Métis, Inuit] or Other [please specify]); the “mixed/other” category includes respondents who selected more than one race/ethnicity category, as well as those who did not respond

(Statistics Canada, 2014b). National estimates of food security status also indicate that families with children are more vulnerable to food insecurity (PROOF, 2014; Statistics Canada, 2014a); thus, parental status was included in our analyses. Parental status was determined by asking, “Do you have any children (including step children or adopted children)?” and coded as a dichotomous variable (yes/no). To determine education/employment status, respondents were asked, “Do you currently work at a job or business?” with response options ranging from “yes—full time (30 hours or more per week),” “yes—part-time (less than 30 hours per week),” “no—looking for work,” and “no—not looking for work.” A derived occupation variable was created due to the small number of responses when spread across the original four categories. The derived variable reclassified respondents by full- or part-time commitments: full-time or part-time work or student (which included all combinations of full-time and part-time work or study, full-time work with or without part-time study, full-time study with or without part-time work, part-time work and full-time study, and part-time work and study), part-time work or student status only (included part-time work only and part-time study only), and unemployed categories—looking for work or not looking for work. Respondents were not asked for an estimate of household income because this has been shown to be a poor income measure among youth and young adults due to their transitioning lifestyles and living conditions (Baer et al., 2015; PHAC, 2014). To better reflect income status, respondents were asked, “Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?” (Litwin & Sapir, 2009). The categories “easy” and “very easy” were collapsed for analysis.

Self-reported general health, mental health, and diet quality were also considered because health status may impact ability to acquire and access food (FAO, 2018). While there continues to be mixed literature on the relationship between food security and weight status, body mass index (BMI) was included to explore this association among a young adult cohort. BMI was calculated using self-reported height and weight. Respondents were asked, “How tall are you without shoes?” and “How much do you weigh without clothes or shoes?” Responses in centimetres were converted to metres (for height), and stones or pounds were converted to kilograms (for weight). BMI was calculated as kilograms per square metre. Respondents were classified as “underweight” if their BMI was < 18.5, “normal weight” for BMI ranging between 18.5 and 24.9, “overweight” for BMI ranging between 25.0 and 29.9, and “obese” if their BMI was 30 or over (WHO, 2020). Measures from the CCHS (Statistics Canada, 2019) were adopted to assess perceived general health (“In general, would you say your health is [fair, good, very good, excellent]?”), perceived mental health status (“In general, how would you say your mental health is?”), and perceived

diet quality (“In general, how healthy is your overall diet?”), with 5-point Likert scale responses (poor, fair, good, very good, excellent) collapsed into four categories merging “very good” and “excellent” for analysis.

## Statistical analyses

Descriptive statistics were derived to summarize sample characteristics (Table 1). A multinomial logistic regression was fitted with food security as the dependent variable (moderate insecurity and severe insecurity versus food secure as the reference category). The model adjusted for all socio-demographic (age group, sex, race/ethnicity, parental status, education/employment status, income adequacy) and health-related variables (BMI, self-report general health, mental health, diet quality) described above. A variable indicating city of residence was included in models given the stratified nature of the sample. Values of  $p < 0.05$  were considered significant and confidence intervals are also provided to aid interpretation. Multicollinearity between the independent variables was tested using the variable inflation factor, and potential confounding variables were assessed by running and comparing stratified (i.e., by age group, sex) versus full sample models. Logistic regressions were assessed for goodness of fit by comparing  $R^2$  values to determine the final model.

Adjusted odds ratios (AOR) are reported with 95% confidence intervals (CIs). Data were weighted with post-stratification sample weights constructed based on population estimates from the most recent census data available (2011) (Hammond, White & Reid, 2019). Sample probabilities were created for 30 demographic groups (age by sex) based on weighted proportions. Weights were calculated as (1/sample probability) for each group and applied to the full dataset of 3000 participants. All reported estimates are weighted unless otherwise specified. Analyses were conducted using IBM SPSS version 24 (Armonk, NY).

## Results

The weighted sample was predominantly White (53%), did not identify as parents (97.6%), and were students/working part- or full-time (87.7%) (Table 1). The majority of the sample was classified as living in food-secure households (71.7%), 18.9% lived in households affected by moderate food insecurity, and 9.5% lived in severely food-insecure households (Table 1). A high proportion of respondents between the ages of 19 and 21 years lived in moderately (20%) and severely (10.4%) food-insecure households, as did respondents between the ages of 22 and 25 years (18.3% moderately food insecure, 11.4% severely food insecure) and 26 and 30 years (19.6% moderately food insecure, 9.3% severely food insecure) (Table 2). A high proportion of respondents who had part-time work or were students experienced

**Table 1** Sample characteristics ( $N = 2149$ ), Canada Food Study, 2016

Characteristic	Unweighted % ( <i>n</i> )	Weighted % ( <i>n</i> )
Age group (years)		
16–18	20.2% (423)	13.2% (284)
19–21	28.9% (604)	18.8% (405)
22–25	29.3% (613)	29.5% (633)
26–30	21.6% (451)	38.5% (827)
Sex at birth		
Male	39.1% (818)	50.7% (1090)
Female	60.9% (1273)	49.3% (1059)
City of residence		
Edmonton	24.2% (505)	23.7% (509)
Halifax	16.8% (352)	18.1% (388)
Montreal	20.3% (425)	18.0% (387)
Toronto	18.4% (385)	17.4% (374)
Vancouver	20.3% (424)	22.8% (490)
Race/ethnicity		
White only	51.9% (1086)	53.1% (1140)
Asian (Chinese or South Asian)	15.8% (330)	15.9% (341)
Black only	5.0% (105)	4.7% (100)
Aboriginal (inclusive)	3.8% (79)	3.5% (76)
Mixed or other, not stated or missing	23.5% (491)	22.9% (492)
Parental status		
Yes (at least one child)	2.4% (51)	3.9% (83)
No	97.6% (2040)	96.1% (2066)
BMI category		
Underweight	7.8% (164)	6.4% (137)
Normal weight	62.8% (1314)	62.0% (1332)
Overweight	19.8% (415)	21.7% (466)
Obese	9.5% (198)	10.0% (214)
Education/employment status		
F/T or P/T work or student	87.7% (1834)	84.9% (1824)
P/T work or student status only	6.6% (139)	7.7% (165)
Unemployed—looking for work or not looking for work	5.6% (118)	7.4% (160)
Income adequacy		
Very difficult to make ends meet	5.6% (117)	5.9% (126)
Difficult to make ends meet	18.4% (384)	18.7% (403)
Neither easy nor difficult to make ends meet	43.6% (911)	43.1% (926)
Easy or very easy to make ends meet	32.5% (679)	32.3% (694)
Household size		
One	23.0% (481)	26.2% (563)
Two	23.8% (497)	28.3% (609)
Three	19.7% (411)	17.8% (383)
Four	18.5% (386)	15.2% (327)
Five or more	15.1% (316)	12.4% (267)
Perceived general health		
Poor	3.2% (66)	2.9% (62)
Fair	25.3% (528)	24.1% (518)
Good	42.7% (893)	42.4% (912)
Very good or excellent	28.9% (604)	30.5% (656)
Perceived diet quality		

**Table 1** (continued)

Characteristic	Unweighted % (n)	Weighted % (n)
Poor	8.6% (179)	7.9% (170)
Fair	31.3% (655)	30.0% (645)
Good	38.7% (809)	38.9% (845)
Very good or excellent	21.4% (448)	23.2% (499)
Perceived mental health		
Poor	8.0% (167)	6.7% (144)
Fair	23.0% (480)	20.2% (433)
Good	33.8% (707)	34.2% (734)
Very good or excellent	35.2% (737)	39.0% (838)
Household food security status		
Food secure	72.0% (1506)	71.7% (1540)
Food insecure, moderate	18.6% (389)	18.9% (405)
Food insecure, severe	9.4% (196)	9.5% (204)

Notes: *BMI* body mass index, *F/T* full-time, *P/T* part-time

\* BMI was classified using the World Health Organization cut-offs where underweight is < 18.4999, normal weight is 18.50–24.991, overweight is 24.992 to 29.991, and obese is 29.992 and above

moderate food insecurity (29.7%), and respondents who were “looking” or “not looking” for work made up the greatest proportion of those who were severely food insecure (20.1%) (Table 2).

Based on the multinomial logistic regression (Table 2), males were 1.32 times more likely to live in moderately food-insecure households than food-secure households compared with females (adjusted odds ratio [AOR] = 1.32, CI: 1.02, 1.71). Those who worked part-time or were students had 2.83 times higher odds (CI: 1.49, 5.36) of living in moderately food-insecure households than those “looking” or “not looking” for work. Respondents with children also had higher odds of living in moderately (AOR = 3.37, CI: 1.74, 6.53) and severely (AOR = 4.36, CI: 1.88, 10.08) food-insecure households compared with those without children. Those who identified as Black or Indigenous had higher odds of moderate (AOR = 1.96, CI: 1.10, 3.50; AOR = 3.15, CI: 1.60, 6.20, respectively) and severe (AOR = 4.25, CI: 2.07, 8.74; AOR = 6.34, CI: 2.81, 14.30, respectively) food insecurity, compared with those who identified as mixed/other ethnicity. Respondents who found it “very difficult” to make ends meet had significantly higher odds of living in moderately (AOR = 20.37, CI: 11.07, 37.46) or severely (AOR = 101.33, CI: 41.11, 249.77) food-insecure households compared with those who found it “easy” or “very easy” to make ends meet. Respondents who found it “difficult” to make ends meet were significantly more likely to be affected by moderate (AOR = 16.49, CI: 10.88, 25.00) and severe (AOR = 34.52, CI: 15.63, 76.32) household food insecurity compared with those who found it “easy” or “very easy” to make ends

meet. Those who reported that it was “neither easy nor difficult” to make ends meet were also significantly more likely to be classified as moderately and severely food insecure (AOR = 3.69, 2.51, 5.41; AOR = 5.85, CI: 2.67, 12.82). Age group and household size were not significantly associated with household food security status.

Respondents classified as “normal” weight and those affected by overweight were less likely to be classified as living in moderately food-insecure households compared to those affected by obesity (AOR = 0.64, CI: 0.43, 0.96; AOR = 0.53, CI: 0.34, 0.83, respectively). Respondents who reported poor health had 7.09 times higher odds of living in severely food-insecure households (CI: 2.44, 20.61). Respondents who reported fair health were twice as likely to live in moderately food-insecure households (CI: 1.25, 3.17) and 2.52 times as likely to live in severely food-insecure households (CI: 1.29, 4.94) compared with those who reported very good or excellent health. Those who reported good health were also more likely to report indications of moderate household food insecurity compared with those reporting very good or excellent health (AOR = 1.68, CI: 1.16, 2.45). Respondents who reported poor diet quality had higher odds of living in moderately (AOR = 2.19, CI: 1.14, 4.22) and severely (AOR = 2.63, CI: 1.08, 6.41) food-insecure households compared with those who reported very good or excellent diet quality. Those who reported fair diet quality were also more likely to live in moderately (AOR = 1.95, CI: 1.21, 3.14) and severely (AOR = 2.20, CI: 1.06, 4.60) food-insecure households. Respondents who reported poor mental health were more likely to be classified as living in severely food-insecure households compared with those who reported very good or excellent mental health (AOR = 2.09, CI: 1.03, 4.23).

**Table 2** Socio-demographic and health correlates of household food insecurity status among youth and young adults, aged 16–30 years, Canada Food Study, 2016

Variable	Food security status, weighted						
	Food secure (ref)	Food insecure, moderate			Food insecure, severe		
	% (n)	% (n)	AOR (95% CI)	p value	% (n)	AOR (95% CI)	p value
Age group (years) ( <i>n</i> =2149, <i>p</i> =0.03)							
16–18	79.2% (225)	16.2% (46)	0.98 (0.61, 1.55)	<i>p</i> =0.917	4.6% (13)	0.71 (0.33, 1.52)	<i>p</i> =0.375
19–21	69.6% (282)	20.0% (81)	1.08 (0.74, 1.59)	<i>p</i> =0.687	10.4% (42)	1.44 (0.84, 2.45)	<i>p</i> =0.181
22–25	70.3% (445)	18.3% (116)	0.91 (0.67, 1.26)	<i>p</i> =0.581	11.4% (72)	1.30 (0.84, 2.02)	<i>p</i> =0.234
26–30 (ref)	71.1% (588)	19.6% (162)	-	-	9.3% (77)	-	-
Sex ( <i>n</i> =2149, <i>p</i> =0.072)							
Male	70.6% (769)	20.6% (225)	1.32 (1.02, 1.71)	<i>p</i> =0.033	8.8% (96)	1.03 (0.72, 1.48)	<i>p</i> =0.863
Female (ref)	72.8% (771)	17.0% (180)	-	-	10.2% (108)	-	-
City of residence ( <i>n</i> =2149, <i>p</i> =0.005)							
Toronto	72.4% (369)	19.0% (97)	1.41 (0.96, 2.07)	<i>p</i> =0.078	8.6% (44)	1.08 (0.63, 1.86)	<i>p</i> =0.788
Montreal	72.9% (283)	20.9% (81)	1.64 (1.09, 2.44)	<i>p</i> =0.016	6.2% (24)	0.82 (0.45, 1.50)	<i>p</i> =0.516
Halifax/Dartmouth	64.9% (251)	21.2% (82)	1.71 (1.13, 2.59)	<i>p</i> =0.011	13.9% (54)	1.54 (0.90, 2.65)	<i>p</i> =0.118
Edmonton	71.4% (267)	18.7% (70)	1.18 (0.78, 1.80)	<i>p</i> =0.431	9.9% (37)	0.90 (0.50, 1.60)	<i>p</i> =0.714
Vancouver (ref)	75.5% (370)	15.3% (75)	-	-	9.2% (45)	-	-
Education/employment status ( <i>n</i> =2148, <i>p</i> <0.001)							
F/T or P/T work or student	73.6% (1343)	18.1% (330)	1.40 (0.83, 2.35)	<i>p</i> =0.201	8.3% (151)	0.80 (0.44, 1.44)	<i>p</i> =0.449
P/T work or student only	57.6% (95)	29.7% (49)	2.83 (1.49, 5.36)	<i>p</i> =0.001	12.7% (21)	1.333 (0.611, 2.910)	<i>p</i> =0.470
Unemployed—looking for work or not looking for work (ref)	63.5% (101)	16.3% (26)	-	-	20.1% (32)	-	-
Children ( <i>n</i> =2148, <i>p</i> <0.001)							
Yes	46.3% (38)	30.5% (25)	3.37 (1.734 6.53)	<i>p</i> <0.001	23.2% (19)	4.36 (1.88, 10.08)	<i>p</i> =0.001
No (ref)	72.7% (1502)	13.5% (380)	-	-	8.9% (184)	-	-
Race/ethnicity ( <i>n</i> =2149, <i>p</i> <0.001)							
White only	73.9% (842)	16.9% (193)	1.01 (0.73, 1.40)	<i>p</i> =0.950	9.2% (105)	1.05 (0.67, 1.65)	<i>p</i> =0.818
Asian	78.3% (267)	19.3% (66)	1.09 (0.72, 1.63)	<i>p</i> =0.693	2.3% (8)	0.24 (0.10, 0.56)	<i>p</i> =0.001
Black only	53.0% (53)	27.0% (27)	1.96 (1.10, 3.50)	<i>p</i> =0.023	20.0% (20)	4.25 (2.07, 8.74)	<i>p</i> <0.001
Aboriginal inclusive	43.4% (33)	27.6% (21)	3.15 (1.60, 6.20)	<i>p</i> =0.001	28.9% (22)	6.34 (2.81, 14.30)	<i>p</i> <0.001
Mixed/other/not stated/missing (ref)	70.1% (345)	20.1% (99)	-	-	9.8% (48)	-	-
Income adequacy ( <i>n</i> =2150, <i>p</i> <0.001)							
Very difficult to make ends meet	24.4% (31)	33.1% (42)	20.37 (11.07, 37.46)	<i>p</i> <0.001	42.5% (54)	101.33 (41.11, 249.77)	<i>p</i> <0.001
Difficult to make ends meet	39.4% (159)	39.7% (160)	16.49 (10.88, 25.00)	<i>p</i> <0.001	20.8% (84)	34.52 (15.63, 76.32)	<i>p</i> <0.001
Neither easy nor difficult to make ends meet	75.8% (701)	17.9% (166)	3.69 (2.51, 5.41)	<i>p</i> <0.001	6.3% (58)	5.85 (2.67, 12.82)	<i>p</i> <0.001
Easy or very easy to make ends meet (ref)	93.4% (649)	5.5% (38)	-	-	1.1% (8)	-	-
Household size ( <i>n</i> =2150, <i>p</i> =0.04)							
One	67.0% (377)	20.2% (114)	1.07 (0.68, 1.68)	<i>p</i> =0.774	12.8% (72)	1.79 (0.92, 3.50)	<i>p</i> =0.085
Two	73.6% (449)	17.4% (106)	0.98 (0.62, 1.54)	<i>p</i> =0.923	9.0% (55)	1.56 (0.79, 3.10)	<i>p</i> =0.203
Three	73.6% (282)	17.0% (65)	0.79 (0.49, 1.26)	<i>p</i> =0.328	9.4% (36)	1.07 (0.52, 2.20)	<i>p</i> =0.848
Four	73.1% (239)	20.2% (66)	0.99 (0.62, 1.58)	<i>p</i> =0.928	6.7% (22)	0.88 (0.41, 1.87)	<i>p</i> =0.731
Five or more (ref)	72.7% (194)	20.2% (54)	-	-	7.1% (19)	-	-
BMI classification ( <i>n</i> =2149, <i>p</i> <0.001)							
Underweight	767.9% (93)	19.7% (27)	0.75 (0.41, 1.38)	<i>p</i> =0.356	12.4% (17)	1.74 (0.34, 4.11)	<i>p</i> =0.209
Normal weight	75.2% (1001)	17.3% (231)	0.64 (0.43, 0.96)	<i>p</i> =0.029	7.5% (100)	1.28 (0.70, 2.35)	<i>p</i> =0.425
Overweight	70.0% (326)	17.1% (80)	0.53 (0.34, 0.83)	<i>p</i> =0.006	12.9% (60)	1.55 (0.82, 2.95)	<i>p</i> =0.179
Obese (ref)	56.1% (120)	31.3% (67)	-	-	12.6% (27)	-	-
Perceived general health ( <i>n</i> =2148, <i>p</i> <0.001)							
Poor	43.5% (27)	22.6% (14)	1.85 (0.75, 4.56)	<i>p</i> =0.184	33.9% (21)	7.09 (2.44, 20.61)	<i>p</i> <0.001
Fair	57.3% (297)	26.2% (136)	1.99 (1.25, 3.17)	<i>p</i> =0.004	16.4% (85)	2.52 (1.29, 4.94)	<i>p</i> =0.007
Good	72.1% (658)	20.2% (184)	1.68 (1.16, 2.45)	<i>p</i> =0.007	7.7% (70)	1.33 (0.76, 2.35)	<i>p</i> =0.320
Very good or excellent (ref)	85.1% (558)	10.7% (70)	-	-	4.3% (28)	-	-

**Table 2** (continued)

Variable	Food security status, weighted						
	Food secure (ref)		Food insecure, moderate		Food insecure, severe		
	% (n)	% (n)	AOR (95% CI)	p value	% (n)	AOR (95% CI)	p value
<b>Perceived diet quality</b> (n=2149, p<0.001)							
Poor	43.8% (74)	27.8% (47)	2.19 (1.14, 4.22)	p=0.019	28.4% (48)	2.63 (1.08, 6.41)	p=0.034
Fair	63.9% (413)	24.8% (160)	1.95 (1.21, 3.14)	p=0.006	11.3% (73)	2.20 (1.06, 4.60)	p=0.035
Good	74.1% (619)	18.1% (151)	1.51 (0.99, 2.31)	p=0.057	7.8% (65)	1.73 (0.90, 3.33)	p=0.102
Very good or excellent (ref)	87.0% (434)	9.4% (47)	-	-	3.6% (18)	-	-
<b>Perceived mental health</b> (n=2148, p<0.001)							
Poor	52.4% (75)	21.7% (31)	1.00 (0.56, 1.76)	p=0.995	25.9% (37)	2.09 (1.03, 4.23)	p=0.040
Fair	63.5% (275)	22.6% (98)	1.15 (0.79, 1.67)	p=0.450	13.9% (60)	1.50 (0.87, 2.60)	p=0.114
Good	69.6% (511)	21.0% (154)	1.17 (0.86, 1.60)	p=0.319	9.4% (69)	1.61 (1.00, 2.60)	p=0.052
Very good or excellent (ref)	81.0% (679)	14.6% (122)	-	-	4.4% (37)	-	-

Notes: *AOR* adjusted odds ratio, *CI* confidence intervals, *ref* reference category. Multinomial logistic regression was fitted with food security (moderate insecurity and severe insecurity versus food secure) as the dependent variable. *AOR* is reported alongside *CI* with values  $p < 0.05$  considered significant

## Discussion

This study addresses a key gap in the literature by focusing on food insecurity among young adults and provides important insights into the characteristics of young adults who live in food-insecure households in Canada. A range of potential socio-demographic and self-reported health correlates were assessed. Our findings were consistent with existing literature with respect to the factors associated with food insecurity among adults (Dietitians of Canada, 2016; Kirkpatrick & Tarasuk, 2008; PHAC, 2014; PROOF, 2014; Statistics Canada, 2010; Statistics Canada, 2015a, Statistics Canada, 2015b). Approximately 19% of the sample reported moderate household food insecurity, and 9.5% of young adults were classified as living in severely food-insecure households. These estimates are somewhat higher than estimates for the overall Canadian population (PROOF, 2014; Statistics Canada, 2014a).

Nationally representative data collected in 2011/2012 show that the prevalence of moderate and severe food insecurity (combined) was 9% among youth and young adults aged 12 to 19 years, and 10% among young adults and adults aged 20 to 34 years (Statistics Canada, 2015b). Estimates of food insecurity among young adults in the current study may be higher because more than half of the study sample were students. Studies have shown that students experience specific risk factors for food insecurity, including limited income, increases in cost of tuition and housing, reliance on credit cards and loans, and poor financial and food management skills (Alaimo, 2005; Gaines et al., 2014). In addition, Gaines et al. (2014) note that young adults often lack skills, knowledge, and resources for food management and preparation which contributes to their risk of food insecurity (Gaines et al., 2014). The higher estimates of

food insecurity in this cohort may also be attributed to the sampling strategy, which included recruitment from public spaces including lower income areas in various cities. There is also potential response bias associated with in-person recruitment compared with census data (Haring et al., 2009; Patel, Doku & Tennakoon, 2003).

Nevertheless, this study confirmed income adequacy as a strong correlate of food security status, as participants who reported that it was “very difficult” to make ends meet were more likely to experience moderate or severe household food insecurity. The income adequacy measure is a unique feature of this study, which likely captures the influence of income on food security status more accurately than traditional household income measures for young adults who may be living outside the home (i.e., not with family) (Baer et al., 2015; PHAC, 2014). Income adequacy inherently suggests whether the respondent’s income is sufficient to support their needs, and in the context of food security, is more informative than actual income among this cohort (Litwin & Sapir, 2009).

In general, the relationship between income and food security status is well established, as the ability to afford and access adequate food is largely influenced by income (Darmon & Drewnowski, 2015; Gundersen et al., 2011; Kirkpatrick & Tarasuk, 2008; Kirkpatrick & Tarasuk, 2011; Loopstra & Tarasuk, 2013; McIntyre, Bartoo & Emery, 2012; Middleton et al., 2018; PROOF, 2014; Tarasuk, St-Germain, & Mitchell, 2019). The unique financial situation of youth and young adults, which is commonly characterized by debts or student loans, increases the likelihood that they are unable to afford daily necessities such as food (Alaimo, 2005; Gaines et al., 2014). Among low-income families, purchasing decisions must be made in light of competing demands due to challenges in affording basic needs (i.e., food, shelter). Research



focusing on low-income households residing in the Toronto region found that higher housing costs were associated with higher vulnerability to food insecurity (Kirkpatrick & Tarasuk, 2011), and changes in full-time and part-time employment significantly affected the severity of food insecurity (Loopstra & Tarasuk, 2013). This study similarly found a high proportion of young adults who worked or studied part-time experienced moderate food insecurity (29.7%), and those in the “unemployed” category made up the greatest proportion of those who were severely food insecure (20.1%). Research has shown that household food security is more closely tied to income than employment status; however, respondents “looking for work” were likely most severely impacted due to the lack of income (Dachner & Tarasuk, 2018; McIntyre, Bartoo & Emery, 2012).

Consistent with existing literature, respondents with children were more likely to be classified as food insecure. In Canada, approximately 16% of households with children under 18 years were food insecure in 2012 (PROOF, 2014; Tarasuk, St-Germain, & Mitchell, 2019). Our analysis suggests that 31% of young adults who had children lived in moderately food-insecure households, whereas 23% lived in severely food-insecure households. Parents in this study sample were relatively young, as the oldest respondents were 30 years old, which is the average age of parenthood in Canada (Statistics Canada, 2018b). Thus, respondents who were parents in this study were more likely to have had children at earlier ages. Early parenthood is associated with economic difficulties (Boden et al., 2008; Kirkpatrick & Tarasuk, 2011), likely increasing vulnerability to food insecurity.

The results of this study are similar to those of other Canadian studies with respect to the high levels of vulnerability among Indigenous and Black Canadians (PROOF, 2014; Tarasuk, St-Germain & Mitchell, 2019; Tarasuk, Dachner, & Loopstra, 2014). Analyses of data from the 2014 CCHS found that approximately 26% of Indigenous Canadians and 29% of Black Canadians lived in food-insecure households (PROOF, 2014). Marginalized groups are more likely to experience food insecurity, and while some of these associations can be explained by low income, socio-economic status is a complex concept that cannot be captured using a single measure of income or education. Moreover, the literature suggests that other markers of disadvantage, including social exclusion, structural racism, and intergenerational trauma, also strongly impact food security status by directly or indirectly limiting people’s access to food, nutrition knowledge and food literacy, or the resources required to adapt or cope with food insecurity (Bailey et al., 2017; Gee & Ford, 2011; McKinnon, Giskes, & Turrell, 2013; Odoms-Young, 2018; PROOF, 2014; Ramsey et al., 2012). For example, a recent report found that racialized groups and immigrants experienced greater unemployment and underemployment than other Canadians (Ng & Gagnon, 2020). Indigenous and Black Canadians are also disproportionately

affected by socio-demographic risk factors for food insecurity, including poverty, living in rental accommodations, lone parenthood, and reliance on social assistance (Government of Canada, 2013; PROOF, 2014; Tarasuk, St-Germain & Mitchell, 2019; Tarasuk, Dachner, & Loopstra, 2014).

There is mixed evidence on the relationship between weight status and food insecurity among young adults (Franklin et al., 2012). This study found that respondents classified as “normal” weight and “overweight” based on self-reported height and weight were more likely to be characterized as living in moderately food-insecure versus food-secure households compared with respondents affected by obesity. A study of young adults by Darling et al. (2015) found that those with a history of food insecurity had higher BMI and greater likelihood of disordered eating patterns compared with participants without a history of food insecurity (Darling et al., 2015). In contrast, Sarlio-Lahteenkorva and Lahelma (2001) found that participants classified as “thin” demonstrated the highest levels of food insecurity; however, respondents affected by obesity reported purchasing more inexpensive food items than participants characterized as “normal” weight (Sarlio-Lahteenkorva & Lahelma, 2001). Some literature points to diet quality as an underlying mechanism for associations between weight and food insecurity, as nutrient-poor, energy-dense foods may be more affordable than nutritious foods, and consumers experiencing food insecurity may prioritize price over other attributes of foods and beverages (Franklin et al., 2012). Given the complexity of both food insecurity and body weight, it is not surprising that contradictory findings have been observed.

Regardless of the association between weight status and food insecurity, the consistency with which food insecurity is correlated with poor physical and mental health is worrisome given the implications on later life among youth (Baer et al., 2015; Bruening et al., 2017; FAO, 2018; PROOF, 2014). This study found a higher likelihood of severe food insecurity among respondents reporting poor health, diet quality, or mental health. Associations between poor health and food insecurity may be explained, in part, by socio-demographic risk factors associated with food insecurity (e.g., poverty) (Dietitians of Canada, 2016; Gundersen & Ziliak, 2015; Kirkpatrick & Tarasuk, 2008; PHAC, 2014; PROOF, 2014; Seligman, Laraia & Kushel, 2010; Statistics Canada, 2015b). However, food insecurity itself appears to be a potent indicator of vulnerability to poor physical and mental health. This finding is especially concerning given the already high risk of poor mental health among youth and young adults in Canada (Wiens et al., 2020). Physical health, diet, and mental health are interconnected, and while the association between food security and health outcomes can be considered bi-directional, food insecurity poses a major risk to health and well-being (Davison, Marshall-Fabien & Tecson, 2015; Nagata et al., 2019).

While this study did not explore the coping strategies employed by young adults facing food insecurity, the high risk of food insecurity among youth and young adults warrants appropriate national policies and initiatives. The current approach to address food insecurity in Canada overwhelmingly focuses on providing families with access to food through charitable, community-based programs (i.e., food banks) (Dietitians of Canada, 2016; PHAC, 2014; PROOF, 2014; Tarasuk, Dachner, & Loopstra, 2014; Dachner & Tarasuk, 2018).

Food banks are the primary response to food insecurity in many high-income countries, including Canada, the United Kingdom, the USA, and Australia (Booth & Whelan, 2014; Lambie-Mumford, 2013; Middleton et al., 2018; Riches, 2003). Studies among young adults in these countries have shown a similarly high prevalence of food insecurity, with ethnicity, income, and employment status as key determinants (Food Bank Australia, 2020; Larson et al., 2020; McKay, Haines & Dunn, 2019; Seivwright, Callis & Faltau et al., 2020; Sosenko et al., 2019; Walker et al., 2020). Given the lack of evidence that food bank use alleviates food insecurity, as well as research linking food insecurity to poverty, policies targeting income and employment opportunities for young adults are crucial for promoting food security (PROOF, 2014; Dachner & Tarasuk, 2018).

A growing body of evidence suggests the need for a national food policy which integrates efforts across social, economic, health, and agricultural sectors, as well as various levels of government, to address food insecurity at its source (Dachner & Tarasuk, 2018), instead of the largely community-driven efforts (Dachner & Tarasuk, 2018; Middleton et al., 2018; Tarasuk, Dachner & Loopstra, 2014). For young adults, in particular, national efforts need to be complemented by school curricula and educational campaigns to improve food management skills which could play an important role in mitigating or coping with food insecurity (Gaines et al., 2014). In addition, targeted initiatives are important for young adults who are part-time or full-time students, and should include promotion and provision of financial resources, debt alleviation strategies such as increases in student stipends, review of affordable housing options, improved access to scholarships, and on-campus support.

The key strengths of this study include the large sample size and participant recruitment from a range of settings across Canada. Several considerations should be borne in mind in interpreting the results of this study. The widely used HFSSM, which has been validated against household food supplies and other indicators of food security (Government of Canada, 2012a), was used to ascertain food security status, enabling comparability with other studies. The HFSSM may not reflect the living arrangements of youth, who may reside in non-traditional households (e.g., with roommates, sometimes sharing resources). While the HFSSM asked about “you or other adults in your household...,” it is unclear to what extent responses reflect only individual food security

status versus that of the household. In addition, grouping full-time students with full-time workers limits our ability to identify differences in food security status between these groups, who could potentially have different experiences and vulnerability to food insecurity. This study did not measure reliance on social assistance programs, which is common among a significant proportion of food-insecure households in Canada (Tarasuk, Dachner, & Loopstra, 2014). Studies in this area have not focused on youth and young adulthood; hence, the association between social assistance and food insecurity warrants exploration in future research to determine what proportion of young adults are on social assistance across the varied household types (i.e., at home with parents, roommates, etc.). Further research is also required to assess whether there is an association between food security status and source of income (i.e., employment, social assistance, scholarships).

This study, like many others in the area of food insecurity, was cross-sectional in nature. The lack of longitudinal study designs makes it difficult to identify long-term impacts at different life stages. With respect to sampling, participants were not recruited using a probability-based sample. However, weighting was applied to increase representativeness of Canadian young adults aged 16–30 years. Nonetheless, a large proportion of the sample were students, and due to the sampling strategy and geographic limitations, this study cannot provide nationally representative estimates. This study is subject to social desirability bias due to the use of self-reported outcome measures, including BMI (Caputo, 2017). US-based studies have shown that weight tends to be under-reported, and while it is unlikely that data are missing at random, it is difficult to discern what might underlie the BMI associations observed in this study (Hattori & Sturm, 2013; King et al., 2018; Lin et al., 2012; Merrill & Richardson, 2009; Visscher et al., 2006). Although self-reported data are prone to measurement error, when questions are administered anonymously online, the risk of social desirability bias may be minimized (Caputo, 2017). On the other hand, the use of online surveys may have contributed to response bias as it is expected that the majority of respondents were from the urban city centres in which recruitment occurred, and only those with internet connectivity and access could participate. Last, this study relied on statistical tests of significance to determine factors associated with food insecurity based on a *p* value of 0.05, which may have resulted in omission of potentially relevant factors such as age group and household size (Greenland et al., 2016).

## Conclusion

This study further demonstrates the need to address food insecurity with upstream solutions targeting the unique challenges and life circumstances experienced by young adults.

Preventive strategies focused on improving income and employment opportunities, as well as policies ensuring affordability of housing and food, are critical steps towards addressing food insecurity among young adults. In order to better characterize the issues facing this vulnerable cohort in Canada, continued monitoring and surveillance are essential to unpack the complex pathways that lead to food insecurity and to identify feasible, long-term solutions.

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**Data availability** Available upon request.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Code availability** Available upon request.

**Ethics approval** This study was reviewed and received ethics clearance through a University of Waterloo research ethics committee (ORE #21631).

**Consent to participate** Informed consent was obtained electronically from all individual participants included in the study.

**Consent for publication** Not applicable.

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## References

- Alaimo, K. (2005). Food insecurity in the United States: an overview. *Topics in Clinical Nutrition*, 20, 281–298.
- Baer, T. E., Scherer, E. A., Flegler, E. W., et al. (2015). Food insecurity and the burden of health-related social problems in an urban youth population. *The Journal of Adolescent Health*, 57, 601–607.
- Bailey, Z. D., Krieger, N., Agenor, M., Graves, J., Linos, N., & Bassett, M. T. (2017). Structural racism and health inequities in the USA: evidence and interventions. *Lancet*, 389, 1453–1463.
- Boden, J. M., Fergusson, D. M., & Horwood, J. L. (2008). Early motherhood and subsequent life outcomes. *Journal of Child Psychology*, 49, 151–160.
- Booth, S., & Whelan, J. (2014). Hungry for change: the food banking industry in Australia. *British Food Journal*, 116(9), 1392–1404.
- Bruening, M., Dinour, L. M., & Chavez, J. B. R. (2017). Food insecurity and emotional health in the USA: a systematic narrative review of longitudinal research. *Public Health Nutrition*, 20, 3200–3208.
- Caputo, A. (2017). Social desirability bias in self-reported wellbeing measures: evidence from an online survey. *Universitas Psychologica*, 16, 1–13.
- Dachner, N., & Tarasuk, V. (2018). Tackling household food insecurity: an essential goal of national food policy. *Canadian Food Studies*, 5(3), 230–247.
- Darling, K. E., Fahrenkamp, A. J., Wilson, S. M., et al. (2015). Physical and mental health outcomes associated with prior food insecurity among young adults. *Journal of Health Psychology*, 22, 572–581.
- Darmon, N., & Drewnowski, A. (2015). Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. *Nutrition Reviews*, 73(10), 643–660.
- Davison, K. M., Marshall-Fabien, G. L., & Tecson, A. (2015). Association of moderate and severe food insecurity with suicidal ideation in adults: national survey data from three Canadian provinces. *Social Psychiatry and Psychiatric Epidemiology*, 50, 963–972.
- Dietitians of Canada. (2016). Prevalence, severity and impact of household food insecurity: a serious public health issue. <https://www.dietitians.ca/Downloads/Public/HFI-Background-DC-FINAL.aspx>. Accessed 15 Jul 2018.
- Food and Agriculture Organization of the United Nations (FAO). (2018). The state of food security and nutrition in the world. <http://www.fao.org/state-of-food-security-nutrition/en/>.
- Food Bank Australia. (2020). Food bank hunger report. <https://www.foodbank.org.au/wp-content/uploads/2020/10/FB-HR20.pdf?state=nsw-act>. Accessed 25 Oct 2020.
- Franklin, B., Jones, A., Love, D., Puckett, S., Macklin, J., & White-Means, S. (2012). Exploring mediators of food insecurity and obesity: a review of recent literature. *Journal of Community Health*, 37, 253–264.
- Gaines, A., Robb, C. A., Knol, L. L., & Sickler, S. (2014). Examining the role of financial factors, resources and skills in predicting food security status among college students. *Journal of Consumer Studies*, 28, 374–384.
- Gee, G. C., & Ford, C. L. (2011). Structural racism and health inequities: old issues, new directions. *Du Bois Review: Social Science Research on Race*, 8, 115–110.
- Government of Canada. (2012a). The Household Food Security Survey Module (HFSSM). <https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs/household-food-insecurity-canada-overview/household-food-security-survey-module-hfssm-health-nutrition-surveys-health-canada.html>. Accessed 15 Jul 2018.
- Government of Canada. (2012b). Determining food security status. <https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs/household-food-insecurity-canada-overview/determining-food-security-status-food-nutrition-surveillance-health-canada.html>. Accessed 8 Mar 2019.
- Government of Canada. (2013). Poverty profile: a report by the National Council of Welfare. [https://www.canada.ca/content/dam/esdc-edsc/migration/documents/eng/communities/reports/poverty\\_profile\\_snapshot.pdf](https://www.canada.ca/content/dam/esdc-edsc/migration/documents/eng/communities/reports/poverty_profile_snapshot.pdf). Accessed 25 Oct 2020.
- Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., et al. (2016). Statistical tests, P values, confidence

- intervals, and power: a guide to misinterpretations. *European Journal of Epidemiology*, 21, 337–350.
- Gundersen, C., Kreider, B., & Pepper, J. (2011). The economics of food insecurity in the United States. *Applied Economic Perspectives and Policy*, 33, 281–303.
- Gundersen, C., & Ziliak, J. P. (2015). Food insecurity and health outcomes. *Health Affairs*, 34(11), 1830–1839.
- Hammond, D., White, C. M., & Reid, J. L. (2019). *Canada food study: technical report – wave 1 (2016)*. Waterloo: University of Waterloo [http://canadafoodstudy.ca/wp-content/uploads/2019/02/2016-CFS-Tech-Report\\_20190225.pdf](http://canadafoodstudy.ca/wp-content/uploads/2019/02/2016-CFS-Tech-Report_20190225.pdf). Accessed 14 Oct 2019.
- Hattori, A., & Sturm, R. (2013). The obesity epidemic and changes in self-report biases in BMI. *Obesity*, 21, 856–860.
- Haring, R., Alte, D., Volzke, H., Sauer, S., Walaschofski, H., John, U., & Schmidt, C. O. (2009). Extended recruitment efforts minimize attrition but not necessarily bias. *Journal of Clinical Epidemiology*, 62(3), 252–260.
- King, B. M., Cespedes, V. M., Burden, G. K., Brady, S. K., Clement, L. R., Abbott, E. M., Baughman, K. S., et al. (2018). Extreme under-reporting of body weight by young adults with obesity: relation to social desirability. *Obesity Science and Practice*, 4, 129–133.
- Kirkpatrick, S. I., & Tarasuk, V. (2008). Food insecurity in Canada: considerations for monitoring. *Canadian Journal of Public Health*, 99, 324–327.
- Kirkpatrick, S. I., & Tarasuk, V. (2011). Housing circumstances are associated with household food access among low-income urban families. *Journal of Urban Health*, 88, 284–296.
- Lambie-Mumford, H. (2013). ‘Every town should have one’: emergency food banking in the UK. *Journal of Social Policy*, 42(1), 73–89.
- Lin, C. J., DeRoo, L. A., Jacobs, S. R., & Sandler, D. P. (2012). Accuracy and reliability of self-reported weight and height in the Sister Study. *Public Health Nutrition*, 15, 989–999.
- Larson, N., Laska, M. N., Neumark-Sztainer, D. (2020). Food insecurity, diet quality, home food availability, and health risk behaviors among emerging adults: Findings from the EAT 2010–2018 study. *American Journal of Public Health*, 110, 1422–1428.
- Litwin, H., & Sapir, E. V. (2009). Perceived income adequacy among older adults in 12 countries: findings from the survey of health, ageing, and retirement in Europe. *The Gerontologist*, 49(3), 397–406.
- Loopstra, R., & Tarasuk, V. (2013). Severity of household food insecurity is sensitive to change in household income and employment status among low-income families. *Journal of Nutrition*, 143, 1316–1323.
- McIntyre, L., Bartoo, A., & Emery, J. (2012). When working is not enough: food insecurity in the Canadian labour force. *Public Health Nutrition*, 17(1), 49–57.
- McKay, F. H., Haines, B. C., & Dunn, M. (2019). Measuring and understanding food insecurity in Australia: a systematic review. *International Journal of Environmental Research and Public Health*, 16, 476.
- Merill, R. M., & Richardson, J. S. (2009). Validity of self-reported height, weight, and body mass index: findings from the National Health and Nutrition Examination Survey. *Preventing Chronic Disease*, 6, 1–10.
- McKinnon, L., Giskes, K., & Turrell, G. (2013). The contribution of three components of nutrition knowledge to socio-economic differences in food purchasing choices. *Public Health Nutrition*, 17, 1814–1824.
- Middleton, G., Mehta, K., McNaughton, D., & Booth, S. (2018). The experiences and perceptions of food banks amongst users in high-income countries: An international scoping review. *Appetite*, 120, 698–708.
- Nagata, J. M., Palar, K., Gooding, H. C., Garber, A. K., Bibbins-Domingo, K., & Weiser, S. D. (2019). Food insecurity and chronic disease in US young adults: findings from the National Longitudinal Study of Adolescent to Adult Health. *Journal of General Internal Medicine*, 34(12), 2756–2762.
- Ng, E. S., Gagnon, S. (2020). Employment gaps and underemployment for racialized groups and immigrants in Canada: current findings and future directions. <https://ppforum.ca/wp-content/uploads/2020/01/EmploymentGaps-Immigrants-PPF-JAN2020-EN-Feb7.pdf>. Accessed 25 Oct 2020.
- Odoms-Young, A. M. (2018). Examining the impact of structural racism on food insecurity: implications for addressing racial/ethnic disparities. *Family & Community Health*, 41(Suppl 2 FOOD INSECURITY AND OBESITY), S3–S6.
- Patel, M. X., Doku, V., & Tennakoon, L. (2003). Challenges in recruitment of research participants. *Advances in Psychiatric Treatment*, 9, 229–238.
- Public Health Agency of Canada (PHAC). (2014). The chief public health officer’s report on the state of public health in Canada, 2011: youth and young adults - life in transition. <https://www.canada.ca/en/public-health/corporate/publications/chief-public-health-officer-reports-state-public-health-canada/chief-public-health-officer-report-on-state-public-health-canada-2011.html>.
- PROOF. (2014). Household food insecurity in Canada. [proof.utoronto.ca/food-insecurity/](http://proof.utoronto.ca/food-insecurity/). Accessed 15 Jul 2018.
- Ramsey, R., Giskes, K., Turrell, G., & Gallegos, D. (2012). Food insecurity among adults residing in disadvantaged urban areas: potential health and dietary consequences. *Public Health Nutrition*, 15, 227–237.
- Riches, G. (2003). Food banks and food security: welfare reform, human rights, and social policy. Lessons from Canada? *Social Policy and Administration*, 36(6), 648–664.
- Sarlio-Lahteenkorva, S., & Lahelma, E. (2001). Food insecurity is associated with past and present economic disadvantage and body mass index. *Journal of Nutrition*, 131, 2880–2884.
- Seivwright, A. N., Callis, Z., & Flatau, P. (2020). Food insecurity and socioeconomic disadvantage in Australia. *International Journal of Environmental Research and Public Health*, 17, 559.
- Seligman, H. K., Laraia, B. A., & Kushel, M. B. (2010). Food insecurity is associated with chronic disease among low-income NHANES participants. *Journal of Nutrition*, 140(2), 304–310.
- Sosenko F, Littlewood M, Bramley G, Fitzpatrick S, Blenkinsopp J, Wood J. (2019). State of hunger: a study of poverty and food insecurity in the UK. <https://www.stateofhunger.org/wp-content/uploads/2019/11/State-of-Hunger-Report-November2019-Digital.pdf>. Accessed 25 Oct 2020.
- Statistics Canada. (2010). Canadian community health survey. <https://www150.statcan.gc.ca/n1/pub/82-625-x/2010001/article/11162-eng.htm>. Accessed 15 Jul 2018.
- Statistics Canada. (2014a). Household food insecurity in Canada statistics and graphics (2011 to 2012). <https://www.canada.ca/en/health-canada/services/nutrition-science-research/food-security/household-food-security-statistics-2011-2012.html>. Accessed 8 Aug 2018.
- Statistics Canada. (2014b) Canadian Community Health Survey – annual component: detailed information for 2014. Available at: <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=164081>. Accessed 8 Aug 2018.
- Statistics Canada. (2015a). Low income measures. <https://www150.statcan.gc.ca/n1/pub/75f0002m/2012002/lim-mfr-eng.htm>. Accessed 16 Mar 2019.
- Statistics Canada. (2015b). Percentage of individuals living in households with moderate or severe household food insecurity, by age group,

- household population aged 12 and older, Canada 2011–2012. <https://www150.statcan.gc.ca/n1/pub/82-625-x/2013001/article/11889/c-g/desc/desc02-eng.htm>. Accessed 15 Jul 2018.
- Statistics Canada (2018a). Labour force survey, August 2018. <https://www150.statcan.gc.ca/n1/daily-quotidien/180907/dq180907a-eng.htm>. Accessed 19 Oct 2018.
- Statistics Canada. (2018b). Fertility: overview, 2012 to 2016. <https://www150.statcan.gc.ca/n1/pub/91-209-x/2018001/article/54956-eng.htm>. Accessed 4 Jan 2019.
- Statistics Canada. (2019). Canadian community health survey: public use microdata file. <https://www150.statcan.gc.ca/n1/en/catalogue/82M0013X>. Accessed 16 Mar 2019.
- Tarasuk, V., Dachner, N., & Loopstra, R. (2014). Food banks, welfare, and food insecurity in Canada. *British Food Journal*, *116*(9), 1405–1417.
- Tarasuk, V., St-Germain, A.-A. F., & Mitchell, A. (2019). Geographic and socio-demographic predictors of household food insecurity in Canada, 2011–12. *BMC Public Health*, *19*(1), 12. <https://doi.org/10.1186/s12889-018-6344-2>.
- United States Department of Agriculture (USDA). (2013). Guide to measuring household food security. <https://www.fns.usda.gov/guide-measuring-household-food-security-revised-2000>.
- Visscher, T. L. S., Viet, A. C., Kroesbergen, H. T., & Seidell, J. C. (2006). Underreporting of BMI in adults and its effect on obesity prevalence estimations in the period 1998 to 2001. *Obesity*, *14*, 2054–2063.
- Walker, R. J., Garacci, E., Dawson, A. Z., Williams, J. S., Ozieh, M., Egede, L.E. Trends in food insecurity in the United States from 2011–2017: disparities by age, sex, race/ethnicity, and income. *Population Health Management*, <https://doi.org/10.1089/pop.2020.0123>.
- Weins, K., Bhattarai, A., Pedram, P., Dores, A., Williams, J., Bulloch, A., et al. (2020). A growing need for youth mental health services in Canada: examining trends in youth mental health from 2011 to 2018. *Epidemiology and Psychiatric Sciences*, *29*, e115.
- WHO (2020). Body mass index – BMI. <https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi>.

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