

Title

Prescription medication nonadherence associated with food insecurity in Canada

Affiliations

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Competing interests

None.

Data sharing

Data of this study cannot be shared publicly due to the confidentiality agreement between Statistics Canada and respondents of the Canadian Community Health Survey. Data are available at Statistics Canada Research Data Centre (contact via phone +1 905-525-9140 ext. 23661) for researchers who meet the criteria for access to confidential data.

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3 1 Prescription medication nonadherence associated with food insecurity in Canada
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7 3 **ABSTRACT**

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9 4 Background:

10 5 Food insecurity has been associated with poorer disease management. Cost-related
11 6 nonadherence to prescription drugs is one possible pathway. This study examines the link
12 7 between food insecurity and cost-related nonadherence in Canada.
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15 8 Methods:

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17 9 Drawing on data for respondents 18-64 years old who answered the rapid response module on
18 10 prescription medication use in the Canadian Community Health Survey 2016, we assessed the
19 11 association between food insecurity and cost-related nonadherence in the past 12 months.
20 12 Modified Poisson models were applied adjusting for sociodemographic characteristics.
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23 13 Results:

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25 14 Adults experiencing more severe food insecurity were more likely to have medication
26 15 prescriptions but less likely to have insurance covering prescriptions ($p < 0.001$ for all). Food
27 16 insecurity affected 12.5% of the adherents and 50.4% of the nonadherents. There was a graded
28 17 association between food insecurity status and adjusted prevalence of cost-related nonadherence
29 18 among those with any prescription. Marginal, moderate, and severe food insecurity were
30 19 associated with 2.33 (95% confidence interval [CI] 1.81-3.01), 4.21 (95% CI 3.52-5.03), and 5.32
31 20 (95% CI 4.41-6.42) times higher prevalence of cost-related nonadherence, respectively, relative
32 21 to food security. Severe food insecurity was correlated with higher prevalence of health
33 22 deterioration and greater health care utilization as perceived consequences of cost-related
34 23 nonadherence ($p < 0.01$ for both).
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37 24 Interpretation:

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39 25 Food-insecure adults in Canada are more likely than their food-secure counterparts to experience
40 26 cost-related nonadherence, which may constitute an additional barrier to their health and lead to
41 27 greater health care utilization.
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3 28 Defined as the inadequate access to food due to financial constraints, food insecurity is
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5 29 experienced by 12.6% of Canadian households.¹ In Canada, food insecurity has been linked to
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7 30 increased prevalence of chronic conditions,² poorer disease management,³⁻⁵ greater utilization of
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9 31 health service,^{6,7} and higher mortality risk.⁸ In the US, food insecurity has been associated with
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11 32 cost-related nonadherence to prescription drugs, characterized by delaying, reducing, or skipping
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13 33 prescribed medication due to cost.^{9,10} The difficulty adhering to medications may render the food-
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15 34 insecure patients' conditions less manageable and increase their risk of more serious health
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17 35 outcomes.

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21 36 Prescription drugs in Canada are covered by a patchwork of public and private insurance. Social
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23 37 assistance recipients are generally covered by public insurance, as are most seniors.¹¹ Public
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25 38 insurance plans have limited coverage of non-welfare populations under 65, most of who rely on
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27 39 private insurance attached to their employment.¹² Deductibles, co-insurance, and copayment are
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29 40 common out-of-pocket expenses in public and private insurance policies alike.¹¹ Using Canadian
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31 41 Community Health Survey (CCHS) 2016, Law and colleagues found one-fifth of Canadians had
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33 42 no insurance for prescription drugs while 8.2% of adults with a prescription reported cost-related
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35 43 nonadherence in the past year.¹³ The rate was especially high for working-age adults, lower
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37 44 income households, those with poor health, and the uninsured.^{13,14} However, no research has
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39 45 examined the relationship between food insecurity and cost-related nonadherence in Canada
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41 46 despite their plausible connection. Building on Law and colleagues' work, we designed a cross-
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43 47 sectional study with CCHS 2016 to investigate the question.

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49 **Methods**

50 Study participants

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3 51 CCHS is a cross-sectional telephone survey conducted annually by Statistics Canada,
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5 52 representing 98% of the Canadian non-institutionalized population aged 12 or older. Since 2015,
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7 53 samples of 65000 households per year have been drawn from geographic area and Canadian
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9 54 Child Tax Benefit frames. In 2016, a rapid response module on prescription drugs use was
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11 55 administered to respondents interviewed from January to June except those from the territories.
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13 56 Household food insecurity was also assessed in the survey, however Ontario, Newfoundland and
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15 57 Labrador, and Yukon opted out of this measurement in 2016.

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18 58 From the 28091 respondents to the rapid response module, we excluded those from Ontario and
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20 59 Newfoundland and Labrador as well as anyone with missing data on food insecurity (eFigure 1).
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22 60 We also excluded respondents aged under 18 or over 64 to focus on working-age adults, who are
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24 61 more vulnerable to food insecurity and cost-related nonadherence than other age groups.^{1,13} The
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26 62 analytic sample comprised 11674 adults 18 to 64 years old.

30 63 31 32 33 64 Outcomes

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36 65 Our primary outcome was cost-related nonadherence conditional on receiving a drug prescription.
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38 66 The outcome derived from two survey questions on experiences of i) not filling or collecting a drug
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40 67 prescription or skipping doses, and ii) reducing dosage or delaying filling in the last 12 months,
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42 68 both due to inability to afford the drugs. Affirmation to either question constitutes nonadherence.
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45 69 We also analyzed several secondary outcomes. For the overall sample, we created a binary
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47 70 outcome denoting any self-reported diagnosis of chronic conditions among heart diseases, high
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49 71 blood cholesterol or lipids, high blood pressure, asthma, diabetes, arthritis, migraine, back pain,
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51 72 joint pain, mood disorder, and anxiety disorder. An indicator was created for having three or more
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53 73 of these conditions. Also, for the overall sample, we created an indicator for having any insurance
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55 74 for prescription drugs and another for having any prescription in the past 12 months. For those

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3 75 with a prescription, we further identified those with three or more different drugs prescribed and
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5 76 those spending over \$200 out of pocket on their own prescription. To explore the health conditions,
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7 77 frequency of occurrence, shared costs, and health consequences related to cost-related
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9 78 nonadherence, we further created five binary indicators for the nonadherent subsample: i)
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11 79 whether the unafforded drug was for one of the chronic conditions among heart disease, high
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13 80 cholesterol, high blood pressure, asthma, chronic obstructive pulmonary disease, diabetes, gut
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15 81 problems, arthritis, chronic pain, and mental disorders; ii) whether the cost-related nonadherence
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17 82 occurred at least sometimes versus rarely in the past year; iii) whether the last unafforded drug
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19 83 required an out-of-pocket cost of fifty dollars or less; iv) respondent's perception that their health
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21 84 worsened as a consequence of inability to afford prescription medications; and v) whether the
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23 85 respondent had to visit the doctor, be hospitalized, or go to the emergency department as a
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25 86 perceived result of unaffordable prescriptions.
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32 88 Exposure

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35 89 Our exposure was household food insecurity. Based on the number of affirmative answers to 18
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37 90 questions on a household's access to food over the past 12 months, a household is categorized
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39 91 as "food-secure", "marginally food-insecure", "moderately food-insecure", or "severely food-
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41 92 insecure" (eTable 1; see eAppendix for questionnaire).

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44 93 To control for potential confounders of the relationship between food insecurity and the
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46 94 outcomes,¹³ we included respondent's gender, age, aboriginal identity, education, household
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48 95 income, housing tenure, household type, and province of residence in all models. Quadratic terms
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50 96 were added for age and income to account for non-linearity. We also controlled for insurance
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52 97 coverage of prescription drugs and number of different medications prescribed last year in models
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54 98 predicting cost-related nonadherence and its associated characteristics and consequences. We
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3 99 tagged missing values with a separate category in all categorical variables. Income was imputed
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5 100 by Statistics Canada for the 11.8% of the sample with missing values, with imputation denoted in
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7 101 our analyses by a dichotomous indicator.
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13 103 Statistical analysis

16 104 We first described the sample characteristics through weighted population proportions and means.
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18 105 We then fitted modified Poisson regressions on presence of chronic conditions, prescription
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20 106 receipt, and insurance coverage in the overall sample to obtain prevalence ratios adjusting for
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22 107 food insecurity and confounding factors.¹⁵ Social assistance recipients were excluded from the
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24 108 model predicting insurance coverage since they should all have public insurance. We also
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26 109 regressed presence of three or more conditions among those with any condition, and receipt of
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28 110 three or more prescriptions and out-of-pocket costs over \$200 among those with any prescription.
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30 111 We next conducted our main analysis on cost-related nonadherence for those with a prescription,
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32 112 first analyzing the two relevant question items separately and then collapsing them into a single
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34 113 indicator. We performed sensitivity tests to ensure findings were not driven by households with
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36 114 very low income (bottom income quartile) or possible measurement error (social assistance
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38 115 recipients or those with zero prescription, who should not have reported cost-related
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40 116 nonadherence). Presence of insurance may reduce out-of-pocket drug expenses and increase
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42 117 disposable income for food; therefore, we stratified the sample by insurance status and tested
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44 118 whether insurance coverage moderated the association between food insecurity and cost-related
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46 119 nonadherence. Lastly, we restricted the sample to adults reporting cost-related nonadherence
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48 120 and regressed five self-reported characteristics and consequences of cost-related nonadherence
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50 121 on the same set of covariates used in the main models. Stata SE 15.1 was used for analyses. All
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3 122 models computed robust standard error. Coefficients with two-sided p-value under 0.05 were
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5 123 statistically significant.
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11 125 Ethics approval
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14 126 We obtained approval from ethics committee at University of Toronto under the protocol number
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21 129 **Results**
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24 130 Of the 11674 adults from our sample, 64.0% reported having a chronic condition, 61.9% had a
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26 131 drug prescription last year, and 79.6% had prescription insurance. Among the 7231 adults with a
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28 132 prescription, 7.3% reported not filling or collecting prescription drugs or skipping doses due to
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30 133 cost, 7.2% reported reducing dosage or delaying filling of prescription drugs due to cost. Taken
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32 134 together, 9.2% of respondents with prescriptions reported some act of cost-related nonadherence.
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34 135 Of the 753 nonadherents, 60.0% could not afford drugs for their chronic conditions, 42.7% could
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36 136 not afford prescriptions at least sometimes, and 30.9% had their last nonadherence costing fifty
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38 137 dollars or less. There were 43.0% of the nonadherents who felt their health condition worsened
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40 138 as a result of cost-related nonadherence; 19.9% reported greater health care resource utilization
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42 139 for the same reason.
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46 140 Food-secure adults represented 85.8% of the sample; another 4.5%, 6.8%, and 3.0% were in
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48 141 marginally, moderately, and severely food-insecure households, respectively. There was
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50 142 considerable overlap between food insecurity and cost-related nonadherence. While 5.5% of the
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52 143 food-secure adults reporting cost-related nonadherence, the comparable figures were 13.3%,
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54 144 29.3%, and 47.3% for adults from marginally, moderately, and severely food-insecure households,
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3 145 respectively, among those with prescription. Food insecurity was experienced by 12.5% of the
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5 146 adherents and 50.4% of the nonadherents.
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8 147 We found a graded independent association of food insecurity severity with reporting of any
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10 148 chronic condition among all adults and reporting of three or more conditions among those with
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12 149 any condition (Table 2; $p < 0.001$ for all). We also found a graded association between severity of
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14 150 food insecurity and having any drug prescription ($p < 0.01$ for all). Among those with a prescription,
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16 151 food insecurity was associated with having three or more prescriptions and spending over \$200
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18 152 on prescriptions out of pocket ($p < 0.001$ for all). Compared to the food-secure adults, the food-
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20 153 insecure ones were less likely to have insurance coverage on prescription drugs ($p < 0.05$ for all).
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23 154 There was also a graded association between severity of food insecurity and cost-related
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25 155 nonadherence (Table 3; eTable 2). Adjusting for sociodemographic confounders, cost-related
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27 156 nonadherence was 2.33 (95% confidence interval [CI] 1.81 – 3.01), 4.21 (95% CI 3.52-5.03), and
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29 157 5.32 (95% CI 4.41-6.42) times more prevalent for adults from marginally, moderately, and
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31 158 severely food-insecure households, respectively, relative to their food-secure counterparts.
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33 159 Translating into predicted probability, the figure was 0.06 (95% CI 0.05-0.07) for food-secure
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35 160 adults and 0.14 (95% CI 0.11-0.17), 0.26 (95% CI 0.22-0.29), and 0.32 (95% CI 0.28-0.37) for
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37 161 their marginally, moderately, and severely food-insecure counterparts, respectively. The
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39 162 association with food insecurity was qualitatively similar for not filling or skipping doses versus
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41 163 reducing dosage or delaying filling ($p < 0.001$ for all). The graded association between severity of
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43 164 food insecurity and cost-related nonadherence was significant for adults with and without drug
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45 165 insurance, however the associations with moderate and severe food insecurity were stronger for
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47 166 those without insurance than for the insured ones (interaction $p < 0.01$ for both; eFigure 2).
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51 167 Limiting to those reporting any cost-related nonadherence (Table 4), we found severe food
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53 168 insecurity consistently associated with higher nonadherence to drugs for chronic conditions
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55 169 (prevalence ratio [PR] 1.31, 95% CI 1.13-1.52), at least sometimes versus rarely nonadhering
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3 170 (PR 1.58, 95% CI 1.30-1.91), having the last unaffordable prescription costing fifty dollars or less
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5 171 (PR 1.37, 95% CI 1.05-1.77), self-perceived health deterioration as a result of cost-related
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7 172 nonadherence (PR 1.69, 95% CI 1.36-2.09), and self-reported increase in doctor visits, hospital
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9 173 admissions, or emergency department visits as a result of cost-related nonadherence (PR 1.94,
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11 174 95% CI 1.31-2.86). Moderate food insecurity was associated with higher prevalence of cost-
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13 175 related nonadherence to drugs for chronic conditions (PR 1.24, 95% CI 1.06-1.44) and worse
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15 176 health due to unaffordable prescriptions (PR 1.52, 95% CI 1.23-1.89). There were no significant
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17 177 associations with marginal food insecurity.

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21 178 Sensitivity analyses on cost-related nonadherence yielded virtually the same results when limiting
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23 179 the sample to those from the bottom income quartile, excluding those mainly relying on social
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25 180 assistance, or including nonadherent adults reporting zero prescription (eTable 3).

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32 33 183 **Interpretation**

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36 184 Using the CCHS 2016 rapid response module, we documented substantial overlap between food
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38 185 insecurity and cost-related nonadherence: 50.4% of the nonadherents experienced any food
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40 186 insecurity while 47.3% of the severely food-insecure adults reported cost-related nonadherence.
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42 187 Adjusting for sociodemographic confounders, we found a graded association between cost-
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44 188 related nonadherence and severity of food insecurity among those with a prescription. Among
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46 189 nonadherents, severe food insecurity was associated with cost-related nonadherence to drugs
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48 190 for chronic conditions, more frequent nonadherence, lower cost required for nonadhered drugs,
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50 191 and negative health consequences.

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53 192 Consistent with prior research,² we observed a high burden of chronic illness among food-
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55 193 insecure adults, with rates moving in a stepwise fashion with severity of household food insecurity.

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3 194 Moreover, adults experiencing more severe food insecurity were more likely to lack drug
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5 195 insurance and incur high out-of-pocket drug costs. The accumulation of disadvantages has been
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7 196 documented previously, with food-insecure households often simultaneously experiencing
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9 197 multiple material and financial hardships, including out-of-pocket medical expenses.¹⁶⁻¹⁹

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12 198 Our findings suggest that cost-related nonadherence may be on the pathway connecting food
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14 199 insecurity to poor health. Relative to the food-secure nonadherents, those experiencing severe
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16 200 food insecurity tended to report more frequent nonadherence and nonadherence to drugs for
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18 201 chronic conditions, consistent with evidence of poorer disease management among food-insecure
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20 202 adults.³⁻⁵ Medication nonadherence has been associated with heightened risk of hospitalization
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22 203 and mortality among diabetic patients.²⁰ The association we found between food insecurity and
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24 204 worsening health as well as higher health care utilization as a perceived result of nonadherence
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26 205 was also consistent with prior work linking food insecurity and cost-related nonadherence to
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28 206 adverse health outcomes.^{6,8,20} The concurrence of food insecurity with cost-related nonadherence
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30 207 can only compound the health ramifications of either factor alone. Previous studies from the US
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32 208 have reported results qualitatively similar to ours, positively associating food insecurity with cost-
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34 209 related nonadherence^{9,10}

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38 210 Both food insecurity and cost-related nonadherence are a function of low economic resources;
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40 211 accordingly, policies that increase disposable income for food or medication may help mitigate
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42 212 both issues. In the US, participation in the public health insurance program Medicaid has been
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44 213 associated with less cost-related nonadherence and food insecurity,¹⁰ likely by freeing up
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46 214 disposable income as out-of-pocket expenses on health care or food lowered. In Canada, studies
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48 215 have found reductions in food insecurity following policy interventions that increased income for
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50 216 low income households,²¹⁻²⁴ though their impact on cost-related nonadherence remains unknown.
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52 217 Our findings lend support to calls for a pharmacare program, which could potentially reduce
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54 218 prevalence of cost-related nonadherence by providing universal prescription insurance.²⁵⁻²⁷

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3 219 However, having insurance coverage may not eliminate nonadherence. Some insured individuals
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5 220 - especially those in food insecurity - also reported cost-related nonadherence in our study,
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7 221 possibly as a result of high out-of-pocket costs. In addition, the affordable level of out-of-pocket
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9 222 expenses may vary by food insecurity status, as we showed that drug costs of fifty dollars or less
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11 223 were more likely to trigger cost-related nonadherence for severely food-insecure adults than for
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13 224 their food-secure counterparts. Given evidence that copayment exemption in drug insurance
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15 225 reduces cost-related nonadherence,²⁸ lowering or waiving the out-of-pocket expenses on
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17 226 prescriptions based on one's income may help mitigate cost-related nonadherence among food-
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19 227 insecure adults.²⁹

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229 **Limitations**

230 Our survey data was cross-sectional, which limited our ability to ascertain causality. Panel data
231 with repeated measurement of food insecurity and cost-related nonadherence is needed to
232 establish time order of events and reduce bias from unobserved factors. Also, our cost-related
233 nonadherence outcome was conditional on having a prescription, which may be subject to
234 negative selection of patients avoiding physician encounters and prescriptions due to causes
235 related to food insecurity (e.g. shame). In that respect, our estimates should be regarded as
236 conservative. In addition, cost-related nonadherence was never assessed in the territories and
237 we had to exclude two provinces due to their failure to measure food insecurity. Our findings may
238 not apply to the missing jurisdictions. Lastly, all our outcomes were self-reported; research using
239 clinical records would improve measurement precision.

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241 **Conclusion**

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242 This study found a graded association between household food insecurity status and cost-related
243 nonadherence. We also found greater self-perceived negative health impact of cost-related
244 nonadherence as severity of food insecurity increased. Policymakers need to recognize food
245 insecurity as likely co-occurring with cost-related nonadherence and address both issues with
246 adequate measures.

247

248

Confidential

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Table 1: Sample characteristics by food insecurity status based on rapid response module of Canadian Community Health Surveys, 2016

	Food secure <i>n</i> = 9 749	Marginally FI <i>n</i> = 566	Moderately FI <i>n</i> = 855	Severely FI <i>n</i> = 504
Female	48.5	51.1	56.2	62.4
Age at interview (years, mean ± SE)	41.9 ± 0.1	38.9 ± 0.5	37.9 ± 0.4	39.1 ± 0.6
Household income (\$, mean ± SE)	120 540 ± 913	75 874 ± 2 538	69 635 ± 2 189	49 011 ± 1 884
Income imputed	12.5	13.8	16.9	15.0
Main source of household income				
Wage and salary	74.9	73.9	64.2	52.0
Pension	4.1	3.8	2.8	4.5
Social assistance and welfare	1.1	5.5	9.4	15.7
Other sources	11.5	10.1	11.0	17.2
Missing	8.4	6.8	12.7	10.6
Aboriginal identity				
Non-aboriginal	96.1	93.8	90.5	88.4
Aboriginal	3.5	5.8	9.3	11.3
Missing	0.5	0.4	0.2	0.3
Respondent's education				
High school incomplete	8.0	11.7	14.7	18.1
High school graduate	23.4	31.7	27.4	30.7
Some college or college diploma	67.2	54.3	55.9	49.4
Missing	1.4	2.3	2.0	1.8
Housing tenure				
Renter	24.5	43.0	54.1	72.4
Homeowner	75.3	56.9	45.9	27.6
Missing	0.2	0.1	0.0	0.0
Household type				
Couple with children	47.0	41.1	45.3	25.7
Couple without children	27.5	16.1	14.8	12.3
Lone parents	8.2	12.9	14.3	16.7
Other types	16.8	27.9	25.5	44.2
Missing	0.5	1.8	0.1	1.1
Province				
Quebec	38.6	35.4	36.9	26.8
British Columbia	22.4	21.6	20.8	24.5
Manitoba	5.5	7.6	6.3	8.6
Saskatchewan	5.0	8.1	4.7	4.1
Alberta	20.4	17.2	21.2	24.8
Atlantic (PEI/NS/NB)	8.1	10.2	10.0	11.2

Note: FI = food-insecure, SE = standard error, PEI = Prince Edward Island, NS = Nova Scotia, NB = New Brunswick. Weighted by CCHS master file's household weight. All numbers are in percentages unless noted otherwise.

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Table 2: Prevalence ratios of reporting chronic conditions, medication prescription, and medication insurance in relation to household food insecurity status, adjusting for sociodemographic characteristics

Sample	n	Outcome	Food secure	Marginally FI	Moderately FI	Severely FI	P for trend
Overall	11403	Any chronic	1.00 (ref)	1.14 (1.08 - 1.20)	1.19 (1.14 - 1.25)	1.28 (1.23 - 1.34)	<0.001
Chronic	7857	3+ chronic	1.00 (ref)	1.36 (1.21 - 1.54)	1.45 (1.31 - 1.61)	1.75 (1.58 - 1.93)	<0.001
Overall	11643	Any prescription	1.00 (ref)	1.10 (1.03 - 1.17)	1.17 (1.11 - 1.23)	1.27 (1.20 - 1.34)	<0.001
Prescription	7231	3+ prescriptions	1.00 (ref)	1.24 (1.12 - 1.37)	1.29 (1.19 - 1.40)	1.33 (1.21 - 1.46)	<0.001
Prescription	7094	Cost>\$200	1.00 (ref)	1.52 (1.32 - 1.73)	1.56 (1.38 - 1.76)	1.39 (1.19 - 1.63)	<0.001
Non-welfare	11207	Drug insurance	1.00 (ref)	0.93 (0.88 - 0.98)	0.95 (0.91 - 0.99)	0.90 (0.84 - 0.97)	<0.001

Note: Adjusted prevalence ratios from modified Poisson regression with robust standard error. 95% confidence interval in parentheses. FI = food-insecure. All models adjusted for household income, income squared, income imputed, income source, gender, age, aboriginal status, respondent's education, housing tenure, household type, and province. Households mainly relying on social assistance were excluded from the "drug insurance" model. "Overall" denotes overall working-age adults' sample. "Chronic" denotes the subsample with any major chronic condition. "Prescription" denotes the subsample with any drug prescription. "Non-welfare" denotes the subsample with main household income source not being social assistance or welfare.

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Table 3: Prevalence ratios of reporting cost-related prescription drug nonadherence in relation to household food insecurity status

Sample:	Prescription	Prescription	Prescription	Uninsured	Insured
Outcome:	Not filling or skipping doses	Reducing dosage or delaying filling	Nonadherence	Nonadherence	Nonadherence
Food secure	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Marginally FI	2.43 (1.83 - 3.23)	2.59 (1.93 - 3.49)	2.33 (1.81 - 3.01)	1.77 (1.18 - 2.64)	2.58 (1.84 - 3.62)
Moderately FI	3.98 (3.24 - 4.89)	4.90 (3.98 - 6.03)	4.21 (3.52 - 5.03)	3.24 (2.48 - 4.24)	4.87 (3.86 - 6.13)
Severely FI	5.55 (4.48 - 6.87)	6.61 (5.33 - 8.20)	5.32 (4.41 - 6.42)	4.45 (3.42 - 5.77)	5.89 (4.54 - 7.65)
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001
n	7 167	7 226	7 169	1 097	5 774

Note: Adjusted prevalence ratios from modified Poisson regression with robust standard error. FI = food-insecure. 95% confidence interval in parentheses. All models adjusted for household income, income squared, income imputed, income source, gender, age, aboriginal status, respondent's education, housing tenure, household type, province, drug insurance status, and number of different drugs prescribed. "Prescription" denotes the subsample with a drug prescription. "Uninsured" denotes the subsample with prescription but no drug insurance. "Insured" denotes subsample with prescription and drug insurance.

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Table 4: Prevalence ratios of characteristics and consequences of cost-related nonadherence in relation to household food insecurity status among those experiencing cost-related nonadherence

Sample:	Nonadherents with any prescription				
Outcome:	Nonadherence for chronic conditions	At least sometimes nonadhering	Last nonadhered drug ≤ \$50	Worse health	Greater health care usage
Food secure	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Marginally FI	1.03 (0.83 - 1.29)	1.00 (0.72 - 1.38)	1.07 (0.73 - 1.58)	1.17 (0.83 - 1.64)	1.51 (0.87 - 2.62)
Moderately FI	1.24 (1.06 - 1.44)	1.09 (0.87 - 1.37)	1.22 (0.94 - 1.58)	1.52 (1.23 - 1.89)	1.28 (0.83 - 1.95)
Severely FI	1.31 (1.13 - 1.52)	1.58 (1.30 - 1.91)	1.37 (1.05 - 1.77)	1.69 (1.36 - 2.09)	1.94 (1.31 - 2.86)
P for trend	<0.001	<0.001	0.019	<0.001	0.008
n	734	740	707	721	738

Note: Adjusted prevalence ratios from modified Poisson regression with robust standard error. FI = food-insecure. 95% confidence interval in parentheses. All models adjusted for household income, income squared, income imputed, income source, gender, age, aboriginal status, respondent's education, housing tenure, household type, province, drug insurance status, and number of different drugs prescribed. "Nonadherents with any prescription" denotes the prescription subsample who experienced cost-related medication nonadherence.

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Supporting Information

eFig 1. Sample selection process

eFig 2. Adjusted nonadherence by food insecurity and insurance

eTable 1. Food insecurity status, based on CCHS 18-item questionnaire

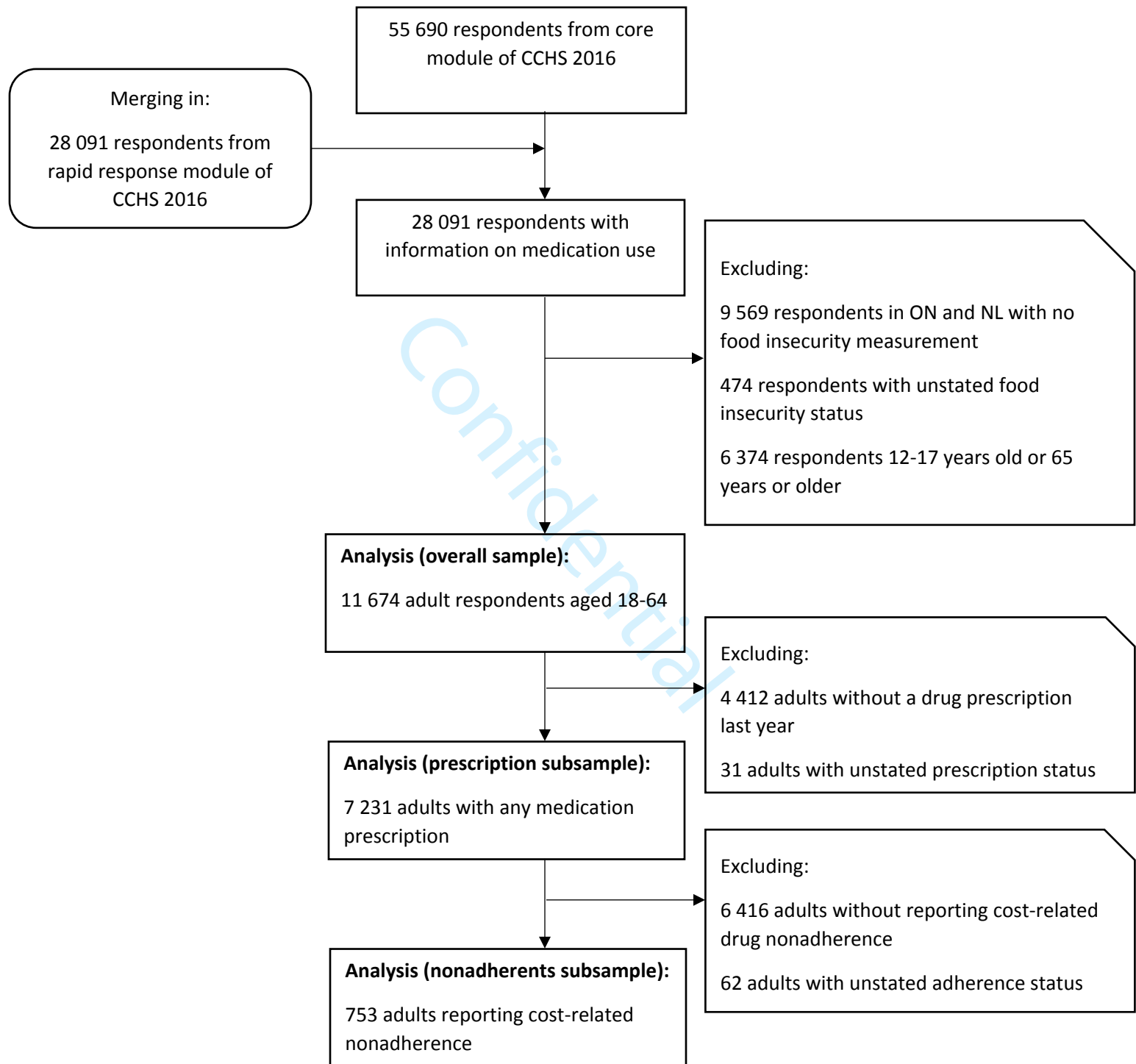
eTable 2. Association between household food insecurity and cost-related nonadherence among adults with any prescription last year ($n = 7\ 169$)

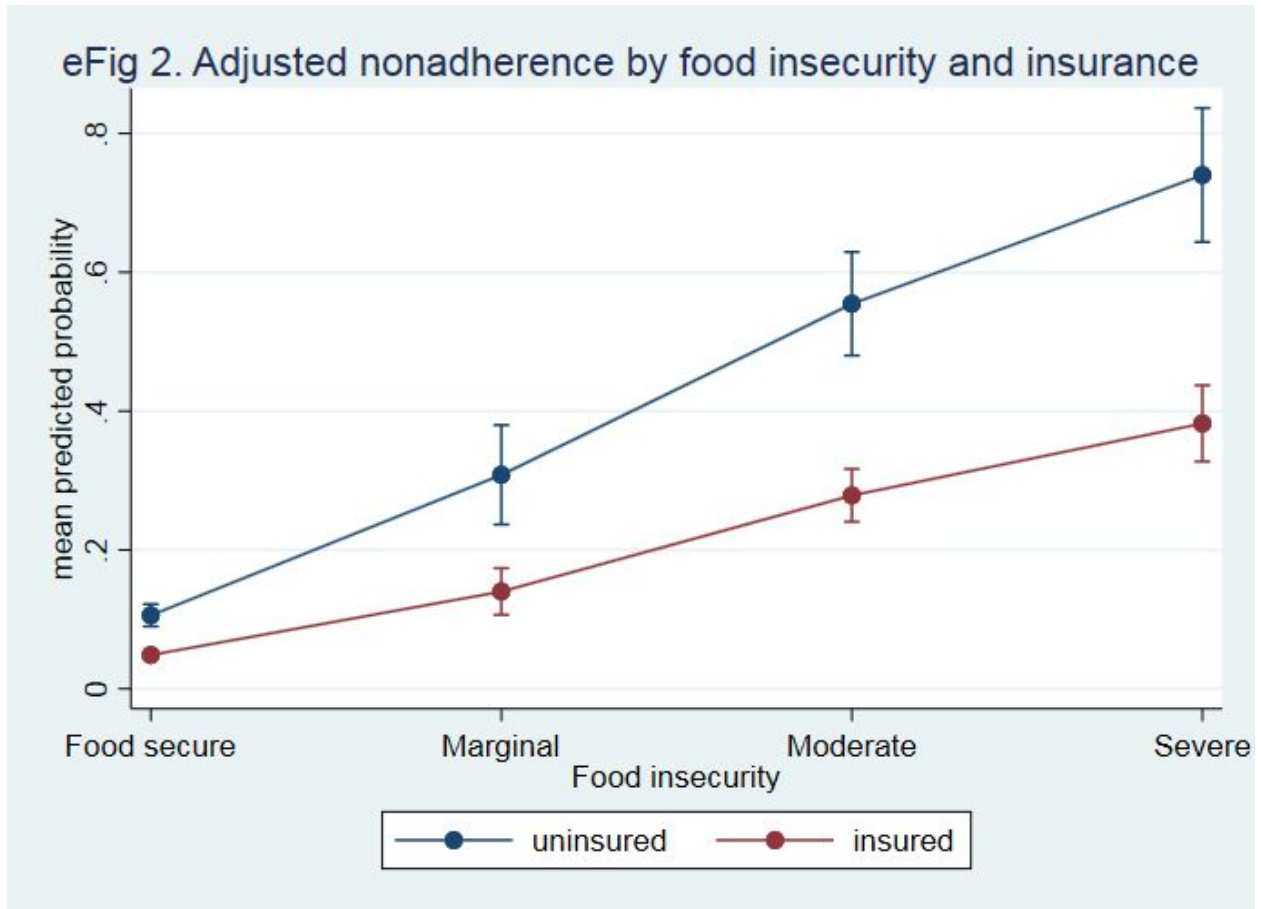
eTable 3. Sensitivity tests on cost-related prescription drug nonadherence in relation to household food insecurity status

eAppendix. CCHS 18-item Household Food Security Survey Module Questionnaire

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eFig 1: Sample selection process





Note: Figure based on mean predicted probability of cost-related nonadherence by food insecurity status and insurance coverage. Modified Poisson regression with robust standard error was used, adjusting for household income, income squared, income imputed, income source, gender, age, aboriginal status, respondent's education, housing tenure, household type, province, and number of different drugs prescribed. Individuals with missing insurance status were excluded from the analysis. Marginal = marginally food-insecure. Moderate = moderately food-insecure. Severe = severely food-insecure.

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Table 1: Food insecurity status, based on CCHS 18-item questionnaire

Status	Measurement	Interpretation
Food secure	Affirmed no item on either the 10-item adult food security scale or 8-item child food security scale	No report of income-related problems of food access.
Marginally food insecure	Affirmed no more than 1 item on either scale	Some indication of worry or an income-related barrier to adequate, secure food access.
Moderately food insecure	Affirmed 2 to 5 items on the adult scale or 2 to 4 items on the child scale	Compromise in quality and/or quantity of food consumed by adults and/or children due to a lack of money for food.
Severely food insecure	Affirmed more than 5 items on the adult scale or more than 4 items on the child scale	Disrupted eating patterns and reduced food intake among adults and/or children

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eTable 2: Association between household food insecurity and cost-related nonadherence among adults with any prescription last year (n = 7 169)

Household food insecurity status	
Food secure	1.00 (ref)
Marginally food insecure	2.33 (1.81 - 3.01)
Moderately food insecure	4.21 (3.52 - 5.03)
Severely food insecure	5.32 (4.41 - 6.42)
Female	1.14 (0.99 - 1.31)
Age (ten years)	0.89 (0.62 - 1.29)
Age squared	1.00 (0.96 - 1.05)
Aboriginal identity	
Non-aboriginal	1.00 (ref)
Aboriginal	1.05 (0.84 - 1.32)
Missing	1.34 (0.51 - 3.49)
Respondent's education	
High school incomplete	1.05 (0.84 - 1.30)
High school graduate	1.00 (ref)
Some college or college diploma	1.16 (0.99 - 1.36)
Missing	1.49 (0.97 - 2.28)
Housing tenure	
Renter	1.00 (ref)
Homeowner	0.96 (0.83 - 1.12)
Missing	3.20 (1.05 - 9.74)
Household type	
Couple with children	1.00 (ref)
Couple without children	0.96 (0.78 - 1.19)
Lone parents	1.12 (0.90 - 1.40)
Other types	1.11 (0.92 - 1.34)
Missing	2.25 (0.97 - 5.20)
Drug insurance coverage	
Uninsured	1.00 (ref)
Insured	0.50 (0.44 - 0.58)
Missing	0.82 (0.36 - 1.89)
Number of different drugs prescribed last year	
One	1.00 (ref)
Two	1.38 (1.18 - 1.61)
Three or more	1.82 (1.55 - 2.14)
Household income (\$10 000)	0.97 (0.95 - 1.00)
Income squared	1.00 (1.00 - 1.00)
Income imputed	0.97 (0.75 - 1.26)
Main source of household income	
Wage and salary	1.00 (ref)
Pension	0.90 (0.67 - 1.21)
Social assistance and welfare	0.39 (0.16 - 0.93)

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Other sources	1.04 (0.86 - 1.24)
Missing	0.98 (0.71 - 1.37)
Province	
Quebec	1.00 (ref)
British Columbia	1.46 (1.21 - 1.76)
Manitoba	1.03 (0.78 - 1.36)
Saskatchewan	1.39 (1.06 - 1.82)
Alberta	1.17 (0.96 - 1.42)
Atlantic provinces (PEI/NS/NB)	1.20 (0.98 - 1.47)

Note: Adjusted prevalence ratios from modified Poisson regression with robust standard error. 95% confidence interval in parentheses. PEI = Prince Edward Island, NS = Nova Scotia, NB = New Brunswick.

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eTable 3: Sensitivity tests on cost-related prescription drug nonadherence in relation to household food insecurity status

Sample:	Bottom income quartile	Non-welfare	Prescription
Outcome:	Nonadherence	Nonadherence	Nonadherence (including zero prescription)
Food secure	1.00 (ref)	1.00 (ref)	1.00 (ref)
Marginally FI	2.22 (1.52 - 3.22)	2.28 (1.75 - 2.96)	2.21 (1.73 - 2.82)
Moderately FI	4.04 (3.12 - 5.23)	4.30 (3.59 - 5.15)	4.10 (3.44 - 4.87)
Severely FI	5.26 (4.05 - 6.82)	5.35 (4.42 - 6.47)	5.18 (4.32 - 6.22)
n	1 798	6 903	8 071

Note: Adjusted prevalence ratios from modified Poisson regression with robust standard error. FI = food-insecure. 95% confidence interval in parentheses. All models adjusted for household income, income squared, income imputed, income source, gender, age, aboriginal status, respondent's education, housing tenure, household type, province, drug insurance status, and number of different drugs prescribed. "Prescription" denotes the subsample with a drug prescription. "Bottom income quartile" denotes the prescription subsample with household-size-adjusted income from the bottom income quartile of the sample. "Non-welfare" denotes the prescription subsample with main household income source not being social assistance or welfare.

eAppendix: CCHS 18-item Household Food Security Survey Module Questionnaire

The following questions are about the food situation for your household in the past 12 months.

Q1. Which of the following statements best describes the food eaten in your household in the past 12 months, that is, since [current month] of last year?

1. You and other household members always had enough of the kinds of foods you wanted to eat.
 2. You and other household members had enough to eat, but not always the kinds of food you wanted.
 3. Sometimes you and other household members did not have enough to eat.
 4. Often you and other household members didn't have enough to eat.
- Don't know / refuse to answer (Go to end of module)

Question Q1 is not used directly in determining household food security status.

STAGE 1 Questions 2 - 6 — ask all households

Now I'm going to read you several statements that may be used to describe the food situation for a household. Please tell me if the statement was often true, sometimes true, or never true for you and other household members in the past 12 months.

Q2. The first statement is: you and other household members worried that food would run out before you got money to buy more. Was that often true, sometimes true, or never true in the past 12 months?

1. Often true
 2. Sometimes true
 3. Never true
- Don't know / refuse to answer

Q3. The food that you and other household members bought just didn't last, and there wasn't any money to get more. Was that often true, sometimes true, or never true in the past 12 months?

1. Often true
 2. Sometimes true
 3. Never true
- Don't know / refuse to answer

Q4. You and other household members couldn't afford to eat balanced meals. In the past 12 months was that often true, sometimes true, or never true?

1. Often true

1
2
3 2. Sometimes true

4
5 3. Never true

6
7 - Don't know / refuse to answer

8
9
10 IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q5 AND Q6; OTHERWISE, SKIP TO FIRST LEVEL
11 SCREEN

12 Now I'm going to read a few statements that may describe the food situation for households with children.

13
14 **Q5. You or other adults in your household relied on only a few kinds of low-cost food to feed the**
15 **child(ren) because you were running out of money to buy food. Was that often true, sometimes**
16 **true, or never true in the past 12 months?**

17
18 1. Often true

19
20 2. Sometimes true

21
22 3. Never true

23
24 - Don't know / refuse to answer

25
26
27 **Q6. You or other adults in your household couldn't feed the child(ren) a balanced meal, because**
28 **you couldn't afford it. Was that often true, sometimes true, or never true in the past 12 months?**

29
30 1. Often true

31
32 2. Sometimes true

33
34 3. Never true

35
36 - Don't know / refuse to answer

37
38 **FIRST LEVEL SCREEN (screener for Stage 2):** If AFFIRMATIVE RESPONSE to ANY ONE of Q2-Q6
39 (i.e., "often true" or "sometimes true") OR response [3] or [4] to Q1, then continue to STAGE 2; otherwise,
40 skip to end.

41
42
43 **Questions 7 - 11 — ask households passing the First Level Screen**

44
45 IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q7; OTHERWISE SKIP TO Q8

46
47 **Q7. The child(ren) were not eating enough because you and other adult members of the**
48 **household just couldn't afford enough food. Was that often, sometimes or never true in the past**
49 **12 months?**

50
51 1. Often true

52
53 2. Sometimes true

54
55 3. Never true

56
57 - Don't know / refuse to answer

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5 The following few questions are about the food situation in the past 12 months for you or any other adults
6 in your household.

7 **Q8. In the past 12 months, since last [current month] did you or other adults in your household**
8 **ever cut the size of your meals or skip meals because there wasn't enough money for food?**
9

- 10 1. Yes
11
12 2. No (Go to Q9)
13
14 - Don't know / refuse to answer
15

16
17 **Q8b. How often did this happen?**

- 18 1. Almost every month
19
20 2. Some months but not every month
21
22 3. Only 1 or 2 months
23
24 - Don't know / refuse to answer
25

26
27 **Q9. In the past 12 months, did you (personally) ever eat less than you felt you should because**
28 **there wasn't enough money to buy food?**
29

- 30 1. Yes
31
32 2. No
33
34 - Don't know / refuse to answer
35

36
37 **Q10. In the past 12 months, were you (personally) ever hungry but didn't eat because you couldn't**
38 **afford enough food?**

- 39 1. Yes
40
41 2. No
42
43 - Don't know / refuse to answer
44

45 **Q11. In the past 12 months, did you (personally) lose weight because you didn't have enough**
46 **money for food?**

- 47 1. Yes
48
49 2. No
50
51 - Don't know / refuse to answer
52

53
54 **SECOND LEVEL SCREEN (screener for Stage 3):** If AFFIRMATIVE RESPONSE to ANY ONE of Q7-
55 Q11, then continue to STAGE
56

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5 **Questions 12 - 16 — ask households passing the Second Level Screen**

6 **Q12. In the past 12 months, did you or other adults in your household ever not eat for a whole day**
7 **because there wasn't enough money for food?**

- 8
9 1. Yes
10
11 2. No (IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q13; OTHERWISE SKIP TO END)
12
13 - Don't know / refuse to answer
14
15

16 **Q12b. How often did this happen?**

- 17 1. Almost every month
18
19 2. Some months but not every month
20
21 3. Only 1 or 2 months
22
23 - Don't know / refuse to answer
24
25

26 IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q13-16; OTHERWISE SKIP TO END
27

28 Now, a few questions on the food experiences for children in your household.

29 **Q13. In the past 12 months, did you or other adults in your household ever cut the size of any of**
30 **the children's meals because there wasn't enough money for food?**

- 31
32 1. Yes
33
34 2. No
35
36 - Don't know / refuse to answer
37
38

39 **Q14. In the past 12 months, did any of the children ever skip meals because there wasn't enough**
40 **money for food?**

- 41
42 1. Yes
43
44 2. No
45
46 - Don't know / refuse to answer
47
48

49 **Q14b. How often did this happen?**

- 50 1. Almost every month
51
52 2. Some months but not every month
53
54 3. Only 1 or 2 months
55
56 - Don't know / refuse to answer
57
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Q15. In the past 12 months, were any of the children ever hungry but you just couldn't afford more food?

1. Yes

2. No

- Don't know / refuse to answer

Q16. In the past 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food?

1. Yes

2. No

- Don't know / refuse to answer

End of module

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