Adequacy of food spending is related to housing expenditures among lower-income Canadian households

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Abstract

Objectives: A number of studies have pointed to the pressure that housing costs can exert on the resources available for food. The objectives of the present study were to characterise the relationship between the proportion of income absorbed by housing and the adequacy of household food expenditures across the Canadian population and within income quintiles; and to elucidate the impact of receipt of a housing subsidy on adequacy of food expenditures among low-income tenant households.

Design: The 2001 Survey of Household Spending, conducted by Statistics Canada, was a national cross-sectional survey that collected detailed information on expenditures on goods and services. The adequacy of food spending was assessed in relation to the cost of a basic nutritious diet.

Setting: Canada.

Subjects: The person with primary responsibility for financial maintenance from 15 535 households from all provinces and territories.

Results: As the proportion of income allocated to housing increased, food spending adequacy declined significantly among households in the three lowest income quintiles. After accounting for household income and composition, receipt of a housing subsidy was associated with an improvement in adequacy of food spending among low-income tenant households, but still mean food spending fell below the cost of a basic nutritious diet even among subsidised households.

Conclusions: This study indicates that housing costs compromise the food access of some low-income households and speaks to the need to re-examine policies related to housing affordability and income adequacy.

Food insecurity and food poverty are growing concerns in many affluent Western nations[1–4], including Canada[5–12]. While national survey data do not enable an examination of trends in the prevalence of the problem, the tripling of the number of Canadians using food banks from 1989 to 2005[13] suggests a pervasive and growing problem. Food insecurity can be understood most simply as deprivation in the basic need for food due to financial resource constraints[14]. Whereas individuals' experiences of food insecurity centre on issues of food selection and consumption, food acquisition and supply management issues define the household situation[15]. Lower food expenditures in relation to the estimated cost of a nutritious, low-cost diet have been observed among food-insecure compared with food-secure households[16–20], while household food inventories indicate that supplies decline and food selection becomes more limited with increasing severity of food insecurity[21,22].

Although the majority of food-insecure households in Canada and the USA are low-income[8–11,20], there is not a one-to-one correspondence between poverty-level incomes and measures of hunger or food insecurity[8–11,23]. Fewer than half of low-income households report problems of food insecurity, with prevalence rates varying depending on the definition of low income and the indicators of food insecurity used[8–11,20]. Why are some low-income households more vulnerable to problems of food insecurity than others?

Recent studies have pointed to the potential for housing costs to affect the resources available for food. Higher levels of food insecurity were associated with an increasing percentage of income spent on housing in a US sample[16], and median housing costs emerged as a significant predictor of food insecurity in an examination of state-level factors explaining variations in the prevalence of this problem in the USA[24]. While other basic needs such as transportation and childcare can also exert pressure on the food budgets of low-income households[25], housing costs form the largest component of the monthly budget for most households[26]. Further, housing costs are

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typically fixed, at least over the short term, and must be fully paid each month to avoid the threat of eviction. In contrast, food expenditures are more elastic, and can be manipulated in relation to available financial resources. The tension between housing and food needs, epitomised in the phrase 'pay the rent or feed the kids'[27], is well documented in in-depth studies of food insecurity[1,15,25,28–34].

Housing affordability problems among those with low incomes have long been recognised, with housing subsidies constituting the primary policy response in Canada and other Western countries[35,36]. Subsidies typically function to fix rent based on conventional notions of affordable housing as that which consumes 30% or less of a household's income[26,35]. However, empirical evidence of the relationship between this standard and a household's financial well-being is lacking[35,37–39], and there has been little research to assess the relationship between housing costs and household food security.

Efforts to better understand how housing costs affect the food security of Canadian households are hindered by the lack of population data that include detailed information on both housing circumstances and food security. However, insight into the potential for households to achieve a basic nutritious diet can be gleaned from an examination of household expenditure patterns, monitored annually in Canada through the Survey of Household Spending (SHS). Examinations of inadequacy identified through comparisons of food spending with the cost of a basic nutritious diet[17–20,40,41], sometimes termed food poverty[40], are valuable for elucidating social and economic influences on food access and characterising vulnerability across populations.

Secondary analysis of data from the 2001 SHS was undertaken to shed light on the role of economic aspects of housing on food access in Canada. The objectives of this study were: (1) to characterise the relationship between the proportion of income allocated to housing and the adequacy of household food expenditures, across the full sample and within income quintiles; and (2) to elucidate the impact of receipt of a housing subsidy on the adequacy of food expenditures among lower-income tenant households. We hypothesised that housing costs would be inversely related to adequacy of food spending among lower-income households, and that the receipt of housing subsidies would be associated with a lower proportion of income allocated to housing and increased adequacy of food spending among lower-income tenant households.

Methods

Data

The 2001 SHS included a sample of 16 901 Canadian households drawn through stratified multistage sam-

pling[42]. Detailed information on household socio-demographic characteristics and expenditures for goods and services was collected for the calendar year 2001 through a personal interview with the member of the household with primary responsibility for its financial maintenance[42]. This is a recall survey, but to improve the accuracy of the data collected, respondents were encouraged to consult records such as mortgage statements, cheque registers, credit card account statements and income tax returns[43]. For items purchased at regular intervals such as food, annual figures were derived from data collected over a short period such as a week or month[43].

Data for part-year households ($n = 516$; composed of persons who were members of other households for part of the reference year) and full-year households that reported zero income ($n = 36$) or zero housing expenditures ($n = 63$) were excluded. As well, data for households that reported spending more than 100% of their income on food and housing costs were excluded ($n = 259$). Preliminary analysis revealed that households that had purchased a home during the reference year ($n = 620$) allocated a significantly higher proportion of income to housing compared with other households, and thus data for such households were also excluded. Multiple exclusion criteria applied to some households, resulting in a total of 1366 exclusions and an analytic sample of 15 535 households.

Measures

Adequacy of household food expenditures was assessed by examining whether the dollars spent on food by a household were adequate to purchase a basic nutritious diet[20,40,41]. Estimates of the cost of an economical and nutritious diet were based on the Nutritious Food Basket (NFB)[44], which 'represents a nutritional diet which is consistent with the food purchases of ordinary Canadian households'[45]. Annual cost estimates for the NFB for urban and rural areas within each province for the year 2000 were available from Human Resources Development Canada's Market Basket Measure (MBM) (Table 1)[45,46]. The MBM does not include estimated costs for households in the territories[47]; cost estimates for such households were drawn from pricing conducted by Indian and Northern Affairs Canada (Table 1)[48].

Cost estimates are based on a four-person reference family consisting of one male and one female adult aged 25–49 years and two children, a girl aged 9 and a boy aged 13 years (Table 1)[45]. These estimates were adjusted to reflect economies associated with household size using the equivalence scale employed by the MBM. This scale assigns the oldest person in the family a factor of 1, the second oldest person and each additional adult a factor of 0.4, and each additional child a factor of 0.3[45,46]. Although the MBM identifies 16 years as the cut-off for children[45,46],

Table 1 Market Basket Measure-estimated annual cost† of the nutritious food basket for a reference family‡ by province/territory

Province/Territory	Cost (Can$)
Newfoundland & Labrador	
St. John's	6796
Urban	7045
Rural	7045
Prince Edward Island	
Charlottetown	6335
Urban	6335
Rural	6335
Nova Scotia	
Halifax	6476
Urban	6584
Rural	6584
New Brunswick	
Saint John	6499
Urban, 100 000+ inhabitants	6431.5¶
Urban, <30 000 inhabitants	6573
Rural	6573
Québec	
Québec City	6014
Montréal	6017
Urban	6064
Rural	6064
Ontario	
Ottawa	6280
Toronto	5778
Urban, 100 000–499 999 inhabitants	5833
Urban, <100 000 inhabitants	5546
Rural	5546
Manitoba	
Winnipeg	5972
Urban	5935
Rural	5935
Saskatchewan	
Saskatoon	6356
Regina	6112
Urban	6133
Rural	6133
Alberta	
Edmonton	6259
Calgary	6183
Urban	6499
Rural	6499
British Columbia	
Vancouver	6697
Urban, 100 000–499 999 inhabitants	6801
Urban, <100 000 inhabitants	7623
Rural	7623
Nunavut§	14 640
Northwest Territories§	13 520
Yukon§	11 154

† The available cost estimates are for the calendar year 2000.
‡ The reference family includes two adults and two children.
§ Based on pricing conducted by Indian and Northern Affairs Canada[48].
¶ Average of estimated costs for Moncton and Fredericton.

the SHS age variable includes persons aged 15 to 19 years in one category; thus, those aged 19 years and under were considered children in the application of the equivalence scale. Although the equivalence scale was not specific to food, repeating the analyses presented below without this adjustment did not markedly change our findings.

Food expenditure for each household was indicated by total dollars spent on food at stores as well as dollars spent at restaurants and other sources of food away from home. Each household's total food expenditure was divided by the estimated annual cost of the NFB for that household based on size, composition and geographic region of residence. The resulting adequacy ratio indicates whether a household could have purchased the NFB given the total dollars that were allocated to food. Thus, households with inadequate food spending are defined as those that do not achieve a ratio of one. An examination of food purchasing patterns indicated that a ratio below one was associated with the purchase of significantly lower quantities of food, energy and energy-adjusted nutrients (Appendix), lending support to the use of this measure to assess household food access.

Although the NFB cost estimates relate only to food purchasing in stores[44], the total dollars spent on food were used to provide a more complete indication of the resources that a given household had available for food over the year. The inclusion of spending at restaurants could overestimate the adequacy of food spending in relation to the cost of a basic nutritious diet; however, repeating our analyses considering only food expenditures at stores did not markedly change our findings and thus only the analyses utilising total food expenditures are presented.

The dollar amount spent on mortgage or rent plus utilities for each household's primary residence (excluding vacation or other residences) was divided by the household's total income to derive a variable indicating the proportion of income absorbed by housing. Expenditures on utilities were considered together with rent or mortgage expenses because 13% of households recorded zero utility costs, presumably indicating that their utilities were included in their rent.

Statistical methods

Statistical analyses were performed using SAS, version 9.2 (SAS Institute). All estimates are weighted to account for unequal probabilities of selection, non-response bias and population demographics[42]. The complex sampling design of the SHS was accounted for through SAS survey analysis techniques, which use a Taylor expansion to approximate sampling error[49].

Multivariate logistic regression analysis was utilised to examine the relationship between adequacy of food expenditures and household sociodemographic variables, including region of residence, income quintile, main source of household income and household type.

Regression analysis was used to characterise the relationship between adequacy of food expenditures and share of income spent on housing among the full sample. Given the crude nature of the household composition and size adjustment in the derivation of the food spending adequacy ratio, it is possible that we have not adequately accounted for differences in these household characteristics. Thus, the model was repeated including a

series of continuous variables indicating the number of people in the household in six age groups (less than 5 years, 5 to 14 years, 15 to 19 years, 20 to 24 years, 25 to 64 years, 65 or more years). Finally, the model was repeated including variables indicating the proportions of household income allocated to childcare and to transportation expenditures to enable an examination of the relative importance of housing expenditures in relation to other basic needs.

It is plausible that households' preferences might partially account for relationships observed between housing burden and adequacy of food expenditures. Some households may choose to spend less on housing to leave more money for other expenditure categories, while others may opt to spend more for housing than required to meet their basic needs. To examine whether consumer choice regarding the allocation of income to housing could account for any observed relationships, a sub-sample of households that required two bedrooms based on their composition ($n = 3906$) was selected. Regression modelling was used to calculate predicted housing costs for each household based on household income and median housing costs for a two-bedroom apartment depending on province of residence[50] (households residing in the territories were excluded since the housing cost data related only to the provinces). The predicted share of income allocated to housing for each household

was calculated by dividing predicted housing costs by household income. Regression analysis was then used to examine the relationship between both actual and predicted housing share and adequacy of food expenditures within this sub-sample, adjusting for household composition as above.

To assess whether the relationship between housing affordability and adequacy of food spending differed according to income, regression analysis was used to examine the association between reported housing share and food spending adequacy among strata defined by quintiles of total household income. Preliminary analysis indicated that a quadratic model provided a better fit than a linear model within the income quintiles where an effect was found; thus, only results from the quadratic models are presented here. The models were repeated including covariates to account for household composition and proportion of income allocated to childcare and transportation.

The impact of housing subsidies on adequacy of food spending was examined among tenants in the bottom income quintile ($n = 1984$). This sub-sample was selected because subsidies are an intervention generally targeted to low-income renters, and our preliminary analysis indicated that three-quarters of subsidised households fell within the lowest quintile. Analysis of variance was used to assess whether the proportion of income allocated to

Table 2 Food spending adequacy in relation to household sociodemographic characteristics ($n = 15\,535$)

		Adequacy of food spending		Proportion (%) with food spending adequacy ratio <1	Odds ratio (95% confidence interval)† of achieving food spending adequacy ratio <1
	n	Mean (median)	Standard error		
Total sample	15 535	1.32 (1.23)	0.0071	32.3	–
Region					
Central‡	9813	1.40 (1.31)	0.010	26.3	1.00
Atlantic	1198	1.08 (1.03)	0.0081	48.0	2.62 (2.36–2.92)
Western	4484	1.21 (1.10)	0.0092	40.9	2.50 (2.26–2.77)
Territories	40	0.82 (0.76)	0.014	75.9	18.76 (14.66–24.01)
Income quintile					
1 (lowest)	3107	0.87 (0.83)	0.0064	67.9	13.23 (10.81–16.19)
2	3113	1.15 (1.09)	0.0086	40.9	4.20 (3.59–4.91)
3	3101	1.32 (1.26)	0.010	26.6	1.95 (1.67–2.28)
4‡	3105	1.49 (1.40)	0.012	16.4	1.00
5 (highest)	3110	1.77 (1.66)	0.016	9.7	0.50 (0.42–0.61)
Main source of household income					
Wages and salaries‡	9758	1.42 (1.33)	0.0091	24.4	1.00
Self-employment	990	1.43 (1.35)	0.015	25.9	0.80 (0.66–0.98)
Investment income	248	1.32 (1.20)	0.021	37.1	1.61 (1.10–2.35)
Government transfers	3418	0.97 (0.91)	0.0082	57.8	1.30 (1.11–1.53)
Miscellaneous	1120	1.39 (1.31)	0.013	28.0	0.98 (0.80–1.21)
Household type					
One person	3846	1.14 (1.00)	0.015	49.6	1.57 (1.21–2.03)
Couple only	3502	1.41 (1.31)	0.0097	25.9	1.06 (0.88–1.27)
Couple with single children‡	4959	1.42 (1.33)	0.011	23.2	1.00
Couple with other relatives & non-relatives	774	1.34 (1.24)	0.017	29.6	1.38 (1.03–1.85)
Lone male parent	292	1.34 (1.34)	0.0076	23.4	0.76 (0.51–1.15)
Lone female parent	1168	1.19 (1.10)	0.011	40.4	1.13 (0.88–1.46)
Other household	993	1.35 (1.25)	0.015	28.7	1.06 (0.82–1.35)

† Adjusted for all other variables in table and household composition using multivariate logistic regression analysis.
‡ Reference category.

housing differed significantly among subsidised and non-subsidised households. Analysis of variance was also employed to examine whether adequacy of food spending was associated with receipt of a housing subsidy, adjusting for household composition as above. Preliminary analysis indicated that household incomes were lower on average among subsidised vs. non-subsidised households; therefore, the analysis was repeated including household income as a potential confounding variable. The dependent variables for analyses of variance were Box–Cox transformed to approximate the normal distribution.

Results

On average, Canadian households' food expenditures equalled 132% of the cost of the NFB (Table 2). Inadequate food expenditures were evident among 32.3% of households (Fig. 1). The likelihood of inadequate food expenditure increased with decreasing income (Table 2), and was higher among households whose main source of income was investment income or government transfers compared with those reliant on wages and salaries. Those in one-person households and households made up of couples with other relatives or non-relatives were more likely to have inadequate food spending than households consisting of a couple and their child/children (Table 2).

The median proportion of income allocated to housing was 21.74% (standard error (SE) 0.14), ranging from 11.89% (SE 0.13) among the highest income quintile to 34.03% (SE 0.25) among the lowest income quintile. Government housing subsidies were received by 4.08% of households.

A significant negative relationship was evident between adequacy of food spending and the proportion of income allocated to housing among the full sample (Table 3, Fig. 2). The observed relationship did not change with the inclusion of variables indicating household composition and the proportions of income allocated to childcare and to transportation (Table 3, models

2 and 3). Further, the proportions of income allocated to childcare and to transportation were not significantly associated with adequacy of food expenditures (Table 3, model 3).

Among households requiring two bedrooms, the substitution of predicted housing costs for actual housing expenditures diminished the strength of the relationship between adequacy of food spending and share of income allocated to housing, but the significant negative association persisted, suggesting that consumer choice cannot fully account for the observed relationship (Table 4).

Within income quintiles, there was a negative relationship between proportion of income allocated to housing and adequacy of food spending among the bottom three quintiles (Table 5, Fig. 3). There was no significant association between proportion of income allocated to housing and food spending adequacy among the upper two income quintiles (Table 5). The findings
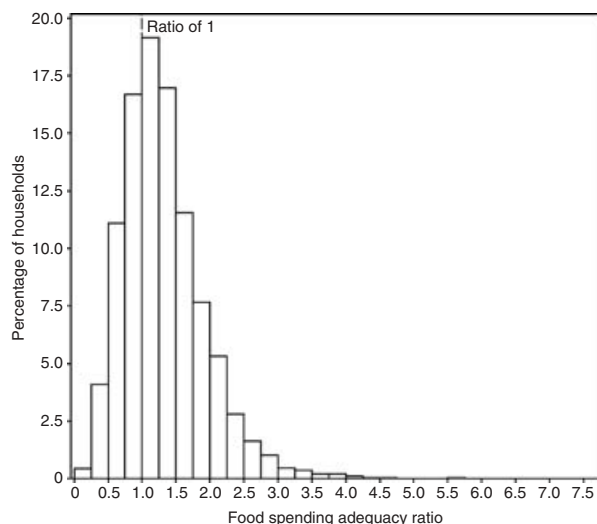

Fig. 1 Distribution of the food spending adequacy ratio across the sample ($n = 15\,504$*). *Households with food spending adequacy ratios >4 ($n = 31$; 0.2% of the sample) are excluded from this figure due to Statistics Canada data release guidelines on minimum cell sizes

Table 3 Relationship between adequacy of food spending and proportion of income allocated to housing among the full sample ($n = 15\,535$)

	$\beta \pm$ standard error		
	Model 1	Model 2†	Model 3†
Intercept	1.68 ± 0.015	1.58 ± 0.031	1.59 ± 0.031
Proportion of income allocated to housing costs	-0.017 ± 0.00051***	-0.015 ± 0.00056***	-0.015 ± 0.00056***
Proportion of income allocated to childcare costs			0.0003 ± 0.0032
Proportion of income allocated to transportation costs			-0.00068 ± 0.00049
Model R^2‡	0.13	0.15	0.15

*** $P < 0.001$, derived from linear regression model.
†Household composition variables were entered into the model as continuous independent variables indicating the number of persons in each household in each of six age categories (less than 5 years, 5 to 14 years, 15 to 19 years, 20 to 24 years, 25 to 64 years, 65 or more years).
‡Explained variance.

did not change with the inclusion of variables indicating household composition and the proportions of income allocated to childcare and to transportation (Table 5, models 2 and 3).

Among tenant households in the lowest income quintile, food spending that fell below the cost of a basic nutritious diet was reported by 71.4% of households. On average, 31.60% (SE 0.22) of income was allocated to housing among subsidised households ($n = 472$) compared with 41.35% (SE 0.31) among households not in receipt of a housing subsidy ($n = 1512$) ($F = 12.11$, $P < 0.001$). Households with subsidies achieved a food spending adequacy ratio of 0.85 (SE 0.0091) compared with 0.84 (SE 0.0081) among non-subsidised households ($F = 0.37$, $P = 0.54$). After accounting for household income and composition, analysis of variance indicated a significant positive effect of receipt of a housing subsidy on food spending adequacy ($F = 5.34$, $P = 0.024$).
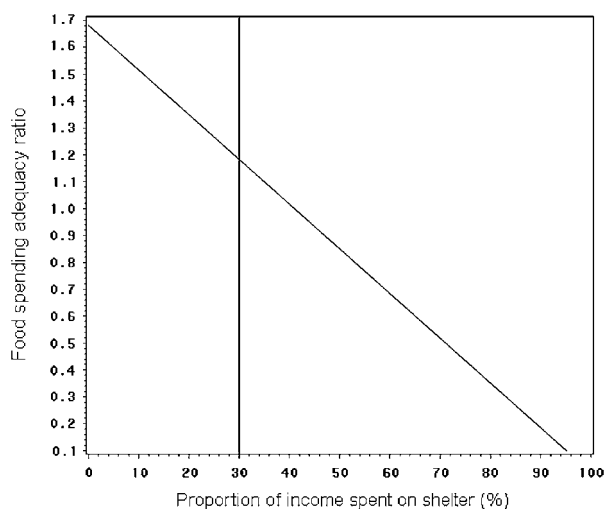

Fig. 2 Relationship between adequacy of food spending and proportion of income allocated to housing among the full sample, based on linear regression analysis ($n = 15\ 535$)

Discussion

A negative relationship was observed between the proportion of income allocated to housing and the adequacy of food spending among households at the lower end of the income spectrum. The gradual decline in the food spending adequacy among households in the lower income quintiles as the share of income allocated to housing increases may be indicative of efforts to maintain adequacy of food spending. However, among households in the lowest income quintile, food spending does not reach the cost of a basic nutritious diet even when the proportion of income allocated to housing is at or below 30%, raising questions about the applicability of current notions of housing affordability to lower-income households. The receipt of housing subsidies had a positive effect on adequacy of food spending among renter households in the bottom income quintile when household composition and income were taken into account. Even among subsidised households though, food spending fell below the cost of a basic nutritious diet on average, indicating that housing subsidies may not be sufficient to ensure adequate resources for food. While the scarcity of housing subsidies has been documented elsewhere[51–53], this study highlights the need to also consider the adequacy of subsidy levels. Furthermore, our findings indicate that the impact of housing costs on food budgets is most salient to households with lower incomes. This study thus speaks to the need for household incomes that are adequate to meet basic needs, and attention to the adequacy of social assistance rates, minimum wage levels, and other policy and programme initiatives that impact upon a household's financial resources.

This study is not without limitations. Food spending was used as an indicator of a household's ability to meet its food needs, but this variable is neither a measure of food security nor dietary adequacy. There are a number

Table 4 Relationship between actual and predicted housing costs and adequacy of food expenditures among households requiring two bedrooms ($n = 3906$)

	$\beta \pm$ standard error	
	Proportion of income allocated to housing based on ACTUAL housing expenditures	Proportion of income allocated to housing based on PREDICTED housing expenditures
Model 1		
Intercept	1.68 ± 0.029	1.56 ± 0.085
Proportion of income allocated to housing	-0.016 ± 0.0011***	-0.0091 ± 0.0037*
Model R^2†	0.11	0.10
Model 2‡		
Intercept	1.41 ± 0.075	1.27 ± 0.19
Proportion of income allocated to housing	-0.014 ± 0.0011***	-0.0080 ± 0.0036*
Model R^2†	0.15	0.14

* $P < 0.05$, *** $P < 0.001$, derived from linear regression model.
† Explained variance.
‡ Household composition variables were entered into the model as continuous independent variables indicating the number of persons in each household in each of six age categories (less than 5 years, 5 to 14 years, 15 to 19 years, 20 to 24 years, 25 to 64 years, 65 or more years).

Table 5 Relationship between adequacy of food spending and housing burden among sample stratified by income quintile, based on multiple regression analysis ($n = 15\,535$)

	$\beta \pm$ standard error				
	Quintile 1 (low)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (high)
Model 1					
Intercept	0.96 ± 0.045	1.14 ± 0.048	1.31 ± 0.050	1.54 ± 0.052	1.85 ± 0.069
Proportion of income allocated to housing	0.0015 ± 0.002	0.0052 ± 0.0034	0.0048 ± 0.004	-0.0013 ± 0.0058	-0.0072 ± 0.0094
Proportion of income allocated to housing squared	$-0.000098 \pm 0.000030^{**}$	$-0.00015 \pm 0.000052^{**}$	$-0.00018 \pm 0.000074^{*}$	-0.000089 ± 0.00014	0.000037 ± 0.00028
Model R^2†	0.064	0.013	0.0090	0.0056	0.0033
Model 2‡					
Intercept	0.89 ± 0.058	1.23 ± 0.06	1.43 ± 0.063	1.91 ± 0.076	2.05 ± 0.10
Proportion of income allocated to housing	0.0023 ± 0.0024	0.0059 ± 0.0035	$0.0091 \pm 0.0040^{*}$	0.00087 ± 0.0058	-0.0029 ± 0.0094
Proportion of income allocated to housing squared	$-0.00010 \pm 0.000030^{***}$	$-0.00015 \pm 0.000055^{**}$	$-0.00021 \pm 0.000070^{**}$	-0.000088 ± 0.00014	-0.000029 ± 0.00028
Model R^2†	0.083	0.041	0.064	0.083	0.033
Model 3‡					
Intercept	0.88 ± 0.057	1.22 ± 0.060	1.44 ± 0.065	1.93 ± 0.080	2.05 ± 0.10
Proportion of income allocated to housing	0.0025 ± 0.0024	0.0060 ± 0.0035	$0.0089 \pm 0.0040^{*}$	0.00051 ± 0.0058	-0.0027 ± 0.0094
Proportion of income allocated to housing squared	$-0.00010 \pm 0.000029^{***}$	$-0.00015 \pm 0.000054^{**}$	$-0.00021 \pm 0.000070^{**}$	-0.000079 ± 0.00014	-0.000035 ± 0.00028
Proportion of income allocated to childcare costs	-0.0020 ± 0.0054	-0.0019 ± 0.0052	-0.0013 ± 0.0048	-0.00021 ± 0.00071	-0.014 ± 0.011
Proportion of income allocated to transportation	0.00030 ± 0.00047	0.0011 ± 0.00076	-0.00057 ± 0.00081	-0.0017 ± 0.0011	0.0014 ± 0.0029
Model R^2†	0.083	0.044	0.065	0.084	0.035

$^*P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$, derived from quadratic regression model.
† Explained variance.
‡ Household composition variables were entered into the model as continuous independent variables indicating the number of persons in each household in each of six age categories (less than 5 years, 5 to 14 years, 15 to 19 years, 20 to 24 years, 25 to 64 years, 65 or more years).
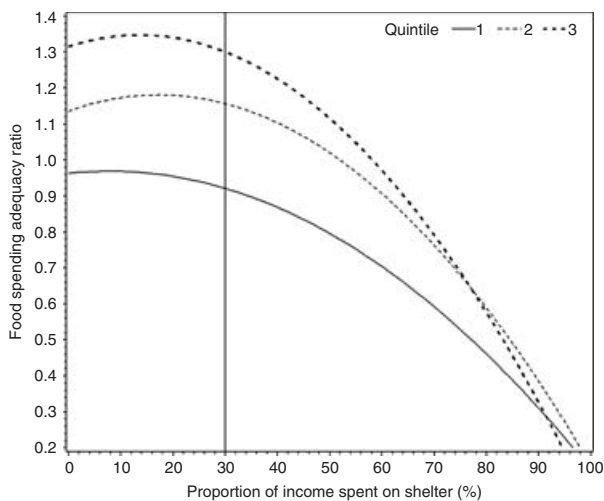

Fig. 3 Relationship between adequacy of food spending and proportion of income allocated to housing among the three lowest income quintiles, based on quadratic regression analysis

of sources of error in our estimates of the cost of an economical nutritious diet that could have affected our findings. The available estimates pertain to one household type for the year 2000, and the cost of the NFB for rural areas is assumed to be the same as the smallest urban area for which price data were collected. Further, cost estimates were not available for the territories, requiring the use of a second data source. Finally, the NFB has not been revised for several years and likely underestimates the cost of a basic nutritious diet consistent with recently updated nutrient requirements[54–58] and dietary guidance[59]. Despite the limitations in our food spending adequacy variable, it is interesting that the sociodemographic correlates of inadequate food spending are similar to the correlates of food insecurity observed in analyses of national health survey data[8–11].

The data used in this study pertained to annual expenditures; however, it is likely that the amounts spent on housing and food fluctuated throughout the year for some households. Recent ecological evidence from the USA indicates associations between fluctuations in heating and cooling costs and seasonal variations in food insecurity[60,61]. Some households in our sample would be protected from fluctuations in their housing costs by virtue of having their utilities included in their rent, while others may have been enrolled in billing plans that equalise their payments over the year. It is possible that for other households though, seasonal variations in heating and cooling costs were related to variations in food expenditures that we were not able to examine with the available data. Although the proportions of income allocated to childcare and to transportation were not significantly associated with adequacy of food spending

in this study, these costs could vary throughout the year, warranting further research to examine the impact of such variations on the resources available for food.

The observed relationships between housing expenditures and adequacy of food spending might reflect consumer preferences in the allocation of resources. However, our analysis using predicted housing costs suggests that consumer preferences in relation to how much is spent on housing cannot fully account for the relationship observed between share of income allocated to housing and adequacy of food expenditures. None the less, one must be cautious about making causal interpretations based on the findings of this study.

Currently, the only national monitoring of food security in Canada occurs on health surveys. While these surveys have provided insights into the vulnerability of Canadians affected by food insecurity in terms of physical, mental and social health[9], the lack of detail on household sociodemographic and economic circumstances makes it difficult to examine the determinants of the problem. In order to better understand the factors that mitigate food insecurity among low-income households and to inform policies to alleviate it, food security must be viewed through an economic lens, necessitating the inclusion of food security measures on routine surveys that collect detailed data on household economics, such as the SHS. Further, the cross-sectional nature of the data that do exist limits our ability to make causal inferences about the impact of shelter costs and other household economic factors on food security, highlighting the need for inclusion of food security indicators in longitudinal data collection efforts.

While this study is cross-sectional and the food adequacy measure is limited, our findings suggest that housing costs compromise the food access of some low-income households and speak to the need to re-examine policies related to housing affordability and income adequacy.

Acknowledgements

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Appendix – Relationship between food adequacy spending ratio and food purchasing patterns

While the NFB is routinely used to monitor the cost of a basic nutritious diet, we are not aware of previous applications of this tool in the manner described here. The 2001 SHS included estimates of food spending at stores and at restaurants but not detailed information on the types and quantities of foods purchased by households. Thus, we drew upon data from the 2001 Family Food Expenditure Survey (FOODEX), a nationally representative Statistics Canada survey which collected detailed household data on food expenditures at stores for two consecutive one-week periods[62], to examine the relationship between adequacy of household food spending expressed as a ratio of food expenditures to the cost of the NFB and food purchasing patterns. Data for 4988 households that provided food expenditure data for both weeks and that did not report zero food expenditures were used. The complex sampling design of the survey was accounted for using SAS survey commands.

The cost of the NFB for a 2-week period was calculated using the methods described above for the SHS and this cost estimate was used to compute a food spending adequacy ratio for each household in the FOODEX sample. A dichotomous variable was derived to indicate whether a household achieved adequate (indicated by a ratio of 1 or above) or inadequate (a ratio below 1) food spending.

Foods purchased from stores by households in the FOODEX sample were coded into 195 codes by Statistics Canada; 178 of these codes were classified into the four food groups plus the 'other foods' group from *Canada's Food Guide to Healthy Eating*[63]. The remaining 17 food codes were classified as 'miscellaneous'. The edible quantities of food from each food group were calculated using conversion factors from Agriculture and Agri-Food Canada to account for trim and cooking losses (Robbins L, personal communication, 2005). Nutrient conversion factors, also obtained from Agriculture and Agri-Food Canada (Robbins L, personal communication, 2005), were then used to calculate the quantity of energy as well as energy-adjusted macronutrients, vitamins and minerals available to each household.

Associations between the dichotomous food spending adequacy variable and the quantities of foods purchased from each group were assessed by analysis of variance, adjusting for household composition with a series of covariates indicating the number of people in the household within five age categories. Associations between food spending adequacy and purchased quantities of energy and macro- and micronutrient densities (nutrient/MJ) were also assessed using analysis of variance. Prior to analysis, the quantities of food and energy purchased and the nutrient densities were Box–Cox transformed to approximate the normal distribution.

Inadequate food spending was associated with the purchase of significantly lower edible quantities of foods from each of the food groups (Table A1) and significantly lower quantities of energy and energy-adjusted nutrients (with the exception of fibre, phosphorus, vitamin A, vitamin B_6 and cholesterol).

Table A1 Relationship between not achieving food spending at least equivalent to the cost of the Market Basket Measure (MBM) and quantities (kg) purchased of fruits and vegetables, grain products, milk products, meat and alternatives, and other foods over a two-week period ($n = 4988$)

	Mean edible quantity (standard error)	
	Adequate food spending, MBM ratio $\geq$1 ($n = 2148$)	Inadequate food spending, MBM ratio $<$1 ($n = 2840$)
Fruits and vegetables	22.16 (0.25)*	10.75 (0.15)
Grain products	7.70 (0.11)*	4.20 (0.08)
Milk products	14.56 (0.21)*	8.54 (0.14)
Meat and alternatives	7.92 (0.11)*	3.50 (0.05)
Other foods	19.55 (0.32)*	9.10 (0.16)
Miscellaneous	5.16 (0.08)*	2.17 (0.04)

* Indicates significant difference ($P < 0.0001$) in edible quantities between subgroups defined by food spending adequacy, based on analysis of variance.