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The impact of changes in social policies on household food insecurity in British Columbia, 2005–2012

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ABSTRACT

As concerns about food insecurity in high income countries grow, there is a need to better understand the impact of social policy decisions on this problem. In Canada, provincial government actions are particularly important because food insecurity places substantial burden on provincial health care budgets. This study was undertaken to describe the socio-demographic and temporal patterning of food insecurity in British Columbia (BC) from 2005 to 2012 and determine the impact of BC's one-time increase in social assistance and introduction of the Rental Assistance Program (RAP) on food insecurity rates among target groups. Using data from the Canadian Community Health Surveys, logistic regression analyses were conducted to identify trends and assess changes in food insecurity among subgroups differentiated by main source of income and housing tenure. Models were run against overall food insecurity, moderate and severe food insecurity, and severe food insecurity to explore whether the impact of policy changes differed by severity of food insecurity. Overall food insecurity rose significantly among households in BC between 2005 and 2012. Following the increase in social assistance benefits, overall food insecurity and moderate and severe food insecurity declined among households on social assistance, but severe food insecurity remained unchanged. We could discern no effect of the RAP on any measure of food insecurity among renter households. Our findings indicate the sensitivity of food insecurity among social assistance recipients to improvements in income and highlight the importance of examining severity of food insecurity when assessing the effects of policy interventions.

1. Introduction

Food insecurity is recognized as a serious social and public health problem in many high income countries. In Canada and the U.S., inadequate or insecure access to food because of financial constraints is routinely monitored at the household level, and the adverse health effects of this condition across the life cycle are becoming increasingly well-documented (see review by Gundersen and Ziliak (Gundersen & Ziliak, 2015)). In Europe and the United Kingdom, concerns about growing food insecurity were initially spawned by reports of escalating demands for charitable food assistance (Loopstra et al., 2015a), but more recently, analyses of indicator questions about compromises in diet quality on European surveys have confirmed this trend (Loopstra et al., 2016; Davis & Baumberg, 2016). Changes in food insecurity rates have been linked to changing macroeconomic conditions such as unemployment rate (Loopstra et al., 2016; Tapogna et al., 2004; Bartfeld & Dunifon, 2006; Gundersen et al., 2014; Sriram & Tarasuk, 2015), wage levels (Loopstra et al., 2016; Bartfeld & Dunifon, 2006) and food price inflation (Gregory & Coleman-Jensen, 2013), but social policy reforms have also been implicated in relation to this problem (Loopstra et al., 2015b; Riches, 2002; Dowler & O'Connor, 2012; Emery et al., 2013a).

Although there has been considerable research in the US to examine the effects of food stamps and other food supplement programs on problems of household food insecurity in that country, e.g. (Wilde & Nord, 2005; Kabbani & Kmeid, 2005; Yen et al., 2008; Mykerezi & Mills, 2010; Arteaga et al., 2016), much less is known about the effects of social policy decisions on problems of food insecurity in welfare states without large-scale public investments in food assistance. A recent cross-national comparison of EU countries found that spending on social programs protected households from food insecurity in the context of the rising unemployment and declining wages that accompanied Europe's recent recessions (Loopstra et al., 2016), but data limitations precluded identification of the specific investments that mitigated food insecurity in these countries. Studies of the effects of policy decisions on households' vulnerability to food insecurity are more viable in Canada, however, where food insecurity has been monitored annually since 2005 in most jurisdictions, using the 18-item Household Food Security Survey Module (HFSSM), the same module used to monitor food insecurity in the US.

Indications that the mix of federal and provincial/territorial income transfer programs intended to mitigate problems of financial hardship

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(i.e., Canada's 'social safety net') shape households' risks of food insecurity come from the social patterning of this problem. Risk of food insecurity among low-income adults falls when they become eligible for an old-age pension because of the protection afforded by this guaranteed annual income (Emery et al., 2013a; Emery et al., 2013b). In contrast, food insecurity is ubiquitous among households reliant on social assistance programs (Tarasuk et al., 2014a), yet improvements to social assistance implemented as part of Newfoundland and Labrador's poverty reduction program halved food insecurity rates among recipients in that province (Loopstra et al., 2015b), suggesting that the extreme vulnerability associated with social assistance elsewhere is a function of the limited benefits provided. Given that food insecurity has been demonstrated to increase the risk of diabetes (Seligman et al., 2007; Seligman et al., 2010a), hypertension (Seligman et al., 2010a), dyslipidemia (Tayie & Zizza, 2009), cardiovascular disease (Ford, 2013), and depression (Muldoon et al., 2012; Heflin et al., 2005) and compromise disease management (Seligman et al., 2010b) and in Canada, it is a robust predictor of health care utilization and costs, independent of other well-established social determinants of health (Fitzpatrick et al., 2015; Tarasuk et al., 2015), a better understanding of how provincial policies can influence food insecurity rates is critical to the identification of strategies to reduce public expenditures in health care and improve overall health.

In 2012, 12.7% of households in the province of British Columbia (BC) were affected by some degree of food insecurity (Tarasuk et al., 2014b). While similar to the national prevalence of 12.6%, this was the highest rate observed since measurement began in the province in 2005 (Tarasuk et al., 2014b). Like other provinces in Canada, the BC government has yet to mount any intervention with the explicit goal of food insecurity reduction, but two policy changes with the potential to impact the material well-being of households at high risk were implemented between 2005 and 2012. First, there was an increase of welfare benefits from 2005 to 2007, with incomes rising by as much as 11.7% among single parent households (Tweddle et al., 2013). Second, the Rental Assistance Program (RAP) was introduced in 2006 to provide support to low-income working families in private market rental accommodations, giving an average of $379/month to participating families (British Columbia Government, n.d.).

The primary objectives of this study were to describe the sociodemographic and temporal patterning of food insecurity in BC from 2005 to 2012 and determine whether BC's increase in social assistance and introduction of the RAP affected food insecurity among the target groups. A secondary objective was to compare the sensitivity of different levels of household food insecurity to these two policy interventions.

2. Methods

All analyses were conducted using master files of the Canadian Community Health Survey (CCHS) from 2005 to 2012. The survey is a de-identified repeated cross-sectional survey that is representative of 98% of the Canadian population aged 12 and over, omitting individuals living on First Nation reserves, in institutions, in the Canadian Armed forces, or in some remote areas. Since 2007, CCHS has included a national sample of approximately 65,000 per year. Because the sample for 2005 and 2006 was concentrated in 2005, we treat that survey as having taken place in 2005. This study was limited to respondents from BC, excluding those with incomplete data on the HFSSM. The analytic sample consisted of 58,656 households. All analysis adopted a bootstrap variance estimation method and household weights supplied by Statistics Canada.

The outcome of interest was household food insecurity over the prior 12 months, determined by the number of affirmative responses to the 18 questions on the HFSSM. Models were run against three different thresholds to explore whether the impact of policy changes differed depending on the severity of food insecurity considered. It should be noted that the coding and terminology we applied to classify severity of food insecurity are based on Health Canada's approach to interpreting data from the HFSSM (Health Canada, 2007), which differs from that employed by USDA (see Appendix A). Overall food insecurity was defined as any affirmative response, in keeping with research indicating heightened vulnerability among households with even a single affirmative response (i.e., 'marginally food insecure' households) (Tarasuk et al., 2015; Coleman-Jensen, 2010; Loopstra & Tarasuk, 2013). We then considered a more conservative measure, including only households classed as moderately or severely food insecure as defined by Health Canada (Health Canada, 2007). Finally, recognizing the higher health risks and health care costs associated with severe food insecurity (Seligman et al., 2007; Tarasuk et al., 2015; Laraia et al., 2006; Whitaker et al., 2006), we considered this outcome alone.

We first examined study population characteristics from 2005 to 2012, applying chi-squared tests (for categorical variables) and linear contrasts (for continuous variables) to identify statistically significant changes over time arising from variations in sampling or macroeconomic or demographic trends within the province. Our goal was to identify compositional changes in the study population that could influence food insecurity over this period.

We next ran a multivariable logistic regression to identify sociodemographic characteristics associated with household food insecurity and examine whether the observed increase in the prevalence from 2005 to 2012 was statistically significant after accounting for compositional variations. We considered household characteristics associated with food insecurity in prior studies (McIntyre et al., 2000; Che & Chen, 2001; Vozoris & Tarasuk, 2003; Tarasuk et al., 2013; McIntyre et al., 2015), including household composition, highest level of education among household members, housing tenure, main source of household income, region of residence (denoted by health authority), and household income. Income was adjusted for household size (by dividing household income by the square root of the number of household members) and inflation (converting income to 2012 constant dollars using the Consumer Price Index for BC), and a dummy variable was included to identify households with income imputed by Statistics Canada (approximately 30% of the sample). We also included respondents' aboriginal status and immigration status, variables not available at the household level but known to associate with risk.

To explore the effects of the two policy interventions of interest, we tested whether temporal changes in food insecurity in BC differed by main sources of household income or housing tenure by testing the joint interactions between i) survey year and main source of income (employment/self-employment income being the comparison group), and ii) year and housing tenure (home owner being the comparison group), in two separate multivariable logistic regression models. Each model was run for all three food insecurity outcome variables and each included the above-listed covariates. Because social assistance payments are part of total household income, income was omitted from the models exploring possible changes in food insecurity related to main source of income. Income was retained in the models considering the vulnerability by housing tenure because rental assistance is unlikely to be reported as income.

Upon observing jointly statistically significant interactions between year dummies and main source of income, we conducted subgroup analyses among households relying on social assistance and employment to confirm that the observed relative decrease in food insecurity among households on social assistance was not attributable to a simultaneous increase in the risk among households relying on employment. The subgroup analyses were only run for the food insecurity outcome variables for which statistically significant interactions were identified, with significance defined as $p < 0.05$.

Similarly, upon observing jointly statistically significant interactions between survey years and housing tenure, we stratified the sample by housing tenure and tested whether the observed relative decline in food insecurity among renter households was spuriously caused by

the fact that homeowners faced increased hardship over this period. Again, the stratified models were only run for the food insecurity outcomes for which the interaction effects were significant.

3. Results

Small but statistically significant differences were observed from 2005 to 2012 in the distribution of the sample by region of residence, main source of income, household income, education, home ownership, aboriginal status, and immigration status (Table 1). Fig. 1 shows household food insecurity status by year for households reliant on social assistance and employment incomes, and Fig. 2 shows prevalence by housing tenure.

After controlling for compositional variations (through multivariable logistic regression) in the survey sample, the odds of experiencing food insecurity rose by 22% in 2012 compared to 2005 (Table 2). Additionally, the odds rose with lower income, being aboriginal, renting rather than owning one's dwelling, and being a couple with children under 18 or being a female lone parent (versus being an unattached individual). Relative to households reliant on employment incomes, the odds ratios of food insecurity ranged from 0.26 (95% CI: 0.22, 0.31) for households reliant on private retirement or investment incomes to 4.21 (95% CI: 3.37, 5.27) for those on social assistance. Immigrants also had lower odds of food insecurity than Canadian-born respondents, and differences in risk were observed in relation to education and region of residence.

When the outcome was moderate and severe food insecurity, the pattern of results was similar for most variables, but some differences emerged when the outcome was severe food insecurity. Compared to 2005, the odds ratio for severe food insecurity was higher in 2008, but not 2012. In addition, whereas couples with children under 18 had a higher odds ratio for overall food insecurity, they had a lower odds ratio for severe food insecurity compared to unattached individuals living alone (Table 2).

The interaction of survey years with main source of income was statistically significant for overall food insecurity ($p = 0.029$) and

Table 1
Sample characteristics of households in British Columbia by survey year ($N = 58,656$).

	2005	2007	2008	2009	2010	2011	2012	P
Region (health authority), %								<0.001
Interior	17.1	16.6	16.5	16.8	16.6	16.2	16.0	
Fraser	32.2	34.3	35.0	34.9	36.0	35.8	35.8	
Vancouver coastal	25.7	25.2	24.9	24.9	24.7	25.3	25.6	
Island	18.6	17.6	17.2	17.3	16.8	17.1	17.2	
Northern	6.4	6.3	6.4	6.0	5.9	5.6	5.4	
Main source of household income, %								<0.001
Employment	65.5	69.4	69.5	67.1	65.3	67.5	66.2	
Private retirement income/investment income[a]	16.4	15.4	14.7	10.8	11.5	12.4	12.4	
Seniors' income from government transfers	6.4	5.2	5.5	8.5	7.7	8.5	9.8	
Social assistance	1.6	2.1	2.3	2.1	2.3	1.9	2.5	
Other income[b] or none	3.9	3.2	3.2	4.3	4.7	4.1	3.8	
Unstated	6.3	4.7	4.9	7.1	8.5	5.6	5.3	
Adjusted total household income ($1000 s), mean ± SEM	42.5 ± 0.3	45.8 ± 0.5	47.4 ± 0.7	47.3 ± 0.5	46.3 ± 0.6	47.8 ± 0.7	50.2 ± 1.5	<0.001
Income imputation, %								<0.001
No	73.5	72.7	73.3	66.6	68.2	69.5	71.5	
Yes	26.5	27.3	26.7	33.4	31.8	30.5	28.5	
Household composition, %								0.243
Unattached, living alone	29.5	30.0	30.4	30.6	28.6	28.8	28.7	
Unattached, living with others	3.3	3.8	3.7	3.4	4.3	4.1	3.7	
Couple, no children	27.2	26.4	27.2	26.6	27.2	27.4	28.3	
Couple, children <18	21.4	19.9	20.0	19.4	20.4	20.5	20.2	
Couple, children ≥18	6.0	5.7	5.6	5.9	6.2	6.0	5.6	
Female lone parent, children <18	3.8	4.1	3.9	4.0	4.2	3.7	4.1	
Female lone parent, children ≥18	1.9	2.5	2.0	2.5	2.6	2.6	1.9	
Other type[c]	6.4	7.2	6.7	7.4	6.4	6.7	7.0	
Unstated	0.5	0.4	0.5	0.3	0.2	0.2	0.5	
Highest level of education in household, %								<0.001
Less than secondary	8.2	7.3	6.8	7.1	6.1	5.1	6.3	
Secondary school graduate	11.5	13.2	12.2	12.0	10.8	12.9	11.4	
Some post-secondary	7.9	7.8	6.9	7.4	7.0	5.2	4.4	
Completed post-secondary, below bachelor's degree	37.2	35.7	36.0	37.4	37.3	38.1	36.5	
Completed Bachelor's degree or higher	28.8	29.8	32.1	30.9	33.6	33.8	36.1	
Unstated	6.5	6.1	5.9	5.2	5.2	4.9	5.3	
Housing tenure, %								0.047
Dwelling owned by member of household	71.3	70.5	69.6	70.7	68.7	70.7	69.1	
Dwelling rented	28.4	29.0	30.0	29.2	30.7	29.0	30.6	
Unstated	0.4	0.5	0.5	0.1	0.6	0.3	0.3	
Aboriginal status of respondent, %								0.014
Non-aboriginal	97.0	95.9	95.0	95.8	95.6	95.8	95.0	
Aboriginal	2.7	3.8	4.7	3.9	4.1	4.0	4.6	
Unstated	0.3	0.3	0.3	0.2	0.2	0.2	0.4	
Immigrant status of respondent, %								<0.001
Canadian born	73.1	70.8	72.5	72.1	71.1	70.6	68.6	
Immigrant <5 years	2.6	3.0	3.0	3.3	3.7	3.5	4.2	
Immigrant 5+ years	24.0	25.4	24.0	24.1	24.5	24.8	26.0	
Unstated	0.3	0.7	0.5	0.5	0.7	1.1	1.2	

[a] Private retirement income includes job-related retirement pensions, superannuation and annuities, registered retirement savings plan (RRSP), and registered retirement income fund (RRIF). Investment income includes dividends and interest.
[b] Other income includes employment insurance benefits, child tax benefits, child support, alimony and other (e.g. rental income, scholarships).
[c] Other household type includes male lone parents with children ≥18, and anyone else who cannot be clearly put into one of the above categories.

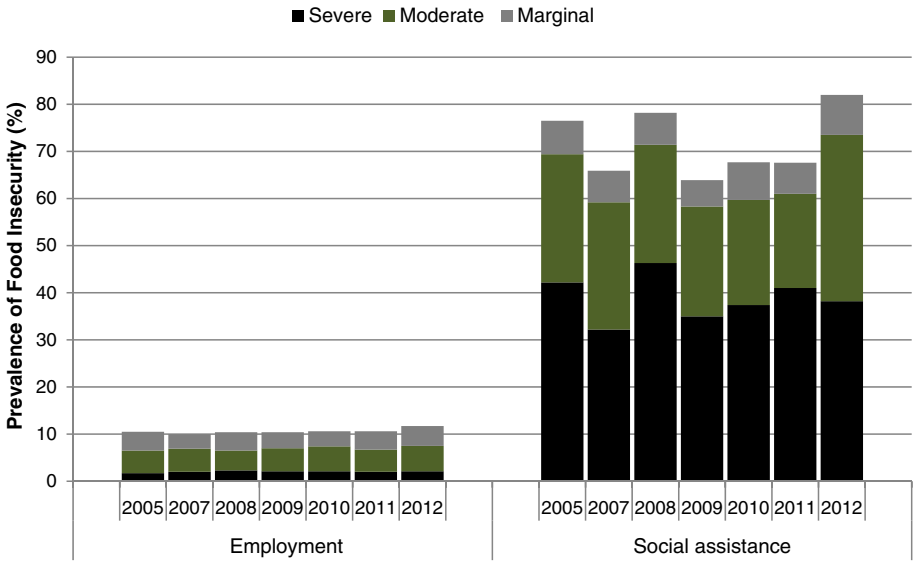

Fig. 1. Prevalence of household food insecurity among households reliant on employment and social assistance by survey year.

moderate and severe food insecurity combined ($p = 0.024$), but not for severe food insecurity ($p = 0.956$).

When stratified regression models were run for households on social assistance and those reliant on employment (i.e., the comparison group in the interaction test), the year fixed effects were not statistically significant among households reliant on employment, but those on social assistance experienced a statistically significant reduction in overall food insecurity in 2007, 2009, and 2011 relative to 2005. When only moderate and severe food insecurity were considered, statistically significantly lower odds ratios were observed for 2007, 2009, 2010, and 2011 relative to 2005 (Table 3).

The statistically significant interactions between year dummies and housing tenure suggest that the year fixed effects for renter households differed significantly from those for homeowners when the outcome was moderate and severe food insecurity ($p < 0.001$) or severe insecurity alone ($p < 0.001$), but no statistically significant interaction was observed for overall food insecurity ($p = 0.106$).

Stratifying by housing tenure, no statistically significant change in the odds ratio of moderate and severe food insecurity was observed over time for renters, but for homeowners the odds ratio increased by 53% in 2009 and 36% in 2012, compared with 2005 (Table 4). The odds ratio of severe food insecurity for renter households rose by 44% in 2008, and the odds ratio for homeowners increased by 62% in 2009.

4. Discussion

The socio-demographic correlates of food insecurity in BC are similar to those identified in other studies in Canada (Che & Chen, 2001; Vozoris & Tarasuk, 2003; Tarasuk et al., 2013; McIntyre et al., 2015; Tarasuk & Vogt, 2009), although the polarization of risk in relation to household's main source of income is more extreme than anything previously reported. We observed a statistically significant increase in the probability of BC residents experiencing some degree of food insecurity between 2005 and 2012, after taking into account changes in the composition of the population. Additionally, we noted an increase in the vulnerability of homeowners in particular over this period. Our results also suggest that the one-time increase to social assistance benefits had a positive, short-term effect on food insecurity rates among recipients, but we could discern no impact of the RAP.

The differences in risk observed in relation to household's main source of income are consistent with US research showing that food insecurity is a function of both the amount and the volatility of household income, with negative income shocks being more damaging to households that face liquidity restraints (Guo, 2011; Leete & Bania, 2010). Households on social assistance, by design, lack savings, property, or other assets that could buffer unexpected expenses or income shocks; thus their vulnerability to food insecurity extends beyond their income

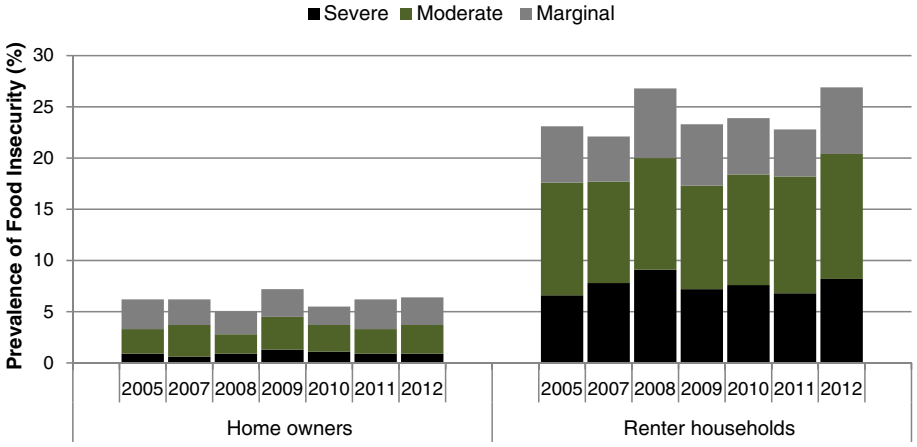

Fig. 2. Prevalence of food insecurity among homeowners and renter households by survey year.

Table 2
Crude prevalence and adjusted odds ratio of household food insecurity in British Columbia in relation to household socio-demographic characteristics and survey year (N = 58,656).

	Overall food insecurity		Moderate and severe food insecurity		Severe food insecurity	
	Unadjusted %	Adjusted OR[d] (95% CI)	Unadjusted %	Adjusted OR[d] (95% CI)	Unadjusted %	Adjusted OR[d] (95% CI)
Year						
2005	11.0	Reference	7.3	Reference	2.5	Reference
2007	10.8	0.96(0.84,1.10)	7.7	1.04(0.88,1.23)	2.7	1.02(0.78,1.33)
2008	11.5	1.09(0.94,1.25)	7.9	1.11(0.93,1.32)	3.3	1.36*(1.07,1.72)
2009	11.9	1.14(0.99,1.31)	8.2	1.17(0.99,1.38)	3.0	1.23(0.96,1.59)
2010	11.1	0.98(0.86,1.12)	8.2	1.08(0.92,1.27)	3.0	1.15(0.89,1.48)
2011	11.0	1.05(0.91,1.22)	7.6	1.08(0.91,1.29)	2.6	1.10(0.85,1.44)
2012	12.7	1.22*(1.05,1.42)	8.8	1.24*(1.04,1.47)	3.2	1.18(0.91,1.54)
Region (health authority)						
Fraser	13.4	Reference	9.6	Reference	3.5	Reference
Interior	9.8	1.31*(1.14,1.50)	6.4	1.36*(1.17,1.59)	2.2	1.24(0.94,1.64)
Vancouver	10.6	0.92(0.79,1.07)	7.5	0.93(0.77,1.11)	3.0	0.94(0.72,1.23)
Island	13.1	1.30*(1.15,1.48)	9.6	1.37*(1.18,1.59)	3.7	1.31*(1.02,1.69)
Northern	14.5	1.37*(1.18,1.59)	10.1	1.35*(1.13,1.62)	3.2	1.04(0.78,1.40)
Main source of household income						
Employment	10.6	Reference	6.9	Reference	2.0	Reference
Private retirement income/investment income[a]	3.1	0.26*(0.22,0.31)	1.7	0.21*(0.17,0.27)	0.5	0.19*(0.13,0.28)
Seniors' income from government transfers	13.0	0.64*(0.54,0.77)	9.4	0.63*(0.52,0.78)	3.3	0.60*(0.43,0.84)
Social assistance	71.9	4.21*(3.37,5.27)	64.8	4.07*(3.24,5.11)	38.8	3.86*(2.88,5.16)
Other income[b] or none	23.9	1.15(0.97,1.36)	18.8	1.22*(1.01,1.47)	8.2	1.41*(1.02,1.95)
Unstated	8.0	0.56*(0.45,0.70)	5.3	0.58*(0.43,0.77)	1.5	0.59*(0.37,0.94)
Adjusted total household income ($1000 s)	–	0.97*(0.97,0.97)	–	0.97*(0.96,0.97)	–	0.96*(0.95,0.97)
Income imputation						
No	12.2	Reference	8.7	Reference	3.3	Reference
Yes	9.6	0.76*(0.69,0.85)	6.4	0.75*(0.66,0.87)	2.0	0.68*(0.54,0.87)
Household composition						
Unattached, living alone	13.8	Reference	10.8	Reference	5.2	Reference
Unattached, living with others	21.6	1.37*(1.08,1.73)	15.8	1.20(0.94,1.53)	6.3	0.97(0.67,1.40)
Couple, no children	5.4	0.76*(0.66,0.87)	3.3	0.65*(0.55,0.77)	0.9	0.45*(0.33,0.62)
Couple, children <18	10.4	1.16*(1.02,1.33)	6.2	0.94(0.80,1.09)	1.2	0.42*(0.32,0.55)
Couple, children ≥18	5.8	0.91(0.73,1.14)	3.4	0.81(0.59,1.10)	0.6	0.38*(0.23,0.64)
Female lone parent, children <18	34.4	1.77*(1.47,2.13)	25.5	1.36*(1.10,1.68)	10.5	0.89(0.67,1.20)
Female lone parent, children ≥18	14.1	1.37*(1.05,1.78)	9.5	1.18(0.86,1.61)	2.3	0.62(0.35,1.12)
Other type[c]	13.6	1.29*(1.08,1.52)	9.2	1.12(0.91,1.37)	2.3	0.57*(0.40,0.79)
Unstated	8.6	0.64(0.3,1.36)	4.9	0.46(0.18,1.21)	2.8	0.64(0.03,14.15)
Highest level of education in household						
Less than secondary	21.5	1.21*(1.02,1.43)	16.5	1.11(0.92,1.35)	7.3	1.05(0.77,1.42)
Secondary school graduate	13.2	0.89(0.77,1.03)	9.4	0.85(0.72,1.01)	3.7	0.95(0.73,1.24)
Some post-secondary	20.3	1.22*(1.04,1.44)	15.5	1.21*(1.00,1.46)	7.3	1.42*(1.08,1.85)
Completed post-secondary, below bachelor's degree	12.0	Reference	8.4	Reference	2.7	Reference
Completed bachelor's degree or higher	5.8	0.65*(0.57,0.75)	3.5	0.62*(0.53,0.74)	1.0	0.70*(0.52,0.93)
Unstated	14.3	1.11(0.92,1.33)	9.4	1.05(0.83,1.33)	2.7	1.05(0.75,1.48)
Housing tenure						
Dwelling owned by member of household	6.1	Reference	3.6	Reference	0.9	Reference
Dwelling rented	24.2	2.65*(2.38,2.95)	18.5	2.95*(2.61,3.34)	7.6	2.87*(2.33,3.53)
Unstated	10.2	1.42(0.64,3.17)	7.0	1.64(0.51,5.30)	2.3	1.97(0.01,314.05)
Aboriginal status of respondent						
Non-aboriginal	10.6	Reference	7.3	Reference	2.6	Reference
Aboriginal	30.5	1.49*(1.26,1.76)	24.3	1.52*(1.25,1.84)	10.7	1.43*(1.06,1.93)
Unstated	21.5	2.51(0.82,7.71)	17.6	3.26(0.77,13.80)	13.1	8.87*(1.15,68.40)
Immigrant status of respondent						
Canadian born	12.6	Reference	9.0	Reference	3.5	Reference
Immigrant <5 years	10.8	0.51*(0.38,0.69)	7.1	0.47*(0.32,0.69)	1.4	0.25*(0.12,0.52)
Immigrant 5+ years	8.4	0.74*(0.65,0.84)	5.4	0.70*(0.60,0.82)	1.6	0.58*(0.45,0.74)
Unstated	9.0	0.78(0.33,1.86)	3.9	0.47(0.07,3.00)	0.1	0.04(<0.01,46.53)

* $p < 0.05$.
[a] Private retirement income includes job-related retirement pensions, superannuation and annuities, registered retirement savings plan (RRSP), and registered retirement income fund (RRIF). Investment income includes dividends and interest.
[b] Other income includes employment insurance benefits, child tax benefits, child support, alimony and other (e.g. rental income, scholarships).
[c] Other household type includes male lone parents with children ≥18, and anyone else who cannot be clearly put into one of the above categories.
[d] Adjusted odds ratios derived from multivariable logistic regression model including all variables in the table.

levels. The lower odds ratio of food insecurity among households reliant on public pensions compared to those in the workforce is consistent with the protective effect of pensions reported elsewhere (Emery et al., 2013b), but this protection appears to pale in comparison to that afforded by private pensions and investment incomes, presumably because households reliant on these income sources have much greater assets.

The observed decline in food insecurity among social assistance recipients between 2005 and 2007 and 2009–11, with no concomitant changes among households reliant on employment incomes, suggests

Table 3
Adjusted odds ratios of food insecurity among households reliant on employment and social assistance in relation to survey year, derived from multivariable logistic regression models[a].

	Overall food insecurity		Moderate and severe food insecurity	
	Employment $n = 36{,}787$	Social assistance $n = 1217$	Employment n = 36,787	Social assistance n = 1217
2005	Reference	Reference	Reference	Reference
2007	0.90(0.77,1.07)	0.67*(0.48,0.93)	1.02(0.83,1.26)	0.67*(0.47,0.97)
2008	0.96(0.81,1.14)	1.12(0.83,1.52)	0.96(0.79,1.18)	1.12(0.81,1.55)
2009	0.99(0.83,1.17)	0.57*(0.40,0.83)	1.08(0.88,1.32)	0.64*(0.44,0.95)
2010	1.00(0.85,1.18)	0.76(0.56,1.02)	1.14(0.93,1.40)	0.72*(0.53,0.99)
2011	1.03(0.86,1.23)	0.64*(0.46,0.88)	1.05(0.84,1.31)	0.66*(0.46,0.95)
2012	1.17(0.97,1.40)	1.38(0.97,1.95)	1.20(0.96,1.51)	1.12(0.77,1.63)

* $p < 0.05$.
[a] Each logistic regression model controls for region, household composition, education, housing tenure, aboriginal status, and immigration status.

that BC's one-time increase in welfare incomes reduced food insecurity among this highly vulnerable group. This finding is consistent with the results of two prior studies identifying reductions in food insecurity following income supplementation interventions in Canada (Loopstra et al., 2015b; Ionescu-Ittu et al., 2015). The fact that food insecurity among social assistance recipients returned to 2005 levels in 2008 may indicate that the increment in incomes was insufficient to insulate recipients from the worsening economic conditions that characterized that period. While inflation remained relatively low in BC in the years immediately following the increase in benefits, food prices rose disproportionately between 2007 and 2012 (Rollin, 2013). The cumulative increase in food prices may explain why food insecurity rates among social assistance recipients returned to 2005 levels in 2012. The indexation of benefits to inflation is imperative to sustain gains achieved by periodic increases. The absence of any indication that the increase in welfare incomes impacted rates of severe food insecurity may mean that households experiencing such extreme levels of deprivation required more assistance (monetary or otherwise). Given the much greater probability of serious adverse health outcomes among those exposed to severe food insecurity (Seligman et al., 2007; Muldoon et al., 2012; Tarasuk et al., 2015; Whitaker et al., 2006; Carmichael et al., 2007), more research is needed to identify the actions necessary to reduce this condition.

We found no reduction in the vulnerability of renters following the introduction of the RAP, instead observing increased severe food insecurity in 2008. Perhaps the program helped to prevent even greater increases in food insecurity among renters during a period of economic downturn and low vacancy rates (Mortgage & Corporation, 2016), but we could not assess this. Our inability to discern an effect of BC's rental assistance program may also be a function of the program's limited coverage and low participation rate (Ostry, 2012). A special application is required to access this benefit, and eligibility is restricted to households not on social assistance, but with incomes under $35,000 (a threshold neither indexed to inflation nor adjusted for household size). More direct program evaluation is required to establish what, if any, effect this program could have on household food insecurity.

Table 4
Adjusted odds ratios of food insecurity among homeowners and renter households in relation to survey year, derived from multivariable logistic regression models[a].

	Moderate and severe food insecurity		Severe food insecurity	
	Homeowners $n = 43{,}974$	Renter households $n = 14{,}497$	Homeowners $n = 43{,}974$	Renter households $n = 14{,}497$
2005	Reference	Reference	Reference	Reference
2007	1.24(0.94,1.65)	0.94(0.75,1.17)	0.78(0.56,1.11)	1.12(0.81,1.53)
2008	0.94(0.72,1.22)	1.20(0.97,1.49)	1.06(0.77,1.47)	1.44*(1.08,1.93)
2009	1.53*(1.22,1.92)	0.97(0.77,1.22)	1.62*(1.15,2.28)	1.09(0.81,1.47)
2010	1.18(0.93,1.51)	1.02(0.83,1.26)	1.32(0.99,1.76)	1.10(0.79,1.53)
2011	1.12(0.84,1.48)	1.06(0.85,1.32)	1.24(0.87,1.79)	1.06(0.78,1.45)
2012	1.36*(1.04,1.78)	1.16(0.92,1.46)	1.34(0.92,1.94)	1.13(0.84,1.52)

* $p < 0.05$.
[a] Each regression controls for region, main source of income, household income, income imputation status, household composition, education, aboriginal status and immigration status.

More research is needed to explain what underpins our finding that households in BC faced greater risk of food insecurity in 2012 than 2005, irrespective of household characteristics. Although owning rather than renting one's dwelling has long been associated with lower risk of food insecurity (McIntyre et al., 2015), in part because of the financial security and stability afforded by home ownership, the protective effect of homeownership may be diminishing in BC. While the increase in moderate and severe food insecurity among homeowners in 2009 may be attributed to the economic downturn of 2008–2009, the statistically significant rise in 2012 perhaps reflects the increasing indebtedness of BC homeowners (Toronto-Dominion Bank, n.d.).

Macroeconomic factors such as food price (Gregory & Coleman-Jensen, 2013), shelter costs (Tapogna et al., 2004; Bartfeld & Dunifon, 2006; Sriram & Tarasuk, 2015), unemployment rate (Loopstra et al., 2016; Tapogna et al., 2004; Bartfeld & Dunifon, 2006; Gundersen et al., 2014; Sriram & Tarasuk, 2015), and average wages (Loopstra et al., 2016; Bartfeld & Dunifon, 2006) have been strongly linked to food insecurity in other contexts, but the available data preclude examination of these factors in relation to food insecurity in BC. Additionally, the BC government's decision to opt out of food insecurity measurement in the 2013–14 CCHS thwarts further examination of this trend until data become available from the 2015–16 survey (when food insecurity measurement was mandatory for all provinces and territories). Given the toll that household food insecurity has been shown to take on individuals' health, it is important to understand what underpins upward trends so that corrective action can be taken.

Our results highlight the importance of considering different levels of food insecurity in order to fully understand patterns of vulnerability within populations and accurately identify the effects of policy interventions. Both our analysis of the apparent impact of BC's increase in social assistance incomes and research into the effects of social assistance policy reforms in Newfoundland and Labrador (Loopstra et al., 2015b) suggest that effects can differ in relation to the severity of food insecurity. A recent US study also found differences in the apparent effects of safety net programs on risk of food insecurity depending on the level of severity considered (Schmidt et al., 2015). Researchers are thus advised to assess interventions against the full spectrum of severity captured in the HFSSM.

Strengths of this study include the relatively large sample size and consistent measure of food insecurity over multiple consecutive years, using a validated scale of severity. Our study is limited, however, by the repeated cross-sectional nature of the data. As a result, year-to-year differences might be spuriously caused by sampling differences between study years, even after controlling for observed household characteristics. Further, the available data do not allow us to fully uncover the factors that underpin the overall pattern of worsening food insecurity in the province over these years. In addition, given that food insecurity was not a rare event over the study period (i.e., provincial prevalence rates exceeded 10%), the odds ratios derived from our logistic regression models cannot be considered to approximate relative risks. While this limitation does not bias the tests of statistical significance reported here, it means the odds ratios may not accurately reflect the true magnitude of observed differences.

Despite these limitations, our results provide evidence of the sensitivity of food insecurity among households reliant on social assistance to a relatively small, one-time increase in benefits. The fact that this improvement occurred in the context of increasing food insecurity in the province overall highlights the value of conducting detailed assessments among specific vulnerable subgroups to gauge the effects of

specific policy changes. This is particularly important in examinations of provincial programs which tend to be more narrowly targeted than federal benefit programs, yet may provide critical support to very high-risk households.

5. Conclusion

This study contributes to an emerging body of research into the effects of social policy decisions on food insecurity rates in welfare states whose policy levers include a mix of long-established social security programs. While documenting an overall increase in risk of food insecurity among BC residents between 2005 and 2012, our findings indicate the sensitivity of food insecurity among social assistance recipients in BC to a modest one-time improvement in benefits. Given the implications of food insecurity for health and public healthcare expenditures, the responsiveness of household food insecurity to improvements in welfare benefits highlights the importance of advocacy for social policies that improve the financial resources of vulnerable groups. Further, this research highlights the need for social policy that is designed to sustain gains throughout periods of economic hardship and beyond, to ensure that improvements are not transient.

Conflict of interest

The authors declare there is no conflict of interest.

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Appendix A

Table A.1
Determination of household food security status, based on household food security survey module.

Status	Interpretation	10 item adult food security scale (and household scale for US households with no children)	8 item child food security scale	18 item household food security scale (for US households with children only)
Canada[a]				
Food secure	No report of income-related problems of food access.	No items affirmed	No items affirmed	–
Marginal food insecure	Some indication of worry or an income-related barrier to adequate, secure food access.	Affirmed no more than 1 item on either scale		–
Moderate food insecure	Compromise in quality and/or quantity of food consumed by adults and/or children due to a lack of money for food.	2 to 5 Positive responses	2 to 4 Positive responses	–
Severe food insecure	Disrupted eating patterns and reduced food intake among adults and/or children	6 or More positive responses	5 or More positive responses	–
US[b]				
Food secure	No reported indications of food-access problems or limitations or only one or two reported indications—typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake.	No items affirmed or 1 to 2 positive responses	Affirmed no more than 1 item	No items affirmed or 1 to 2 positive responses
Food insecure with low food security	Reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake.	3 to 5 Positive responses	2 to 4 Positive responses	3 to 7 Positive responses
Food insecure with very low food security	Reports of multiple indications of disrupted eating patterns and reduced food intake.	6 or More positive responses	5 or More positive responses	8 or More positive responses

[a] Adapted from: Canadian community health survey, cycle 2.2, nutrition (2004): Income related household food security in Canada.
[b] Adapted from: United States Department of Agriculture, economic research report number 194 (2015), household food security in the United States in 2014.

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