Chronic Physical and Mental Health Conditions among Adults May Increase Vulnerability to Household Food Insecurity[1–3]

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Abstract

Analyses of cross-sectional population survey data in Canada and the United States have indicated that household food insecurity is associated with poorer self-rated health and multiple chronic conditions. The causal inference has been that household food insecurity contributes to poorer health, but there has been little consideration of how adults' health status may relate to households' vulnerability to food insecurity. Our objectives were to examine how the presence of an adult with one or more chronic physical or mental health conditions affects the odds of a household being food insecure and how the chronic ill-health of an adult within a food-insecure household affects the severity of that household's food insecurity. Using household- and respondent-level data available for 77,053 adults aged 18–64 y from the 2007–2008 Canadian Community Health Survey, we applied logistic regression analyses, controlling for household sociodemographic characteristics, to examine the association between health and household food insecurity. Most chronic conditions increased the odds of household food insecurity independent of household sociodemographic characteristics. Compared with adults with no chronic condition, the odds of household food insecurity were 1.43 (95% CI: 1.28, 1.59), 1.86 (95% CI: 1.62, 2.14), and 3.44 (95% CI: 3.02, 3.93) for adults with 1, 2, and 3 or more chronic conditions, respectively. Among food-insecure households, adults with multiple chronic conditions had higher odds of severe household food insecurity than adults with no chronic condition. The chronic ill-health of adults may render their households more vulnerable to food insecurity. This has important practice implications for health professionals who can identify and assist those at risk, but it also suggests that appropriate chronic disease management may reduce the prevalence and severity of food insecurity. J. Nutr. 143: 1785–1793, 2013.

Introduction

Household food insecurity affected almost 8% of Canadian households in 2007–2008, with 2.7% of all households reporting severe food insecurity, indicative of disrupted eating patterns and reduced food intake among adults and/or children (1). The social epidemiology of food insecurity in Canada is well characterized. The prevalence of food insecurity is highest among low-income households, in households reliant on social assistance, those reporting Aboriginal status, those renting rather than owning their dwelling, and lone-parent female-led households (1–8). Even taken together, however, these sociodemographic characteristics provide only a partial explanation

for the vulnerability of individual households to food insecurity, suggesting that other factors must be at play. One such factor may be adults' health status.

Analyses of cross-sectional Canadian population survey data indicate that household food insecurity is independently associated with heightened nutritional vulnerability (9) and poor self-rated health; poor mental, physical, and oral health; and multiple chronic conditions, including diabetes, hypertension, heart disease, depression, and fibromyalgia, among adults (2,7,10–14). Similar associations have been observed between household food insecurity and several clinical measures of health and disease status in the U.S. NHANES (15–19). In addition, the likelihood of ill-health rises with severity of food insecurity (10,17,19–22).

Most studies of food insecurity and health have been constructed to predict health status from food security status, consistent with the theory that food insecurity exerts deleterious effects on health and well-being via its effects on dietary intake alone or in conjunction with life stress (18). However, a growing body of evidence suggests that the reverse may also be true: adults' health status may be a determinant of their household

food security status (11,20,23–26). Among Canadian adults with diabetes, a strong inverse association between age at diagnosis and household food insecurity suggests that the likelihood of food insecurity increased with duration of the disease (11). In the US, households that include a working-age adult with a disability have a much higher prevalence of food insecurity and severe food insecurity than other households (27), and households led by adults with work-related disabilities are more likely than others to become food insecure (24). Additionally, a panel survey of women with children receiving cash assistance in Michigan revealed that those with one or more mental health problems were more likely to subsequently report food insufficiency (23). An analysis of longitudinal Canadian population health survey data found only limited evidence that, conditional on current health status, food insufficiency predicted future health status but strong evidence that both men's and women's current functional health status was related to their likelihood of reporting household food insufficiency 2 y later (25). This study was limited by the need to rely of a composite measure of self-reported function (rather than chronic disease status) and the inability to examine relationships between health status and severity of household food insecurity. A fuller understanding of the relationship between adults' health and household food security status in Canada is needed to characterize the conditions that render households vulnerable to food insecurity and identify directions for prevention and intervention.

Drawing on data from a large cross-sectional population health survey, we examine the relationship between adults' chronic disease status and the prevalence and severity of household food insecurity in Canada. We build on prior analyses of food insecurity/health relationships by designing our analyses to predict household food insecurity from health (rather than vice versa), considering multiple physician-diagnosed conditions (rather than a single condition) and comorbidity among adults, taking into account the full spectrum of sociodemographic variables identified to relate to household food insecurity in Canada, and examining effects on both the presence and severity of household food insecurity. Specifically, the objectives of this study were to examine: 1) how the presence of an adult with one or more chronic physical or mental health conditions affects the odds of a household being food insecure, independent of sociodemographic predictors of food insecurity; and 2) how the chronic ill-health of an adult member within a food-insecure household affects the severity of that household's food insecurity, independent of household sociodemographic characteristics.

Methods

The 2007–2008 Canadian Community Health Survey was a population-representative survey of ~130,000 individuals 12 y and older, excluding full-time members of the Canadian Forces and those living on First Nations Reserves or Crown Lands or in prisons or care facilities. The presence of chronic health conditions was ascertained by asking about "long-term conditions which are expected to last or have already lasted 6 mo or longer and that have been diagnosed by a health professional." Household food security during the past 12 mo was assessed using the 18-item Household Food Security Survey Module (28). This module is also used in the United States, but Health Canada applies more liberal thresholds and different labels to describe prevalence and severity, limiting direct country comparisons. For this study, moderate and severe household food insecurity were determined using Health Canada's coding method (28), but respondents with no affirmative responses were considered to be food secure and those with one affirmative response were classified as marginally food insecure, recognizing that even one affirmative response on this module denotes some degree of vulnerability (17,19,20,22,29,30).

This study was limited to respondents 18–64 y of age with complete data on the Household Food Security Survey Module, excluding full-time students and adult children living with their parents, as a means of restricting the analysis to adults in positions of responsibility for the welfare of the household. The analytic sample was 77,053 individuals.

We examined the relationship between household food security status and every chronic health condition with a population prevalence >2%: asthma, arthritis, back problems (excluding arthritis and fibromyalgia), bowel disorders, diabetes mellitus, heart disease, hypertension, migraines, mood or anxiety disorder, and stomach or intestinal ulcers. We also constructed a summary variable denoting how many of these 10 chronic conditions were reported by the respondent.

To determine whether prevalence of chronic conditions increased with severity of food insecurity, logistic regressions were conducted with contrasts to generate paired comparisons of the prevalence of each condition between the 4 levels of food security for men and women separately and combined.

To determine the relationship between adults' health status and the presence of household food insecurity, 3 logistic regression models were conducted. First, household food insecurity [presence (marginal, moderate, or severe) vs. absence] was regressed on household-level sociodemographic characteristics previously identified as significant predictors of food insecurity (1,2,4,6–8). These were province of residence [contrasting provinces with the territories, where food insecurity is substantially more prevalent (1)], household type, highest level of education in the household, household income (adjusted for family size by dividing by the square root of household size) (31), main source of household income, home ownership, and aboriginal status of the respondent (an indicator of household aboriginal status). Second, to evaluate the potential contribution of health status to food insecurity, the respondent's number of chronic health conditions and age and sex were added to the model. Third, to investigate the role of specific health conditions, binary (presence/absence) variables for each of the 10 chronic conditions as well as respondent's age and sex were added to the baseline predictors.

To determine the relationship between respondent's health within a food-insecure household and the severity of household food insecurity independent of household sociodemographic characteristics, 3 multinomial logistic regression models were run: the severity of household food insecurity (marginal and severe vs. moderate) was regressed on chronic health conditions, controlling for household sociodemographics. Ordinal logistic regression was rejected, because our data violated the proportional odds assumption. These models included only respondents in households with some level of food insecurity (n = 6994). Similar to the models described above, we began with a model including only household sociodemographic variables, followed by the model that added respondent age, sex, and number of chronic health conditions, and finally the model that included sociodemographic variables plus age, sex, and binary variables (presence/absence) of each of the 10 health conditions.

Post-hoc inspection of the frequency distributions of individual chronic health conditions among adults with 2 or more conditions indicated an increased frequency of mood and anxiety disorders in particular with increasing severity of food insecurity. To test whether having a mood or anxiety disorder increased the odds of household food insecurity and more severe food insecurity among respondents with 2 or more chronic conditions, logistic regression models were conducted including a binary variable (presence/absence) for mood or anxiety disorder, controlling for sociodemographic variables.

To explore the possibility that observed associations between adults' chronic health conditions and household food insecurity might be explained by the effect of ill-health on employment, the above-described regression models were rerun post-hoc, including variables to account for the respondent's current employment status (no work, part-time work, full-time work) and occupation (as indicated by industrial sector of current employment). Results are not presented, because including these variables had no effect on the observed associations between number of chronic conditions or individual conditions and the presence or severity of their household food insecurity.

Because marked sex differences were observed in the prevalence of some chronic conditions by level of household food insecurity, we examined the interactions between sex and chronic conditions in the above-described regression models. Although there were no significant interactions between sex and individual health conditions, a significant interaction was detected between sex and number of chronic conditions, so this model was rerun stratified by sex.

About one-quarter of the respondents had to be excluded from the regression analyses because of missing values for sociodemographic variables; most were missing household income. Respondents missing household income were less likely to be food insecure ($P < 0\ 0.05$) and more likely to be <25 y or >55 y ($P < 0.0001$), female ($P < 0.0001$), and unattached but living with others or in living arrangements described as "other" ($P < 0.0001$).

All analyses were conducted in SAS version 9.2 using SURVEY commands with bootstrap replication ($n = 500$) and bootstrap weights, provided by Statistics Canada. Person weights were used to construct estimates of chronic health condition prevalence, but household weights were used for the regression analyses, reflecting that household was the unit of analysis for our study.

Institutional ethics approval for this study was received from the Human Research Ethics Boards of the University of Toronto and University of Calgary.

Results

Table 1 presents sociodemographic characteristics of the sample by household food security status.

The prevalence of most chronic conditions increased as household food insecurity worsened (**Table 2**). The most marked trend was observed for mood and anxiety disorders; 47% of women in severely food insecure households reported one of these disorders. The proportion of adults reporting multiple chronic conditions also rose with worsening household food insecurity (**Fig. 1**). Only 9% of adults in food-secure households reported

TABLE 1 Sociodemographic characteristics of adults, 18–64 y, by household food security status (Canadian Community Health Survey, 2007–2008)[1]

		Food insecure		
	Food secure ($n = 67,934$)	Marginal ($n = 2755$)	Moderate ($n = 4139$)	Severe ($n = 2225$)
Age, y	43.9 ± 0.06	39.4 ± 0.33	40.1 ± 0.29	41.5 ± 0.52
Sex, % female	50.1	55.5	59.7	55.5
Province, %				
Newfoundland and Labrador	1.6	2.4	1.9	1.5
Prince Edward Island	0.4	0.6	0.7	0.4
Nova Scotia	2.8	3.9	4.0	2.7
New Brunswick	2.3	3.0	2.8	2.9
Quebec	24.3	21.7	20.7	19.3
Ontario	37.5	40.6	41.4	46.3
Manitoba	3.4	3.6	3.9	3.6
Saskatchewan	2.9	2.2	2.3	1.6
Alberta	11.4	8.2	8.8	7.4
British Columbia	13.2	13.7	12.8	13.8
Yukon, Northwest Territories, or Nunavut	0.3	0.3	0.6	0.6
Education (respondent), %				
Less than secondary education	10.4	16.6	22.2	29.0
Secondary school graduate	16.4	18.4	18.4	16.3
Some postsecondary	6.4	10.2	8.8	13.4
Completed postsecondary	66.9	54.8	50.6	41.3
North American Indian, Metis, Inuit, %	2.9	5.6	6.7	10.1
Household type, %				
Unattached individual, living alone	13.0	13.7	18.9	32.5
Unattached individual, living with others	5.6	7.6	8.7	9.8
Couple, no children	29.3	15.8	13.0	12.0
Couple living with children	40.1	41.7	33.8	22.4
Lone parent	4.4	11.1	14.6	16.5
Other	7.7	10.2	11.0	6.9
Median household income, CAD	$75,000 \pm 167$	$42,000 \pm 1997$	$30,000 \pm 989$	$20,000 \pm 986$
Median household income, CAD (adjusted)[2]	$46,200 \pm 104$	$25,500 \pm 915$	$20,000 \pm 864$	$13,900 \pm 612$
Household main source of income, %				
Wages, salaries, self-employment	90.5	83.3	74.6	55.8
Pension or investments[3]	6.4	4.3	4.7	6.1
Employment insurance or workers' compensation	0.7	2.2	2.8	3.0
Social assistance	1.0	6.7	13.7	27.2
Other or none	1.4	3.5	4.2	7.9
Home ownership, % yes	77.7	53.5	41.9	24.0

[1] Values are means ± SEMs or percentages. CAD, Canadian dollars.
[2] Household income adjusted for family size by dividing by square root of household size.
[3] Includes retirement pensions, Canada Pension Plan/Quebec Pension Plan benefits, Old Age Security/Guaranteed Income Supplement benefits, dividends, and interest.

TABLE 2 Prevalence of chronic conditions among adults, 18–64 y, by household food security status and sex (Canadian Community Health Survey, 2007–2008)[1]

Condition	Food secure (n = 67,934)	Food insecure		
		Marginal (n = 2755)	Moderate (n = 4139)	Severe (n = 2225)
	% of respondents	*% of respondents*		
Asthma				
Both	7.1[a]	9.5[b]	13.1[c]	16.7[d]
Men	5.9[a]	6.7[ab]	9.9[bc]	13.4[c]
Women	8.3[a]	11.7[b]	15.3[c]	19.3[c]
Arthritis				
Both	12.4[a]	13.3[a]	17.5[b]	26.5[c]
Men	10.5[a]	11.0[ab]	14.3[b]	20.3[c]
Women	14.3[a]	15.1[a]	19.6[b]	31.4[c]
Back problems				
Both	20.6[a]	28.3[b]	30.9[b]	38.5[c]
Men	20.5[a]	27.3[b]	29.3[b]	33.4[b]
Women	20.8[a]	29.1[b]	32.0[b]	42.5[c]
Bowel disorders				
Both	4.4[a]	4.9[a]	6.7[b]	10.0[c]
Men	2.8[a]	2.5[a]	4.8[b]	5.0[b]
Women	5.9[a]	7.0[ab]	7.9[b]	14.1[c]
Diabetes mellitus				
Both	4.6[a]	5.2[ab]	6.6[b]	12.8[c]
Men	5.2[a]	5.6[a]	6.3[a]	17.9[b]
Women	4.0[a]	5.0[ab]	6.9[bc]	8.6[c]
Heart disease				
Both	2.7[a]	3.1[ab]	3.5[b]	8.8[c]
Men	3.2[a]	3.3[a]	4.0[a]	11.2[b]
Women	2.2[a]	2.8[ab]	3.2[b]	6.8[c]
Hypertension				
Both	13.5[a]	11.6[b]	15.3[c]	20.1[d]
Men	14.4[ab]	12.0[a]	13.6[ab]	19.0[b]
Women	12.6[a]	11.3[b]	16.4[c]	20.9[c]
Migraines				
Both	11.1[a]	17.4[b]	19.3[b]	25.6[c]
Men	6.4[a]	10.7[b]	12.0[bc]	16.5[c]
Women	15.8[a]	22.8[b]	24.1[b]	32.9[c]
Mood or anxiety disorder				
Both	9.1[a]	16.1[b]	22.4[c]	39.6[d]
Men	6.5[a]	10.9[b]	15.9[c]	23.4[d]
Women	11.6[a]	20.3[b]	26.8[c]	47.1[d]
Stomach or intestinal ulcers				
Both	2.9[a]	4.4[b]	5.7[b]	9.8[c]
Men	2.8[a]	4.3[ab]	6.0[bc]	9.0[c]
Women	2.9[a]	4.6[b]	5.5[b]	10.4[c]

[1] Prevalence estimates in a row without a common letter differ, $P < 0.05$.

having 3 or more conditions, but this number rose to 34% among adults in severely food-insecure households.

Table 3 shows the regression coefficients for each of the predictors in the models tested to investigate the relationship of chronic health conditions and food insecurity. Above and beyond the effects of sociodemographic characteristics (Table 3, model 1), the odds of food insecurity increased from 1.43 (95% CI: 1.28, 1.59) for adults with one condition to 1.86 (95% CI: 1.62, 2.14) for adults with 2 conditions and to 3.44 (95% CI: 3.02, 3.93) for adults with 3 or more conditions (Table 3, model 2). Similar findings were observed when this model was stratified by sex (**Supplemental Table 1**).

When the effects of specific chronic conditions were considered (Table 3, model 3), significant associations were observed for every condition except hypertension and heart disease. Adults diagnosed with a mood or anxiety disorder had 1.81 times (95% CI: 1.62, 2.03) the odds of household food insecurity compared with adults without this condition, even after taking sociodemographic risk factors into account.

Table 4 shows the regression coefficients for each of the predictors in the models tested to investigate the relationship of chronic health conditions and severity of food insecurity. Among food-insecure households, above and beyond the effects of sociodemographic characteristics, having adults with 2 or more chronic conditions increased the odds of more severe food insecurity (Table 4, model 2). Food-insecure households with an adult with 3 or more conditions had 1.98 times (95% CI: 1.49, 2.63) the odds of severe food insecurity and 0.73 times
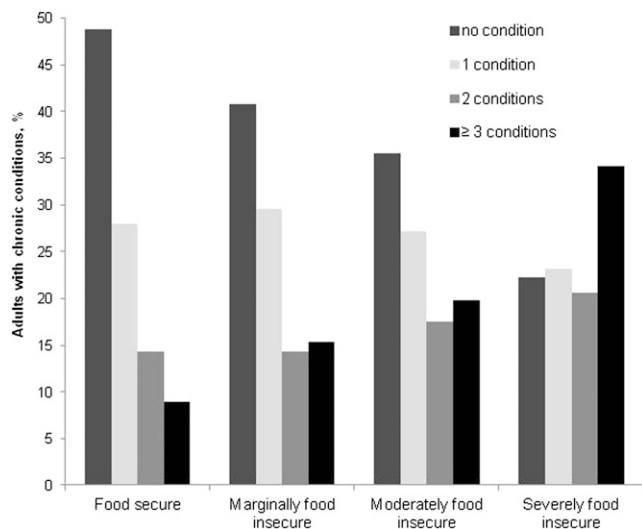
FIGURE 1 Prevalence of number of chronic conditions among adults, 18–64 y, by household food security status, n = 77,053 (Canadian Community Health Survey 2007–2008).

(95% CI: 0.56, 0.93) the odds of marginal food insecurity compared with moderate food insecurity. When stratified by sex, the pattern of results for men was identical to that for the full sample, but among women, the only significant finding was increased odds of severe food insecurity among those with 3 or more conditions (Supplemental Table 1).

Considering specific chronic conditions, respondents reporting a mood or anxiety disorder, migraines, or arthritis had significantly higher odds of severe (vs. moderate) household food insecurity. No significant associations were observed for other conditions (Table 4, model 3).

A post-hoc analysis of comorbidity revealed that the pairing of a mood or anxiety disorder with other conditions (irrespective of which condition) heightened the odds of food insecurity [OR: 1.70 (95% CI: 1.46, 1.97)] and increased the odds of severe food insecurity [OR: 1.59 (95% CI: 1.22, 2.07)] among food-insecure households.

Discussion

Our results indicate that adults' chronic ill health is associated with presence and severity of household food insecurity independent of well-characterized sociodemographic correlates of household food insecurity. Consistent with United States research (17,19,20,22), we found that adults in more severely food-insecure households were more likely to report chronic health problems. A strong dose-response relationship was evident between the number of chronic conditions and the odds of household food insecurity; among food-insecure households, the presence of an adult with multiple chronic conditions increased the likelihood of severe food insecurity. Diagnosis with a mood or anxiety disorder was particularly strongly linked to household food insecurity, but most chronic conditions considered were also associated, implying that it is adults' overall experience of chronic ill health that relates to their household's vulnerability for food insecurity, not the diagnosis of any single condition.

Although longitudinal data are needed to fully understand how adults' health affects household food insecurity, the diverse range of conditions associated with increased odds of food insecurity and the observed dose-response relationships between number of chronic conditions and presence and severity of household food insecurity lend support to the argument that adults' chronic ill-health increases their household's vulnerability to food insecurity. Drawing on the explanatory framework outlined by Heflin et al. (23), there are 3 plausible mechanisms by which adults' ill-health may render their households vulnerable to food insecurity. First and foremost, chronic health problems can affect adults' ability to garner income and as such put household food security at risk (32). However, adults' health status was associated with household food insecurity after controlling for household income, home ownership, and main source of income and after post-hoc analyses in which we also adjusted for respondent's employment status. These findings suggest that the potential for chronic ill-health to limit adults' employment is insufficient to account for the observed association between chronic health problems and household food insecurity. Two other potential mechanisms (23) merit consideration: 1) adults' chronic ill-health may pose additional demands on their households' financial resources; and 2) their ill-health may constrain their ability to cope in situations of scarce household resources.

In support of the first mechanism, the management of many chronic conditions for which significant associations were observed requires additional expenditures for medications, transportation, special dietary requirements, physiotherapy, and other rehabilitative services. Although the costs of physician and hospital services are covered under the Canada Health Act, there is no universal coverage for prescription medications or other health services. Cost-related drug nonadherence is prevalent among low-income working-age adults, and it rises with the number of chronic conditions (33). The high burden of illness among Canadian adults in food-insecure households may reflect the fact that their households require more resources to maintain an equivalent level of food security compared with households whose members suffer no chronic ill-health.

In support of the second mechanism, coping with chronic health problems limits adults' abilities to manage with scarce financial resources. It is well documented that adults in resource-constrained households work diligently to minimize experiences of food insecurity, particularly for their children, employing elaborate, labor-intensive strategies to source food at reduced costs and carefully apportion it (34–40). When threatened with acute food shortages, adults also juggle bill payments, delay rent, forfeit services in the home, sell or pawn possessions, and seek assistance from family, friends, and ultimately whatever charitable programs are accessible to them (35,41–44). Adults coping with chronic illness are likely less able to engage in such measures, rendering them and their families more vulnerable to impending food insecurity and to more severe food insecurity.

Although we argue that our findings suggest that adults' chronic ill-health increases their household's vulnerability to food insecurity, given the cross-sectional nature of Canadian Community Health Survey, we cannot exclude the possibility of reverse causation, nor would we want to. Consistent with the evidence that food insufficiency increases women's risk of depression (45), food insecurity could increase adults' likelihood of developing a wider variety chronic health problems, possibly because of the associated stress but also because food insecurity poses a barrier to health-protective behaviors such as healthy eating and physical activity. It is likely that the relationship between chronic ill-health and food insecurity is bi-directional.

Our study is also limited by a reliance on self-reports of physician-diagnosed chronic illness and a lack of data on the timing of diagnoses. We know only that reported conditions

TABLE 3 Odds of household food insecurity among adults, 18–64 y, in relation to household socio-demographic characteristics and adult's chronic conditions (Canadian Community Health Survey, 2007–2008; *n* = 58,187)

	OR (95% CI)		
	Model 1	Model 2	Model 3
Provinces vs. territories	0.74 (0.60–0.92)	0.66 (0.53–0.83)	0.66 (0.52–0.82)
Education (highest in household)			
Postsecondary graduate	1.0	1.0	1.0
Less than secondary school completion	1.17 (1.01–1.35)	1.20 (1.03–1.39)	1.21 (1.04–1.41)
Secondary school graduate	1.02 (0.91–1.16)	1.04 (0.91–1.18)	1.05 (0.92–1.19)
Some postsecondary	1.48 (1.26–1.74)	1.44 (1.23–1.70)	1.44 (1.22–1.69)
Household income[1]	0.95 (0.95–0.96)	0.95 (0.95–0.96)	0.95 (0.95–0.96)
Main source of household income			
Wages, salaries, self-employment	1.0	1.0	1.0
Employment insurance or workers' compensation	1.63 (1.30–2.04)	1.54 (1.23–1.93)	1.50 (1.19–1.89)
Other/none	1.44 (1.14–1.82)	1.31 (1.02–1.67)	1.26 (0.98–1.63)
Pension, interest[2]	0.79 (0.68–0.91)	0.85 (0.72–0.99)	0.85 (0.72–0.99)
Social assistance	2.72 (2.30–3.21)	2.42 (2.04–2.88)	2.27 (1.90–2.70)
Homeowner (no vs. yes)	2.03 (1.85–2.22)	1.86 (1.69–2.05)	1.87 (1.70–2.06)
Household type			
Couple, no children	1.0	1.0	1.0
Couple with children	1.48 (1.29–1.70)	1.48 (1.28–1.71)	1.49 (1.29–1.73)
Lone parent	1.75 (1.46–2.11)	1.64 (1.36–1.99)	1.62 (1.33–1.96)
Other	1.62 (1.28–2.05)	1.57 (1.24–1.99)	1.60 (1.25–2.04)
Unattached, living alone	1.49 (1.32–1.70)	1.53 (1.35–1.74)	1.50 (1.32–1.70)
Unattached, living with others	1.51 (1.15–1.96)	1.36 (1.05–1.78)	1.34 (1.03–1.76)
Aboriginal (no vs. yes)	1.8 (1.53–2.11)	1.56 (1.32–1.83)	1.55 (1.31–1.82)
Age		0.98 (0.97–0.98)	0.98 (0.98–0.98)
Sex (F vs. M)		1.01 (0.92–1.11)	1.00 (0.91–1.10)
Number of chronic conditions			
0		1.0	
1		1.43 (1.28–1.59)	
2		1.86 (1.62–2.14)	
≥3		3.44 (3.02–3.93)	
Asthma (yes vs. no)			1.28 (1.11–1.48)
Arthritis (yes vs. no)			1.30 (1.15–1.48)
Back problems, etc.			1.53 (1.37–1.71)
Bowel disorders			1.41 (1.19–1.67)
Diabetes			1.33 (1.10–1.61)
Heart disease			1.06 (0.83–1.36)
Hypertension			1.10 (0.96–1.26)
Migraines			1.33 (1.17–1.53)
Mood or anxiety disorder			1.81 (1.62–2.03)
Stomach or intestinal ulcers			1.27 (1.01–1.61)

[1] In thousands of Canadian dollars, adjusted for family size by dividing by square root of household size.
[2] Includes retirement pensions, Canada Pension Plan/Quebec Pension Plan benefits, Old Age Security/Guaranteed Income Supplement benefits, dividends, and interest.

were expected to last or had already lasted 6 mo or longer, and this time period overlaps with the assessment of food insecurity, precluding examination of the temporal relationship between disease onset or duration and household food insecurity.

Although we attempted to confine our analysis to adults with some responsibility for the welfare of their household by excluding students and dependent children, we have no data on respondents' roles and responsibilities in their households or the health of other household members. The results of a U.S. study of disability and food insecurity suggest that the effects of individual household members' disability status on household food insecurity depend on their position within the household (24). Observed sex differences in the prevalence of some chronic conditions by level of household food insecurity and the relation between presence of multiple chronic conditions and severity of household food insecurity may reflect the interrelationship between chronic illness and gendered roles and responsibilities within households, but more research is needed to elucidate this.

Although our results suggest that adults' ill-health may predispose them and their families to food insecurity, the resultant food insecurity can only further compromise health. Food-insecure adults with chronic diseases are less able to manage self-care (11,16,18,19,46,47), and exposure to severe and persistent food insecurity has long-term adverse health consequences for children (48–50). Thus, both adults' and children's health spirals downward in the context of food insecurity.

TABLE 4 Odds of marginal or severe vs. moderate food insecurity among adults, 18–64 y, in food-insecure households in relation to household sociodemographic characteristics and adult's chronic conditions (Canadian Community Health Survey, 2007–2008; n = 6951)

	OR (95% CI)					
	Model 1		Model 2		Model 3	
	Marginal (vs. moderate)	Severe (vs. moderate)	Marginal (vs. moderate)	Severe (vs. moderate)	Marginal (vs. moderate)	Severe (vs. moderate)
Provinces vs. territories	1.49 (0.87–2.54)	1.45 (0.95–0.20)	1.53 (0.89–2.64)	1.31 (0.86–2.00)	1.53 (0.89–2.66)	1.25 (0.80–1.95)
Education						
Postsecondary graduate	1.0	1.0	1.0	1.0	1.0	1.0
<Secondary school completion	0.95 (0.73–1.25)	0.94 (0.72–1.22)	0.96 (0.73–1.27)	0.93 (0.72–1.21)	0.96 (0.73–1.28)	0.92 (0.70–1.20)
Secondary school graduate	1.04 (0.83–1.31)	0.87 (0.68–1.12)	1.04 (0.83–1.31)	0.89 (0.70–1.14)	1.05 (0.84–1.32)	0.89 (0.69–1.14)
Some postsecondary	0.97 (0.72–1.32)	1.10 (0.81–1.50)	0.97 (0.71–1.33)	1.10 (0.80–1.50)	0.97 (0.71–1.33)	1.09 (0.79–1.50)
Household income[1]	1.02 (1.01–1.02)	0.99 (0.98–1.00)	1.02 (1.01–1.02)	0.99 (0.98–0.00)	1.01 (1.01–1.02)	0.99 (0.98–1.00)
Main source of household income						
Wages, salaries, self-employment	1.0	1.0	1.0	1.0	1.0	1.0
Employment Insurance or workers' compensation	0.93 (0.62–1.38)	1.58 (0.98–2.53)	0.97 (0.65–1.44)	1.51 (0.94–2.43)	0.98 (0.66–1.46)	1.44 (0.88–2.34)
Other/none	1.20 (0.75–1.90)	1.49 (0.86–2.57)	1.29 (0.80–2.07)	1.32 (0.78–2.25)	1.32 (0.81–2.15)	1.25 (0.73–2.13)
Pension, interest[2]	0.92 (0.67–1.26)	1.15 (0.80–1.64)	1.04 (0.75–1.46)	0.99 (0.67–1.45)	1.09 (0.78–1.53)	0.95 (0.64–1.40)
Social assistance	0.64 (0.47–0.88)	1.60 (1.22–2.10)	0.70 (0.51–0.96)	1.40 (1.06–1.85)	0.73 (0.53–1.01)	1.36 (1.03–1.82)
Homeowner (no vs. yes)	0.80 (0.65–0.98)	1.67 (1.35–2.07)	0.78 (0.63–0.96)	1.7 (1.36–2.13)	0.78 (0.63–0.97)	1.69 (1.34–2.11)
Household type						
Couple, no children	1.0	1.0	1.0	1.0	1.0	1.0
Couple with children	1.04 (0.80–1.35)	0.68 (0.46–1.02)	0.98 (0.75–1.28)	0.75 (0.49–1.14)	0.98 (0.75–1.29)	0.77 (0.51–1.17)
Lone parent	0.89 (0.63–1.25)	0.83 (0.59–1.18)	0.90 (0.63–1.27)	0.93 (0.65–1.34)	0.91 (0.64–1.30)	0.97 (0.66–1.41)
Other	0.79 (0.50–1.26)	0.70 (0.43–1.15)	0.77 (0.48–1.23)	0.72 (0.44–1.20)	0.78 (0.49–1.25)	0.71 (0.43–1.20)
Unattached, living alone	0.65 (0.50–0.84)	1.29 (0.95–1.76)	0.63 (0.49–0.81)	1.33 (0.96–1.83)	0.63 (0.48–0.82)	1.30 (0.93–1.83)
Unattached, living with others	0.80 (0.50–0.30)	1.31 (0.76–2.24)	0.74 (0.46–1.20)	1.38 (0.78–2.45)	0.77 (0.47–1.26)	1.34 (0.76–241)
Aboriginal (no vs. yes)	0.74 (0.54–1.01)	1.24 (0.89–1.72)	0.74 (0.54–1.02)	1.19 (0.86–1.65)	0.74 (0.54–1.02)	1.17 (0.83–1.64)
Age			1.00 (0.99–1.01)	1.00 (0.99–1.01)	1.00 (0.99–1.01)	1.00 (0.99–1.01)
Sex (F vs. M)			0.92 (0.76–1.11)	0.80 (0.65–0.97)	0.92 (0.76–1.11)	0.76 (0.61–0.93)
Number of chronic conditions						
0			1.0	1.0		
1			0.94 (0.76–1.17)	1.12 (0.87–1.46)		
2			0.72 (0.56–0.93)	1.61 (1.19–2.17)		
≥3			0.73 (0.56–0.93)	1.98 (1.49–2.63)		
Asthma					0.89 (0.65–1.22)	0.94 (0.74–1.20)
Arthritis					0.92 (0.71–1.18)	1.28 (1.00–1.63)
Back problems					0.95 (0.78–1.16)	1.02 (0.85–1.23)
Bowel disorders					0.95 (0.68–1.33)	1.20 (0.87–1.66)
Diabetes					0.80 (0.56–1.15)	1.11 (0.76–1.64)
Heart disease					0.89 (0.56–1.41)	1.50 (0.92–2.46)
Hypertension					0.83 (0.67–1.05)	0.86 (0.64–1.17)
Migraines					0.94 (0.74–1.19)	1.30 (1.01–1.66)
Mood or anxiety disorder					0.84 (0.68–1.03)	1.61 (1.29–2.01)
Stomach or intestinal ulcers					0.97 (0.65–1.45)	1.23 (0.89–1.70)

[1] In thousands of Canadian dollars, adjusted for family size by dividing by square root of household size.

[2] Includes retirement pensions, Canada Pension Plan/Quebec Pension Plan benefits, Old Age Security/Guaranteed Income Supplement benefits, dividends, and interest.

Our results have important implications for health care providers, because they are uniquely positioned to identify adults whose poor health may jeopardize their household food security and help them to access vital material supports (e.g., disability benefits, dietary allowances, drug benefits). In addition, clinical interventions that lead to improved disease management may reduce the likelihood of household food insecurity and/or mitigate its adverse effects on household members.

Recognizing the cross-sectional nature of our analysis, more research is required to establish the causal chain and identify critical points for intervention. However, our findings highlight an important avenue for policy intervention to reduce the prevalence and severity of food insecurity in Canada. Insofar as adults' health is a determinant of household food security status, income assistance programs and extended health-care benefits targeted to low-income adults with chronic health conditions can potentially protect them and their households from food insecurity.

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