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Women respondents report higher household food insecurity than do men in similar Canadian households

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Abstract

Objective: We investigated factors accounting for the consistently higher levels of household food insecurity reported by women in Canada.

Design: Two cycles of the Canadian Community Health Survey for the years 2005/2006 and 2007/2008 were pooled to examine the association between household food insecurity, measured using the Household Food Security Survey Module and other metrics, and respondent sex. We stratified households as married/cohabiting (in which case, the household respondent was chosen randomly) or non-married (single/widowed/separated/divorced) and adjusted for differences in household characteristics, including the presence of children.

Setting: Canada.

Subjects: Analysis was restricted to households dependent on employment/self-employment and whose reported annual household income was below $CAN 100 000. Exclusions included respondents less than 18 years of age, any welfare receipt, and missing food insecurity, marital status, income source and amount, or household composition data.

Results: For non-married households, increased food insecurity in female- *v.* male-led households was accounted for by significant differences in household socio-economic characteristics. In contrast, in married/cohabiting households with or without children, higher food insecurity rates were reported when the respondent was female and neither respondent characteristics nor socio-economic factors accounted for the differences.

Conclusions: Higher rates of food insecurity in non-married households in Canada are largely attributable to women's socio-economic disadvantage. In married households, women appear to report higher levels of food insecurity than men. These findings suggest a possible bias in the measurement of population-level household food insecurity in surveys that do not account for the sex of the respondent in married/cohabiting households.

Keywords
Gender
Food insecurity
Household Food Security
Survey Module
Marital status

Household food insecurity is experienced when there is uncertainty regarding, or a disruption in, food intake or eating patterns by at least one member of a household due to financial constraints[1,2]. As a condition aligned with insufficient household resources necessary to obtain food in socially acceptable ways, it is more common in households with lower education, lower income, reliance on social assistance, of aboriginal status, where there are small children and where households are lone-parent led[3,4]. Intra-household food provisioning protects some household members, such as children, from food deprivation while differentially exposing other members, such as mothers, to compromises in food quality or intake[5–10]. Thus, as a household measure, food insecurity reflects an overall state of food access adequacy. Household food insecurity is of public health concern because of its association with poor physical and mental health among household members[11–13] as well as indicators of household stress such as family dysfunction[14].

Women are more likely to report living in a food-insecure household than men[15–18]. This is not surprising, given that women compared with men are more likely to be poor[18–20], to live alone with their children[16,21,22], and to be dependent on welfare[4,23,24]; all factors which are related to increased levels of household food insecurity in both Canada and the USA[4,21,25,26]. According to Health Canada, in 2007–2008 for example, 7·7 % of Canadian households were food insecure, and the prevalence of food insecurity among households led by female lone parents was 25·0 %; twice that of households led by male

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lone parents (11·2 %) and four times that of households led by couples (6·3 %)[27].

Household food insecurity is currently measured in Canada and the USA using the US Department of Agriculture's Household Food Security Survey Module (HFSSM)[1,28–30]. The eighteen-question multi-stage module includes three items relating to the household as a whole, seven items related to the adults in the household and eight further items pertaining to children. Of note, the module does not distinguish which adults or which children in the household are food insecure. Although a few international studies have aimed to assess if females and males respond differently to questions in the HFSSM[31,32], response differences by sex of the respondent were not interrogated in the extensive validation studies for the HFSSM in Canada and the USA[1,28–30]. We wondered if increased rates of household food insecurity observed in women living in disadvantaged households were entirely explained by such circumstances, or whether socio-culturally prescribed gender roles such as 'gatekeeper of the family meal'[33,34] might account for some of the differences, in which case a systematic reporting bias by respondent sex would be at play.

The nationally representative Canadian Community Health Survey (CCHS), which has included the HFSSM since 2002, provided an opportunity to interrogate this issue, because in households where both an adult male and female are present, selection of the respondent is randomized. This created a natural experiment in which the sex of the respondent was independent of the socio-demographic characteristics of the household for married/cohabiting households. Therefore, male–female differences in the population-level prevalence of food insecurity for such households would be attributable to respondent sex. The objective of the present study was therefore to investigate if there is a gender/sex-associated bias in the reporting of household food insecurity for married/cohabiting households in Canada and to contrast these results with household food insecurity reporting in households where the sex of the respondent is predetermined by household structure (e.g. lone mother-led).

Methods

Data and survey design

The CCHS is a survey conducted by Statistics Canada which collected data on a two-year cycle until 2008, after which it became a rolling survey with a similar sampling strategy. The sample represents approximately 98 % of the Canadian population aged 12 years and older[35] and excludes individuals living on aboriginal reserves, those residing in institutions, and those in full-time service with the Canadian Forces. CCHS sampling follows a multistage cross-sectional design in which the dwelling is the final sampling unit[35]. Once a household is selected, the household member to be surveyed is randomly determined by Statistics Canada prior to the interview. Approximately half of all interviews are conducted by telephone and half are conducted in person. This complex design ensures that the resulting sample is representative of the underlying population and, in households with both an adult male and adult female, the sex of the respondent is randomly determined.

To ensure a large sample for the present study, we pooled CCHS 3·1 (60 910 males and 72 037 females) and CCHS 4·1 (60 027 males and 71 932 females). Cycles 3·1 and 4·1 of the CCHS were conducted in 2005/2006 and 2007/2008, respectively. In cycle 3·1 the inclusion of the HFSSM was optional and implemented in six of ten Canadian provinces. In cycle 4·1 the module was mandatory. In order to assemble households that were sociodemographically similar for male and female respondents, we limited our analysis to households dependent on employment or self-employment for their primary income source, whose reported annual household income was less than $CAN 100 000. We excluded respondents living with parents, those less than 18 years of age, and those whose marital status was unclear. To ensure that our results were not driven by regions whose food insecurity might be driven by geographic lack of food access and potentially challenge the generalizability of our results, we also excluded respondents living in the three northern territories (Yukon, Nunavut, Northwest Territories). Respondents with missing observations for food insecurity, income source and amount, or household composition were also excluded. This resulted in a final sample of 25 176 non-married (i.e. single/widowed/separated/divorced; 11 865 male and 13 311 female) and 40 014 married (19 261 male and 20 753 female) respondents.

Measures

Outcome

The primary outcome of the study was household food insecurity as ascertained through the HFSSM. The HFSSM metric is based on a series of component questions, ten asked of all households and an additional eight in households with children, regarding the household's ability to meet its basic food needs. The questions referred to the 12-month period prior to the interview and specified lack of money or other resources as being the reason for difficulty in meeting food needs. Component questions were asked over three stages, with each stage increasing in severity. A respondent was asked questions in the second or third stage only if an affirmative answer was given to at least one question in the previous stage[1,36]. In the USA, a household is labelled as 'food secure' if the respondent answers affirmatively to no more than two of the component questions; as having 'low food security' if between three and seven affirmative answers are given in households with children or if three to five affirmative answers are given in households without children; and as having 'very low food security' if eight or more affirmative

answers are given in households with children or if six or more affirmative answers are given in households without children[1,29,37]. For our primary analysis, households were considered food insecure if they were identified as having low food security or very low food security; otherwise they were considered food secure.

Because a gender/sex difference in reporting might differ by the sensitivity of the classification system, we considered alternative metrics for household food insecurity for married households. The first was the Health Canada metric of household food insecurity which, while based on the same component questions as the HFSSM, explicitly analyses food insecurity pertaining to children separately from that pertaining to adults. The metric identifies a household as food insecure if an affirmative answer is provided for two or more of the ten adult/household questions or if an affirmative answer is provided for two or more of the eight child questions. Note that any household identified as food insecure under the HFSSM metric will be identified as food insecure under the Health Canada metric. The latter metric was also used to examine adult/household and child scales of food insecurity separately, potentially mitigating any measurement bias between households with and without children resulting from differences in component questions[2,38]. As a further sensitivity check, we considered as separate outcomes three of the first-stage component questions, asked of all respondents before staging for children. This avoided a potential bias between households with and without children that could result from higher response burden on respondents in households with children, who are asked more questions. Specifically, respondents were asked whether statements regarding the household members worrying about running out of food, having insufficient food and having a compromised diet were 'often' or 'sometimes' (classified as affirmative) *v.* 'never' true.

Respondent characteristics

Primary analyses focused on stratification by respondent sex and marital status (married or living common-law (hereafter referred to as 'married')) *v.* other living arrangements such as single, widowed, separated/divorced (herein referred to as 'non-married'). Additional analysis stratified married respondents by highest level of respondent education (less than high school, high-school diploma, post-secondary less than baccalaureate, and baccalaureate or higher) and respondent age group (18–29, 30–39, 40–49 and 50–64 years).

Household characteristics

Household characteristics used in the analysis included household income, presence of children, number of children under 15 years of age or under 16–17 years of age, number of adults in household, home ownership, highest level of education attained by any household member, province of residence, and urban or rural residence.

Statistical analysis

Data were analysed using the Stata statistical software package version 10. Weights reflecting the respondent's contribution to the population were used to correct for sample selection and oversampling, and bootstrap weights were used to estimate standard errors, both provided by Statistics Canada[35]. Household characteristics were compared by respondent sex and marital status using t tests and χ^2 tests as appropriate with a significance level of $P < 0{\cdot}05$. Univariate logistic regression was used to calculate unadjusted odds ratios reflecting the association between respondent sex and household food insecurity and between household characteristics and household food insecurity. This was extended to a multivariate logistic regression to calculate adjusted odds ratios, simultaneously adjusted for respondent sex and household characteristics. For married respondents the logistic regression analysis was repeated, stratifying separately by household characteristics (the presence of children in the household, household income, home ownership, urban or rural status of the household) and respondent characteristics (respondent's age group, respondent's highest level of education).

For married respondents the analysis was repeated replacing the HFSSM classification outcome with the Health Canada metric for household food insecurity, the Health Canada adult and child scales of food insecurity and, in separate analyses, with each of the three first-stage component questions described above. Finally, we examined HFSSM severity measures using multinomial logistic regression to calculate a relative risk ratio (RRR) reflecting the change in the risk of the household being identified as having low food security or very low food security, relative to food secure, when the respondent was female *v.* male. Bivariate multinomial logistic regression was used to calculate the unadjusted relative risk ratio with 95% confidence interval, and multivariate multinomial logistic regression was used to calculate the relative risk ratio adjusting for household characteristics. Ethical approval was received from the Conjoint Health Research Ethics Board at the University of Calgary.

Results

Household characteristics by respondent sex and married* v. *non-married status

Estimated differences in mean and proportional household characteristics by respondent sex and married *v.* non-married status are reported in Table 1. For non-married respondents, the household was 3·97 (95% CI 2·93, 5·01) percentage points more likely to be classified as food insecure when the respondent was female rather than male. Significant differences across household characteristics between females and males were observed for non-married respondents. These included lower mean and median household incomes, larger households with more

Table 1 Means†, proportions and differences in household characteristics by respondent married *v.* non-married status and sex: Canadian Community Health Survey, 2005/2006 and 2007/2008

	Non-married				Married			
Variable	Male (*n* 11 865)	Female (*n* 13 311)	Difference	Difference 95 % CI	Male (*n* 19 261)	Female (*n* 20 753)	Difference	Difference 95 % CI
Food insecurity (%)	6·62	10·59	3·97***	2·93, 5·01	4·03	5·80	1·78***	1·11, 2·44
Annual household income (mean $CAN)	45 964	41 264	−4 699***	40 739, 41 790	60 163	59 577	−585	−1240, 69
Annual household income (median $CAN)	43 000	36 000	−7000***	*P* = 0·000	60 000	60 000	0·00	*P* = 1·000
Home ownership (%)	47·61	49·66	2·04*	0·16, 3·93	75·75	75·63	−0·12	−1·48, 1·25
No. of persons ≤15 years old	0·10	0·38	0·28***	0·25, 0·30	0·84	0·83	0·00	−0·03, 0·03
No. of persons ≤16–17 years old	0·03	0·08	0·05***	0·04, 0·06	0·09	0·09	0·00	−0·01, 0·01
No. of persons ≥18 years old	1·05	1·19	0·14***	0·12, 0·15	2·19	2·20	0·01	−0·01, 0·03
Household education (%)‡								
<High school	10·56	5·09	−5·47***	3·45, 5·51	3·99	3·96	−0·03	−0·59, 0·53
High-school diploma	15·64	14·49	−1·15	2·49, 0·02	10·32	10·36	0·04	−0·87, 0·95
Post-secondary <BA	50·91	53·45	2·54**	0·73, 4·36	55·21	56·45	1·24	−0·32, 2·80
BA or higher	22·90	26·97	4·07***	2·37, 5·76	30·48	29·23	−1·25	−2·72, 0·23
Province (%)†								
Newfoundland & Labrador	0·51	0·51	0·00	−0·14, 0·14	0·85	0·85	0·01	−0·08, 0·09
Prince Edward Island	0·37	0·44	0·07	−0·02, 0·16	0·56	0·55	0·00	−0·09, 0·08
Nova Scotia	2·44	3·01	0·57*	0·13, 1·00	3·39	3·38	−0·01	−0·39, 0·37
New Brunswick	1·15	1·06	−0·09	−0·32, 0·13	1·46	1·36	−0·10	−0·21, 0·01
Quebec	31·28	28·19	−3·09***	−4·88, −1·30	28·36	28·02	−0·34	−1·57, 0·89
Ontario	33·74	37·17	3·43***	1·64, 5·22	39·61	39·09	−0·52	−1·89, 0·85
Manitoba	2·27	2·02	−0·25	−0·63, 0·14	1·98	1·79	−0·19*	−0·36, −0·02
Saskatchewan	1·86	1·57	−0·29	−0·58, 0·00	1·46	1·50	0·04	−0·07, 0·15
Alberta	10·25	10·18	−0·06	−1·17, 1·04	9·57	9·88	0·31	−0·53, 1·14
British Columbia	16·13	15·85	−0·28	−1·45, 0·89	12·77	13·58	0·81	−0·04, 1·67
Urban residence (%)	85·59	90·07	4·48***	3·45, 5·51	79·47	79·09	−0·38	−1·59, 0·83

BA, baccalaureate.
Significant difference between males and females: *$P < 0·05$, **$P < 0·01$, ***$P < 0·001$; confidence intervals are based on bootstrapped standard errors.
†Means calculated using population weights.
‡Bootstrapped χ^2 statistic was used to test the null hypothesis of equivalent distribution between males and females. For non-married households the corresponding *P* values for household education are $P < 0·001$ (non-married) and $P = 0·316$ (married), and for province of residence $P < 0·001$ (non-married) and $P = 0·623$ (married).

children (both under 15 and 16–17 years of age) and adults, higher home ownership, urban residence, and higher levels of household education for female respondents. Non-married women were also less likely than non-married men to reside in Quebec and more likely to reside in Ontario. For married respondents, the household was 1·78 (95 % CI 1·11, 2·44) percentage points more likely to be classified as food insecure if the respondent was female rather than male. Other than a small difference in residence in the province of Manitoba, for all other household characteristics, married male and female respondents were statistically indistinguishable. This is consistent with the randomization of respondent sex and suggests that the sample of married male respondents and married female respondents is representative of the same underlying population of households.

Household characteristics and food insecurity

Estimates of the unadjusted and adjusted logistic odds ratios for food insecurity by sex, married *v.* non-married status and household characteristics are reported in Table 2. Households with higher income, higher education, who owned their home and who lived in Quebec or Saskatchewan *v.* Ontario had lower adjusted odds of being classified as food insecure for both unmarried and married respondents. Households with children either under age 15 or 16–17 years were significantly more likely to be classified as food insecure, regardless of unmarried *v.* married status of the household; this may partially be attributed to the well-documented and significant measurement bias attributed to differences in component questions between households with and without children[2,38]. The presence of an additional adult increased the odds of food insecurity when controlling for other household characteristics in married households. Food insecurity was not independently associated with urban *v.* rural residence.

Respondent sex and household food insecurity

The unadjusted odds of a household being classified as food insecure was higher when the respondent was female rather than male, for both unmarried and married respondents (Table 2). After adjusting for household characteristics, the association between food insecurity classification and respondent sex was near zero and statistically insignificant for non-married households (OR = 1·01; 95 % CI 0·86, 1·19) and remained significant in households of married respondents (OR = 1·46; 95 % CI 1·24, 1·72). For non-married respondents, higher household food insecurity for female respondents than male respondents can be almost entirely attributed to less advantageous economic and demographic characteristics and circumstances particularly associated with lone parenthood, as inferred by controlling for number of

Table 2 Unadjusted and logistic regression-adjusted odds ratios for household food insecurity for non-married *v.* married respondents: Canadian Community Health Survey, 2005/2006 and 2007/2008

	Non-married (*n* 25 176)				Married (*n* 40 014)			
Risk category	Unadjusted OR	95 % CI	Adjusted OR	95 % CI	Unadjusted OR	95 % CI	Adjusted OR	95 % CI
Sex (Ref. Male)								
Female	1·67***	1·45, 1·93	1·01	0·86, 1·19	1·47***	1·26, 1·71	1·46***	1·24, 1·72
Annual household income/$CAN 10 000	0·60***	0·57, 0·62	0·62***	0·59, 0·66	0·66***	0·64, 0·69	0·69***	0·66, 0·71
No. of person ≤15 years old	1·70***	1·55, 1·87	1·64***	1·46, 1·85	1·47***	1·37, 1·57	1·52***	1·42, 1·63
No. of persons ≤16–17 years old	2·90***	1·99, 4·21	3·01***	1·91, 4·76	1·74**	1·26, 2·40	1·98**	1·35, 2·90
No. of persons ≥18 years old	0·90	0·64, 1·28	1·41	0·95, 2·09	1·10	0·89, 1·37	1·40**	1·13, 1·73
Highest education in household (Ref. BA or higher)								
<High school	3·28***	2·46, 4·37	1·68**	1·23, 2·28	2·46***	1·77, 3·42	1·92***	1·35, 2·74
High-school diploma	3·36***	2·62, 4·30	1·81***	1·39, 2·34	1·80***	1·36, 2·37	1·54**	1·14, 2·09
Post-secondary <BA	3·04***	2·45, 3·77	2·06***	1·63, 2·60	1·52***	1·25, 1·86	1·76***	1·42, 2·19
Dwelling tenure (Ref. Rented)								
Owned	0·33***	0·28, 0·39	0·44***	0·37, 0·54	0·31***	0·26, 0·36	0·43***	0·36, 0·50
Province (Ref. Ontario)								
Newfoundland & Labrador	1·09	0·65, 1·82	0·79	0·46, 1·37	0·58	0·32, 1·07	0·63	0·33, 1·21
Prince Edward Island	1·48	0·96, 2·30	0·87	0·56, 1·37	0·73	0·45, 1·19	0·81	0·48, 1·35
Nova Scotia	1·19	0·89, 1·59	0·82	0·59, 1·13	1·07	0·81, 1·40	1·09	0·80, 1·47
New Brunswick	1·32	0·92, 1·89	1·02	0·68, 1·53	0·64*	0·43, 0·93	0·77	0·51, 1·16
Quebec	0·60***	0·50, 0·73	0·44***	0·36, 0·55	0·45***	0·37, 0·55	0·42***	0·34, 0·51
Manitoba	0·74	0·48, 1·12	0·67	0·44, 1·03	0·84	0·51, 1·37	0·93	0·55, 1·57
Saskatchewan	0·55**	0·39, 0·77	0·52**	0·36, 0·76	0·56*	0·36, 0·88	0·59*	0·37, 0·96
Alberta	0·74*	0·56, 0·98	0·77	0·58, 1·01	0·90	0·69, 1·17	1·00	0·76, 1·31
British Columbia	0·87	0·72, 1·05	0·83	0·68, 1·02	0·81	0·65, 1·03	0·81	0·64, 1·03
Rural *v.* urban (Ref. Rural)								
Urban	1·31**	1·08, 1·59	1·09	0·88, 1·36	1·32**	1·11, 1·56	1·15	0·96, 1·38

Ref., reference category; BA, baccalaureate.
Significant difference: *$P < 0·05$, **$P < 0·01$, ***$P < 0·001$; *P* values based on bootstrapped standard errors.

household members under 18 years of age. For married respondents, the observations based on the univariate statistics are confirmed; adjusting for differences in household characteristics does not explain observed differences in the reporting of food insecurity.

Stratification by household and respondent characteristics: married respondents

The increase in the odds of a household being identified as food insecure when the respondent was female *v.* male persisted when we repeated the analysis for married respondents stratified by various household and respondent characteristics (Table 3). In households both with and without children, both the unadjusted and adjusted odds of the household being classified as food insecure were significantly higher for female respondents and changed little with adjustment. For example, for households without children unadjusted odds were (OR = 1·41; 95 % CI 1·11, 1·79) and adjusted odds were (OR = 1·43; 95 % CI 1·11, 1·85). Similar results were found when we stratified by home ownership and urban or rural status of the household. When we stratified by household income, we found that the increase in odds of a household being classified as food insecure for female respondents was most pronounced for households reporting a total annual income of $CAN 30 000–49 999 and $CAN 70 000–99 999.

By respondent age group, sex-stratification differences in the adjusted odds ratio were most pronounced for ages 30–39 years (OR = 1·62; 95 % CI 1·26, 2·07). The differences also remained apparent for other age groups in the sample, although generally not statistically significant. By respondent education, the adjusted odds ratio was largest across respondents who reported their highest level of education as some post-secondary education (less than a baccalaureate; OR = 1·63; 95 % CI 1·30, 2·05) and a baccalaureate degree or higher (OR = 1·84; 95 % CI 1·14, 2·97).

Alternative metrics for household food insecurity: married respondents

For married respondents, the adjusted and unadjusted odds ratios for female respondents exhibited a similar pattern to results using the HFSSM when we repeated the analysis using the Health Canada metrics for household food insecurity (Table 4). The estimated adjusted odds ratio differed, but not significantly, between using the child scale *v.* the adult scale; however, both were large in magnitude and consistent with the HFSSM estimates (OR = 1·38; 95 % CI 1·19, 1·60 for adult scale; OR = 1·44; 95 % CI 1·09, 1·91 for child scale).

A similar pattern was observed when the three first-stage component questions were examined for married respondents. For each question, the adjusted odds ratio was approximately equal to the unadjusted odds ratio. These estimates suggest that in married households, female respondents are more likely than male respondents to provide an affirmative response to each of the three first-stage component questions.

Table 3 Unadjusted and logistic regression-adjusted odds ratios reflecting the increases in odds of household food insecurity for female *v.* male respondents, stratified by household and respondent characteristics, married respondents only: Canadian Community Health Survey, 2005/2006 and 2007/2008

Stratification	Unadjusted OR	95 % CI	Adjusted OR	95 % CI
Children in household				
No children (9961 males, 10 459 females)	1·41**	1·11, 1·79	1·43**	1·11, 1·85
Children (9300 males, 10 294 females)	1·49***	1·23, 1·80	1·47***	1·21, 1·79
Annual household income				
<$CAN 30 000 (1483 males, 1706 females)	1·31	0·96, 1·79	1·15	0·82, 1·59
$CAN 30 000–49 999 (4125 males, 4611 females)	1·76***	1·36, 2·27	1·88***	1·45, 2·45
$CAN 50 000–69 999 (5744 males, 6443 females)	1·14	0·82, 1·59	1·23	0·88, 1·72
$CAN 70 000–99 999 (7909 males, 7993 females)	1·94***	1·35, 2·81	1·86***	1·27, 2·72
Home ownership				
Home owned (3840 males, 4109 females)	1·43***	1·14, 1·80	1·33*	1·04, 1·71
Home rented (15 421 males, 16 644 females)	1·52***	1·25, 1·86	1·57***	1·27, 1·93
Urban or rural				
Urban (5617 males, 6169 females)	1·75***	1·29, 2·38	1·66***	1·20, 2·30
Rural (13 644 males, 14 584 females)	1·42***	1·19, 1·69	1·42***	1·19, 1·71
Age group of respondent				
18–29 years (2550 males, 4047 females)	1·21	0·92, 1·59	1·27	0·93, 1·73
30–39 years (5367 males, 5969 females)	1·61***	1·26, 2·06	1·62***	1·26, 2·07
40–49 years (4435 males, 4665 females)	1·35	0·97, 1·88	1·40	1·00, 1·97
50–64 years (6909 males, 6072 females)	1·29	0·87, 1·92	1·62*	1·06, 2·49
Highest education of respondent				
<High school (3186 males, 2404 females)	1·56*	1·10, 2·23	1·18	0·81, 1·73
High-school diploma (3227 males, 3843 females)	1·19	0·83, 1·70	1·14	0·78, 1·67
Post-secondary <BA (9834 males, 10 952 females)	1·63***	1·31, 2·02	1·63***	1·30, 2·05
BA or higher (2974 males, 3513 females)	1·44	0·92, 2·26	1·84*	1·14, 2·97

BA, baccalaureate.
Logistic regression-adjusted OR adjusted for: household income, presence of children, number of children under 15 years of age or under 16–17 years of age, number of adults in household, home ownership, highest level of education attained by any household member, province of residence, and urban or rural residence.
Significant difference: *$P < 0·05$, **$P < 0·01$, ***$P < 0·001$; *P* values based on bootstrapped standard errors.

Severity of household food insecurity: married respondents

Table 4 also presents multinomial logistic regression estimates of relative risk ratios for the two levels of food insecurity relative to being food secure for female *v.* male respondents. The adjusted odds of a married household being identified as having low food security relative to being food secure was significantly higher for female respondents than male respondents (RRR = 1·34; 95 % CI 1·12, 1·62). Further, a household being identified as very low food security relative to being food secure was also more likely for female respondents (RRR = 1·93; 95 % CI 1·30, 2·86).

Discussion

In our sample of Canadian households, stratified by married and non-married respondents, we found that a household is more likely to be classified as food insecure, based on responses to the HFSSM, if the survey respondent is female. For non-married respondents, after adjusting for household characteristics, the difference in household food insecurity classification according to respondent sex disappears. This suggests that the differential classification can be attributed to differences in household composition and socio-economic resources. In particular, we found that, on average, the households of female respondents had more children and lower household income than the households of male respondents, suggesting insufficient material resources to feed the family[26,39–41].

In contrast, in married households where the odds of household food insecurity were also higher when women were respondents, the difference between the sexes persisted after adjusting for both household and other respondent sociodemographic characteristics, including the presence of children. Different metrics used for household food insecurity measurement revealed similar differences and, on the whole, a similar magnitude of difference between female and male respondents. Thus we suggest that the difference between male and female respondents is real and not a result of confounding factors.

Two mechanisms may lead to differential survey responses by respondent sex. The first mechanism is that men and women may have the same objective information about the household's food security situation but report it differently. This may result if women exhibit greater sensitivity to household needs than men, supported by the observation that women exhibit greater concern than men for the well-being of others[42]. The second mechanism is that men and women have different information available to them when they report on the household food security situation. This could be the case

Table 4 Unadjusted and logistic regression-adjusted odds ratios and unadjusted and multinomial logistic regression-adjusted relative risk ratios reflecting the increase in odds of outcome for female *v.* male respondents, married respondents only: Canadian Community Health Survey, 2005/2006 and 2007/2008

Outcome	Unadjusted OR	95 % CI	Adjusted OR	95 % CI
Health Canada metric: household	1·37***	1·19, 1·57	1·37***	1·19, 1·58
Health Canada metric: adult scale	1·38***	1·20, 1·59	1·38***	1·19, 1·60
Health Canada metric: child scale	1·48***	1·14, 1·93	1·44*	1·09, 1·91
First-stage component questions				
Worried about food	1·40***	1·23, 1·58	1·41***	1·23, 1·61
Insufficient food	1·34***	1·16, 1·55	1·33***	1·14, 1·55
Compromised diet	1·32***	1·15, 1·52	1·31***	1·13, 1·52
Severity: multinomial logistic regression	Unadjusted RRR	95 % CI	Adjusted RRR	95 % CI
HFSSM				
Low food security†	1·35***	1·12, 1·61	1·34***	1·12, 1·62
Very low food security†	1·95***	1·43, 2·67	1·93***	1·30, 2·86

HFSSM, Household Food Security Survey Module; RRR, relative risk ratio.
Logistic regression-adjusted OR and multinomial logistic regression-adjusted RRR adjusted for: household income, presence of children, number of children under 15 years of age or under 16–17 years of age, number of adults in household, home ownership, highest level of education attained by any household member, province of residence, and urban or rural residence.
Significant difference: *$P < 0{\cdot}05$, **$P < 0{\cdot}01$, ***$P < 0{\cdot}001$; *P* values based on bootstrapped standard errors.
†Relative to food secure.

if women either deprive themselves of food in a food-insecure situation to protect others, including husbands, from experiencing food insecurity, or if women are more fully aware of constraints on food in the household because of their role as principal food provider. Indeed, both scenarios have been well described in food-insecure households[6,23,33,34].

Beyond the gendered social role of managing household food security, there is evidence of gendered roles in married households that might also make women's reporting different from men's. Survey evidence for married households has shown that women are more likely to take care of household budgeting and purchases of food, clothing and other essential items[43,44]. As a consequence, they may have better information about household food needs.

Several lines of evidence also suggest that women in married households may experience inequitable access to household resources[43,45,46]. Studies have shown that resource allocation within a family, especially for child care and food[43], depends on income distribution among husband and wife. Inequity within the household might explain why married women could report higher rates of food insecurity compared with married men.

Our analysis does not distinguish between these mechanisms, any or all of which may be important. The resulting gender/sex-based bias in reporting does have implications though for the measurement of population levels of household food insecurity. To illustrate, consider the following thought exercise. Our sample is representative of approximately 4·5 million married households in Canada. Based on the estimated rates of food insecurity reported in Table 1, 189 410 households will be identified as food insecure if all respondents are male and 272 600 will be identified as food insecure if all respondents are female, a difference of 83 190 food-insecure households. This difference may have important implications for perception of the problem and consideration of allocation of public resources to address it.

Limitations

Because we used a working sample, we could not examine whether stay-at-home parents *v.* working parents report food insecurity differentially, after accounting for household characteristics, particularly income.

Our results rely on the fact that married or cohabitating male and female respondents statistically represent the same population of households. We could not examine the responses of females and males in the same household to definitively show differential reporting within households by sex of respondent. Further, we lacked the information to distinguish between the different mechanisms by which differential reporting takes place and could not draw conclusions regarding whether male or female respondents more accurately report household food insecurity.

Our results do not negate the possibility of a reporting bias according to respondent sex in non-married households. Because respondent sex was not randomized across these households, we could not rule out the existence of unobserved household characteristics, correlated with sex, that influence the reporting of food insecurity of the household. Rather, we conclude that, in non-married households, differences in household classification of food insecurity by respondent sex are at least primarily accounted for by economic and sociodemographic disadvantages among respondent women.

Conclusions and implications

Food insecurity provides a unique measure of a household's physical and socio-economic lack of well-being[4] with implications for public health responses and advocacy.

We have shown that for households of married respondents, differences in measured household food insecurity by respondent sex appear to be associated with the respondent herself, not the household *per se*. One important implication of this finding is that the HFSSM may produce different food insecurity estimates in married households depending on whether the respondent is male or female. Despite validity and reliability testing of the HFSSM across different settings, but not according to marital status and sex in Canada and the USA[1,14,28–30,47,48] as we have, there may be a need to reconsider who is best positioned to answer the food insecurity questions in dual-parent households. The Food Security Supplement in the US Current Population Survey is introduced in cohabituating households by requesting the adult most knowledgeable about food shopping and meal preparation act as respondent[49]. We expect that this may mitigate reporting bias that arises from differential information between men and women, but a reporting bias may still exist if both men and women in the household contribute to food shopping and meal preparation; if men and women in a household take differential responsibility for these duties, i.e. she shops, he cooks; and if men and women in the same household report the same objective information differently.

Our results cannot distinguish between under-reporting by males *v.* over-reporting or accurate reporting by females, which offers an important avenue for future research. Even without knowing which sex more accurately reports the food insecurity status of the household though, it is desirable to have consistent estimates to ensure comparability across the population and over time. To ensure consistency in the measurement of population-level household food insecurity, standards should be adhered to regarding respondent selection. For example, in married households, always randomizing or always selecting a female respondent will ensure that population-level estimates remain consistent.

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