ORIGINAL PAPER

The Intersectional Impact of Cost-Related Non-Adherence and Depression: A Cross-Sectional Analysis of the Canadian Community Health Survey by Sex, Race, and Indigeneity

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Abstract

We evaluated the relationship between cost-related non-adherence (CRNA) and depressive symptoms. Pooling data from the 2015, 2016, 2018, and 2019 annual Canadian Community Health Survey, we analyzed the relationship between CRNA and moderate to severe depressive symptoms, assessed by the Patient Health Questionnaire (PHQ-9). Among the sample, 4.9% experienced CRNA and 6.8% experienced moderate to severe depressive symptoms. Respondents who reported CRNA had 1.51 (95% confidence interval [CI], 1.51–1.52) greater odds of experiencing moderate to severe depressive symptoms. Stratified analysis by sex and race showed the association between CRNA and depressive symptoms was greatest among racialized males (aOR: 1.83, 95% CI: 1.81– 1.85). Stratified analysis by sex and Indigeneity showed this association was greatest for Indigenous males (aOR: 2.16, 95% CI: 2.10–2.22). Forgoing prescribed medications due to cost is associated with more severe depressive symptoms among Canadians, particularly racialized and Indigenous males.

Keywords Depression · Cost-related non-adherence · Cross-sectional Study · Intersectional Analysis

Introduction

Prescription medications, the 2nd most expensive component of Canadian healthcare spending – costing $39 billion and accounting for 15.4% of annual healthcare costs in 2019 (National Health Expenditure Trends, 2019. Series G: Expenditure on drugs., 2019) – are a necessary healthcare intervention for disease prevention and management, particularly for people living with chronic conditions. However, the costs of long-term medication use may impose considerable economic hardship and subsequently, lead to suboptimal care choices (Tang et al., 2014). Prescription medications are not an essential service under Medicare, Canada's national public health insurance that is intended to cover the costs of all medically necessary hospital and outpatient physician visits for Canadian citizens and permanent

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residents (Dewa et al., 2005). Instead, medication costs are paid through a combination of public and private insurance coverage, which have been shown to vary extensively between provinces and individuals (Demers et al., 2008), as well as out-of-pocket costs incurred by patients (Daw & Morgan, 2012; Morgan & Boothe, 2016). Consequently, the costs deferred to individuals can be considerable. In 2019, Canadian households paid an estimated $6.9 billion out-of-pocket or $185 per capita for prescription medications, accounting for 17.2% of total prescription drug expenditures (National Health Expenditure Trends, 2019. Series G: Expenditure on drugs., 2019).

In order to reduce out-of-pocket costs, many Canadians alter their prescribed medication regimen through skipping doses, reducing dosages, delaying refilling prescriptions, or not filling at all, a phenomenon known as cost-related non-adherence (CRNA; Law et al., 2012). A 2018 scoping review of the extent, determinants, and consequences of CRNA in Canada found that its prevalence varied between 4.1% and 35.6% and was commonly associated with younger age (i.e., < 65 years), lower income, precarious or irregular employment, reduced health status, lack of insurance coverage, and high out-of-pocket medication costs (Gupta et al., 2018). Additional reported factors included female sex (Dewa et al., 2005; Law et al., 2018; Zhong, 2007) and being Indigenous, racialized, or an immigrant (Law et al., 2018; Zhong, 2007); although, evidence of their association with CRNA was limited (Gupta et al., 2018). Notably, several of these demographic factors, including age, sex, income, and employment status, have been shown to be associated with mental health conditions, particularly depression and anxiety (Akhtar-Danesh & Landeen, 2007; Fuller-Thomson et al., 2020; Patten et al., 2015; Watterson et al., 2017).

Research on the impact of CRNA on health outcomes and healthcare utilization in Canada is sparse (Law et al., 2012). A 2018 cross-sectional study of the Canadian population by Law et al. found that 1.45 million Canadians reduced spending on basic necessities (e.g., food, heat, and other health care expenses) due to medication costs and an estimated 24% of those experiencing CRNA reported using additional health care services (e.g., physician and/or emergency department visits, and hospitalizations). When medications were foregone due to cost, medication regimens prescribed to treat depression, anxiety, and other mental health conditions were most often affected at a prevalence of 21.4% (confidence interval [CI], 18.0–24.9), followed by those for arthritis, chronic pain, and cardiovascular disorders (Law et al., 2018). However, the influence of CRNA on mental health, specifically depression, has not been reported.

As medications for managing mental health conditions are among the first to be forgone due to CRNA, we posit that experiencing CRNA is associated with more severe depressive symptoms. Using the Canadian Community Health Survey (CCHS), a national, comprehensive, up-to-date, cross-sectional dataset of the Canadian population, the objective of this study is to quantify the relationship between CRNA and depression; therein, addressing this critical knowledge gap.

Methods

Data Sources

The Canadian Community Health Survey (CCHS) is a national telephone survey administered annually by Statistics Canada that collects data on self-reported health, healthcare utilization, and determinants of health. The survey is representative of 97% of the community-dwelling household population aged 12 years or older living in Canada's 10 provinces and 3 territories (Statistics Canada, 2020). We pooled data from the 2015, 2016, 2018, and 2019 independent annual cycles of the CCHS, which used comparable sampling designs and population representation targets, at the microdata level. Confidential microdata master files for the four survey cycles were accessed through Statistic Canada's secure research facility, the Research Data Centre (RDC).

Analytic Sample

The CCHS included core content asked of all respondents, as well as optional content that provinces and territories can choose to include for additional health information on their residents. We restricted our sample to respondents who responded to questions about experiencing cost-related non-adherence (CRNA) and symptoms of depression. The CRNA question was asked of respondents in all 10 provinces in the Patient experience (PEX) module in 2015 and 2016, in the Prescriptions cost-related non-adherence (PCN2) module in 2018, and in the PCN2 (in Ontario) and PEX modules in 2019. The Depression module questions were optional content in all cycles and were asked in 8 provinces (excluding Alberta and Québec) in 2015, 7 provinces (excluding Alberta, British Columbia, and Québec) in 2016, 1 province (Prince Edward Island) in 2018, and 2 provinces (Manitoba and Ontario) in 2019.

Explanatory Variable

The occurrence of CRNA within the preceding 12 months was coded as a binary variable and assessed based on participants' response to the question: "During the last 12 months, was there a time when you did not fill or collect a

prescription for your medicine, or you skipped doses of your medicine because of the cost?" with 'Yes' responses coded as the presence of CRNA. The alternative responses ('No', 'N/A, no medication prescription in the last 12 months', 'Don't know', 'Refusal', and 'Not stated') were coded as no presence of CRNA.

Primary Outcome

The primary outcome was the occurrence of moderate to severe depressive symptoms. The 10-item Patient Health Questionnaire (PHQ-9), a validated instrument for assessing depressive symptoms within the previous 2 weeks, was used to assess the severity of depressive symptoms (Kroenke et al., 2001; Statistics Canada, 2018). The PHQ-9 assesses each of the DSM-IV (*Diagnostic and statistical manual of mental disorders: DSM-5*, 2013) diagnostic criteria for depression by frequency of occurrence from 'not at all' (0 points) to 'nearly every day' (3 points), which is then scored on a scale from 0 to 27 (Kroenke et al., 2001). The established guidance for interpreting PHQ-9 scores categorizes depressive symptoms as 'minimal' (0 to 4), 'mild' (5 to 9), 'moderate' (10 to 14), 'moderately severe' (15 to 19), and 'severe' (20 to 27)(Kroenke et al., 2001). We dichotomized depressive symptoms as presence or absence of moderate to severe depressive symptoms, as current guidelines for treating a major depressive episode indicate pharmacological treatment for moderate to severe cases in combination with non-pharmacological methods (i.e., psychoeducation, self-management, and psychological treatments)(Kennedy et al., 2016). PHQ-9 scores of ≥ 10 have a 88% sensitivity and 88% specificity for detecting a major depressive episode (Kroenke et al., 2001).

Covariates

Potential confounders were selected based on conceptual knowledge and empirical evidence from previous studies on depression and CRNA (Akhtar-Danesh & Landeen, 2007; Fuller-Thomson et al., 2020; Gupta et al., 2018; Law et al., 2012, 2018; Patten et al., 2015; Watterson et al., 2017). Demographic variables included province or territory of residence, age, sex (Male, Female), sexual orientation, racialized identity (White, Racialized), Indigenous identity (Indigenous, non-Indigenous), immigration status, highest level of education, marital status, home ownership, and total annual household income. Health and healthcare utilization variables included overall perceived health status, satisfaction with life, sense of belonging in local community, number of chronic conditions, insurance coverage for prescription medications, and having a regular healthcare provider. Details on included CCHS questions, variables, and derived categories for analysis are described in Supplementary materials Table S1.

Statistical Analysis

To account for the complex sampling design of the CCHS, we used Statistics Canada survey weights in our analysis to report findings representative of the Canadian population. We calculated weighted population proportions of the demographic, health, and healthcare utilization variables for the analytic sample and used compared differences among these variables between respondents who experienced CRNA and those who did not. As we pooled multiple cycles of the CCHS, the obtained estimates are time period estimates and should be interpreted as attributes of the average population covering the time period surveyed (Thomas & Wannell, 2009). We used logistic regression to estimate the unadjusted and adjusted odds ratio (OR) for the relationship between CRNA and moderate to severe depressive symptoms. Final selection of covariates in the adjusted models was based on theoretical and statistical significance. We then performed stratified analyses based on sex, racialized identity, and Indigeneity and reported the unadjusted and adjusted ORs. To test the sensitivity of our results, we repeated our analyses on a subgroup of our sample that reported filling at least one prescription in the previous year. Respondents with missing covariate data were excluded from multivariable regression analyses. All analyses were conducted using SAS Studio 9.4 (SAS Institute, Cary, North Carolina).

Ethics

This study was approved by the University of British Columbia Behavioural Research Ethics Board and Statistics Canada's Data Access Division.

Results

After excluding respondents who were not assessed from for CRNA or depressive symptoms, the final analytic sample consisted of 76,032 respondents. Among the study sample, 4.9% respondents experienced CRNA and 6.8% experienced moderate to severe depressive symptoms overall.

The characteristics of respondents who experienced CRNA and those who did not are summarized in Table 1. Respondents who experienced CRNA tended to be younger, earned less annually, and rented their home. They were also less likely to have excellent or very good perceived health and mental health or have prescription drug insurance. Additionally, respondents who experienced CRNA

Table 1 Characteristics and prevalence of cost-related nonadherence (CRNA) among a sample derived from the 2015, 2016, 2018, and 2019 annual components of the Canadian Community Health Survey

Variable	No. of respondents	Weighted proportion (%) without cost-related non-adherence	Weighted proportion (%) with cost-related non-adherence
Overall	80,593	95.1	4.9
Year			
2015	29,460	39.6	41.8
2016	25,652	32.3	30.6
2018	830	0.3	0.3
2019	20,090	27.8	27.3
Province or Territory			
Ontario	45,417	73.3	73.0
Manitoba	8,054	6.4	6.0
British Columbia	5,908	8.0	8.8
Nova Scotia	4,288	3.4	2.9
Saskatchewan	4,095	3.7	3.6
New Brunswick	2,907	2.6	3.3
Newfoundland and Labrador	2,873	1.9	1.7
Prince Edward Island	2,490	0.8	0.8
Age			
Less than 18	5,788	7.6	2.6
18 to 34	14,706	27.1	38.3
35 to 44	9,673	14.8	17.1
45 to 54	10,913	17.0	16.4
55 to 64	13,242	16.0	16.1
65 to 74	13,275	11.2	7.0
75 and older	8,435	6.3	2.5
Sex			
Male	34,651	49.4	38.2
Female	41,381	50.6	61.9
Sexuality			
Heterosexual	69,460	96.2	93.2
Gay or lesbian	838	1.4	2.1
Bisexual, pansexual, or questioning	1,773	2.4	4.7
Race			
White	61,962	70.6	64.0
Black	1,083	2.8	7.1
East Asian	1,948	5.4	4.0
South Asian	1,934	6.3	5.3
Southeast Asian	1,213	3.6	2.3
West Asian	285	01.0	1.6
Arab	382	1.0	2.5
Latin American	449	1.1	1.2
Multiracial or other	1,893	4.4	5.4
Indigenous (First Nations, Metis, Inuk/Inuit)	4094	3.8	6.7
Immigration status			
Landed immigrant or non-permanent resident	13,561	29.6	30.0
Non-immigrant (Canadian born)	61,847	70.4	70.0
Highest level of education			
Less than secondary school	15,311	16.5	13.9
Secondary school	16,942	22.5	25.3
Post-secondary certificate, diploma, or university degree	43,054	61.0	60.9
Marital status			
Married or common-law	39,488	58.2	49.0
Widowed, divorced, or separated	15,509	11.2	13.5

Table 1 (continued)

Variable	No. of respondents	Weighted proportion (%) without cost-related non-adherence	Weighted proportion (%) with cost-related non-adherence
Single, never married	20,927	30.6	37.5
Home Ownership			
Owned by member of household[a]	57,369	76.6	55.9
Rented[b]	17,924	23.4	44.1
Annual household income			
Less than $19,999	6,384	5.9	13.7
$20,000 to $39,999	13,269	12.9	23.6
$40,000 to $59,999	12,356	13.9	18.2
$60,000 to $79,999	10,607	14.0	14.8
$80,000 to $99,999	8,460	11.9	9.7
$100,000 to $149,999	13,401	20.5	11.8
More than $150,000	11,555	21.0	8.3
Overall perceived health			
Excellent	16,218	25.2	14.6
Very good	28,821	38.7	23.3
Good	21,131	26.8	36.4
Fair	7,217	7.1	17.0
Poor	2,564	2.2	8.7
Overall perceived mental health			
Excellent	24,330	34.2	22.6
Very good	28,080	36.7	26.8
Good	17,779	22.7	28.4
Fair	4,484	5.1	16.2
Poor	1,256	1.3	6.2
Satisfaction with life			
Very satisfied	32,102	42.6	23.2
Satisfied	37,394	51.1	57.6
Neither satisfied nor dissatisfied	3,834	4.1	11.1
Dissatisfied	1,790	1.8	6.6
Very dissatisfied	506	0.5	1.6
Belonging in local community			
Very weak	4,981	6.4	12.1
Somewhat weak	14,621	21.6	24.5
Somewhat strong	38,877	51.6	47.5
Very strong	16,785	20.4	16.0
Number of chronic health conditions[c]			
0	27,432	45.2	23.4
1	17,097	22.7	20.9
2	12,069	13.9	17.5
3	8,138	8.2	13.2
4+	11,296	10.0	24.9
Insurance coverage for part or all of prescription medication cost			
No	16,231	21.1	44.1
Yes	58,666	78.9	55.9
Type of insurance coverage			
Employer	38,086	57.0	32.6
Associate or Private	6,621	8.8	6.5
Government	13,027	13.0	16.8
None	16,231	21.3	44.2
Has a regular health care provider			
No	8,352	11.4	11.1
Yes	67,343	88.6	88.9

Table 1 (continued)

Variable	No. of respondents	Weighted proportion (%) without cost-related non-adherence	Weighted proportion (%) with cost-related non-adherence
Consulted a mental health provider in last 12 months			
No	63,513	86.0	66.9
Yes	11,638	14.0	33.1

[a]Includes respondents who reported living in a home owned by member of household, even if it was still being paid for

[b]Includes respondents who reported living in a home that was rented, even if no rent is paid by the respondent

[c]Includes respondents who reported having allergies, anxiety disorder, arthritis, asthma, back problems, cancer, chronic bronchitis, chronic fatigue syndrome, dementia, diabetes, fibromyalgia, heart disease, hyperlipidemia, hypertension, irritable bowel syndrome, migraine, mood disorder, multiple chemical sensitives, osteoporosis, scoliosis, sleep apnea, stomach ulcers, stroke, and urinary incontinence

Table 2 Unadjusted and adjusted odds of experiencing moderate to severe depressive symptoms between respondents who experienced cost-related non-adherence (CRNA) and respondents who did not among respondents to the 2015, 2016, 2018, and 2019 annual Canadian Community Health Survey

Cost-related non-adherence	Moderate to severe depressive symptoms			
	No. of respondents in analysis	Unadjusted OR (95% CI)	No. of respondents in analysis	Adjusted[a] OR (95% CI)
Yes	76,032	4.33 (4.31, 4.34)	68,388	1.51 (1.51, 1.52)
No		1.00		1.00

Abbreviations: CI = confidence interval; OR = odds ratio

[a]Adjusted for province or territory of residence, age, sex, sexual orientation, racialized identity, Indigenous identity, immigration status, highest level of education, marital status, home ownership, total annual household income, overall perceived health status, satisfaction with life, sense of belonging in local community, number of chronic conditions, insurance coverage for prescription medications, and having a regular healthcare provider

were more likely to have multiple chronic conditions and to have consulted a mental health provider in the preceding 12 months.

Of those who experienced CRNA, 21.9% reported moderate to severe depressive symptoms as compared to 6.1% of those who did not experience CRNA. Unadjusted and adjusted ORs for experiencing moderate to severe depressive symptoms are reported in Table 2. Respondents who experienced CRNA had 1.51 (95% confidence interval [CI], 1.51–1.52) greater odds of experiencing moderate to severe depressive symptoms compared to those who did not experience CRNA. The odds of moderate to severe depressive symptoms was similar (aOR 1.58; 95%CI, 1.58–1.59) among respondents who reported filling at least one prescription in the previous year (see Supplementary materials Table S2).

Unadjusted and adjusted ORs for experiencing moderate to severe depressive symptoms stratified by sex, race, and Indigeneity are reported in Table 3. When stratified by sex, female respondents were more likely to report CRNA (5.9% vs. 3.8%) as well as moderate to severe depressive symptoms (8.3% vs. 5.3%) compared to male respondents. Among female respondents, those who experienced CRNA had 1.45 (95% CI, 1.45–1.46) greater odds of experiencing moderate to severe depressive symptoms compare to those who did not experience CRNA; among male respondents,

those who experienced CRNA had 1.65 (95% CI, 1.63–1.66) greater odds of experiencing moderate to severe depressive symptoms. When stratified by race, racialized respondents were more likely to report CRNA (6.0% vs. 4.5%) and similar rates of moderate to severe depressive symptoms (6.9% vs. 6.6%) compared to white respondents. The adjusted ORs of experiencing moderate to severe depressive symptoms was 1.61 (95% CI, 1.60–1.62) among white respondents who experienced CRNA and 1.37 (95% CI, 1.36–1.38) among racialized respondents who experienced CRNA. When further stratified by race and sex, racialized male (4.9%) and female (7.1%) respondents were more likely to report CRNA comparted to white male (3.5%) and female (5.6%) respondents. White male (5.3%) and female (8.4%) respondents were slightly more likely to report moderate to severe depressive symptoms compared to their racialized male (5.2%) and female (8.0%) respondents. After controlling for confounding, the aOR of experiencing moderate to severe depressive symptoms among respondents who experienced CRNA was greatest among racialized male respondents (aOR 1.83; 95% CI, 1.81–1.85), followed by white female (aOR 1.62; 95% CI, 1.61–1.63), white male (aOR 1.59; 95% CI, 1.57–1.60), and racialized female (aOR 1.14; 95% CI, 1.13–1.16) respondents.

When stratified by Indigeneity, Indigenous respondents were more likely to report CRNA (8.4% vs. 4.8%)

Table 3 Unadjusted and adjusted odds experiencing moderate to severe depressive symptoms between respondents who experienced cost-related non-adherence (CRNA) and respondents who did not among respondents to the 2015, 2016, 2018, and 2019 annual Canadian Community Health Survey stratified by sex, race, and Indigeneity

Stratification of subgroups	Cost-related non-adherence	Moderate to severe depressive symptoms			
		No. of respondents in subgroup analysis	Unadjusted OR (95% CI)	No. of respondents in subgroup analysis	Adjusted OR[a] (95% CI)
Sex					
Male	Yes	34,651	4.48 (4.45, 4.50)	31,399	1.65 (1.63, 1.66)
	No		1.00		1.00
Female	Yes	41,381	4.00 (3.99, 4.02)	37,989	1.45 (1.45, 1.46)
	No		1.00		1.00
Race					
White	Yes	61,962	5.15 (5.12, 5.17)	57,526	1.61 (1.60, 1.62)
	No		1.00		1.00
Racialized	Yes	13,281	3.21 (3.19, 3.23)	11,862	1.37 (1.36, 1.38)
	No		1.00		1.00
Indigeneity					
Non-indigenous	Yes	71,149	4.44 (4.42, 4.46)	65,664	1.57 (1.56, 1.57)
	No		1.00		1.00
Indigenous	Yes	4,094	3.16 (3.12, 3.19)	3,724	1.11 (1.09, 1.13)
	No		1.00		1.00
Sex and race					
Male, white	Yes	28,126	5.32 (5.28, 5.35)	25,935	1.59 (1.57, 1.60)
	No		1.00		1.00
Male, racialized	Yes	6,168	3.40 (3.37, 3.44)	5,464	1.83 (1.81, 1.85)
	No		1.00		1.00
Female, white	Yes	33,836	4.74 (4.72, 4.77)	31,591	1.62 (1.61, 1.63)
	No		1.00		1.00
Female, racialized	Yes	7,113	2.94 (2.92, 2.96)	6,398	1.14 (1.13, 1.16)
	No		1.00		1.00
Sex and Indigeneity					
Male, non-indigenous	Yes	32,517	4.60 (4.57, 4.63)	29,798	1.65 (1.64, 1.66)
	No		1.00		1.00
Male, Indigenous	Yes	1,777	3.50 (3.42, 3.58)	1,601	2.16 (2.10, 2.22)
	No		1.00		1.00
Female, non-indigenous	Yes	38,632	4.12 (4.10, 4.14)	35,866	1.53 (1.52, 1.54)
	No		1.00		1.00
Female, Indigenous	Yes	2,317	2.65 (2.61, 2.69)	2,123	0.94 (0.92, 0.96)
	No		1.00		1.00

Abbreviations: CI = confidence interval; OR = odds ratio

[a]Adjusted for province or territory of residence, age, sex, sexual orientation, racialized identity, Indigenous identity, immigration status, highest level of education, marital status, home ownership, total annual household income, overall perceived health status, satisfaction with life, sense of belonging in local community, number of chronic conditions, insurance coverage for prescription medications, and having a regular healthcare provider

as well as moderate to severe depressive symptoms (13.9% vs. 6.5%) compared to non-indigenous respondents. The adjusted aORs of experiencing moderate to severe depressive symptoms was 1.11 (95% CI, 1.09–1.13) among Indigenous respondents who experienced CRNA and 1.57 (95% CI, 1.56–1.57) among non-indigenous respondents who experienced CRNA. When further stratified by Indigeneity and sex, Indigenous male (5.5%) and female (10.9%) respondents were more likely to report CRNA compared to non-indigenous male (3.8%) and female (5.8%) respondents. Non-indigenous male (5.1%) and female (7.9%) respondents were more likely to report moderate to severe depressive symptoms comparted to Indigenous male (9.4%) and female (18.0%) respondents. After controlling for confounding, the aOR of experiencing moderate to severe depressive symptoms among respondents who experienced CRNA was greatest among Indigenous male respondents (aOR 2.16; 95% CI, 2.10–2.22), followed by non-indigenous

male (aOR 1.65; 95% CI, 1.64–1.66), non-indigenous female (aOR 1.53; 95% CI, 1.52–1.54), and Indigenous female (aOR 0.94; 95% CI, 0.92–0.96) respondents.

Stratified analysis by sex, race, and Indigeneity among respondents who filled at least one prescription in the previous year similarly showed the association between CRNA and depressive symptoms was greatest for racialized (aOR 2.45, 95% CI: 2.41–2.48) and Indigenous (aOR 2.63, 95% CI: 2.55–2.71) males (see Supplementary materials Table S3).

Discussion

Our study examined the relationship between CRNA and symptoms of major depression among Canadian adults. Using multiple cycles of a nationally representative survey of the Canadian population, we demonstrated that Canadians who experienced CRNA were 51% more likely to experience moderate to severe depressive symptoms compared to those who did not experience CRNA. Moreover, the impact of CRNA on depression was most pronounced with racialized and Indigenous male respondents.

The prevalence of CRNA in our sample (4.9%) was slightly lower than previous Canadian population-based estimates ranging from 5.1 to 10.2%(Holbrook et al., 2021). Increased rates of CRNA among racialized respondents in our sample is consistent with previous Canadian studies (Law et al., 2012, 2018). Additionally, prevalence patterns of depressive symptoms across sex and race in our study align with previous research, including higher prevalence of depression among female respondents and variations in depression prevalence between racialized groups and white respondents related to other intersecting sociodemographic (e.g., household income, class, education) and cultural (e.g., community belonging) differences as well as experiences of racial discrimination (Bailey et al., 2019; Grigoriadis & Robinson, 2007; Wu et al., 2003). Our findings call to attention the complex role of intersecting marginalized identities, specifically sex, racialized identity, and Indigeneity, in mediating the effect of CRNA on mental health. The high prevalence of both CRNA (10.9%) and depression (18.0%) among female Indigenous respondents as well as exacerbated impacts of CRNA on mental health among racialized (aOR: 1.83, 95% CI: 1.81–1.85) and Indigenous (aOR: 2.16, 95% CI: 2.10–2.22) male respondents, point to the need to prioritize these groups in the development of future supports for medication affordability and mental health care.

It is important to note the complex relationship between depression and CRNA, as higher rates of more severe depressive symptoms may be a consequence of CRNA as well as contribute to it. Previous studies show depression

is an important factor contributing to CRNA (Alefan et al., 2022; Kang et al., 2018; Zhang et al., 2018), as common cognitions associated with depression (e.g., pessimism about the future, fatalism) may cause patients to question the value of treatment and increase the likelihood of forgoing medications, particularly when cost concerns are present (Piette et al., 2011). This may be particularly pronounced among racialized males and Indigenous male respondents for whom we found the highest associations between CRNA and depression. Moreover, income poverty and economic hardships have been shown to negatively affect mental health, which in turn may worsen individuals' economic outcomes by affecting how they think, work, invest, and consume (Heflin & Iceland, 2009; Ridley et al., 2020) as well as their capacity to engage in self-care activities, including adherence to pharmacological treatments and other health care interventions (Gonzalez et al., 2008).

Our results have implications for addressing the impacts of CRNA and depression in Canada. Specifically, it's important that healthcare providers discuss medication affordability with patients and factor this into their clinical decision making to minimize the impacts of CRNA (Piette et al., 2011; Tamblyn et al., 2014; Tang et al., 2014). Moreover, policy makers need to consider CRNA and other sociodemographic factors in Canada's public health response for promoting positive mental health, specifically the individual cost to patients for adhering to treatment, with particular focus on the impacts of proposed policies to reduce the effects of CRNA on the mental health and healthcare utilization of Canadians with historically marginalized identities (Public Health Agency of Canada, 2014). Ongoing research on these topics should assess the effectiveness of such interventions on medication adherence.

Strengths and limitations of our study warrant comment. Using four cycles of a nationally representative Canadian survey was a major strength of our study. As this was a cross-sectional study, we can only comment on the association between moderate to severe depressive symptoms and CRNA. It is important to note the potential role of social desirability response bias as the data were self-reported and both money/personal finance and mental health are stigmatized topics which may be downplayed. The use of the PHQ-9, a validated tool for assessing depression severity in primary care has been shown to be comparatively reliable when comparing sex and racial groups (Kroenke et al., 2001; Patel et al., 2019), added further strength to our analysis. Nonetheless, this measure is not a substitute for a comprehensive clinical assessment by a qualified healthcare provider. As the Depression module was optional content, this limited our sample size and ability to extrapolate our findings to jurisdictions not captured in our analysis. We also did not have information on respondents' specific

diagnoses or prescribed medications and were unable to make inferences on how and to what extent self-reported depressive symptoms were being managed.

It has been established that out-of-pocket spending on prescription medications can have a negative impact on access to care and disease management. Our nationally representative study of the Canadian population demonstrates that foregoing medication taking due to cost may further erode the mental health of Canadians. With growing emphasis on the importance of mental health on overall wellbeing, it is critical that policy makers consider the impact of pharmaceutical drug coverage in public health strategies for promoting positive mental health and tailor these strategies to Canadians many diverse and intersecting identities.

Declarations

Competing interests Dr. Law has consulted for Health Canada, the Hospital Employees' Union, and provided expert witness testimony for the Attorney General of Canada and the Federation of Post-secondary Educators. Dr. Brotto is the Executive Director for the Women's Health Research Institute. All other authors declare no competing interests.

References

Akhtar-Danesh, N., & Landeen, J. (2007). Relation between depression and sociodemographic factors. *Int J Ment Health Syst*, *1*(1), 4. https://doi.org/10.1186/1752-4458-1-4

Alefan, Q., Cheekireddy, V. M., & Blackburn, D. (2022). Cost-related nonadherence can be explained by a general nonadherence framework. *Journal of the American Pharmacists Association*, *62*(3), 658–673. https://doi.org/10.1016/j.japh.2022.01.011

Bailey, R. K., Mokonogho, J., & Kumar, A. (2019). Racial and ethnic differences in depression: Current perspectives. *Neuropsychiatric Disease and Treatment*, *15*, 603–609. https://doi.org/10.2147/NDT.S128584

Daw, J. R., & Morgan, S. G. (2012). Stitching the gaps in the Canadian public drug coverage patchwork? A review of provincial pharmacare policy changes from 2000 to 2010. *Health Policy*, *104*(1), 19–26. https://doi.org/10.1016/j.healthpol.2011.08.015

Demers, V., Melo, M., Jackevicius, C., Cox, J., Kalavrouziotis, D., Rinfret, S., & Pilote, L. (2008). Comparison of provincial prescription drug plans and the impact on patients' annual drug expenditures. *Cmaj*, *178*(4), 405–409. https://doi.org/10.1503/cmaj.070587

Dewa, C. S., Hoch, J. S., & Steele, L. (2005). Prescription drug benefits and Canada's uninsured. *International Journal of Law and Psychiatry*, *28*(5), 496–513. https://doi.org/10.1016/j.ijlp.2005.08.003

Diagnostic and statistical manual of mental disorders: DSM-5. (2013). Arlington, VA: American Psychiatric Association.

Fuller-Thomson, E., Lee, S., Cameron, R. E., Baiden, P., Agbeyaka, S., & Karamally, T. M. (2020). Aboriginal peoples in complete mental health: A nationally-representative Canadian portrait of resilience and flourishing. *Transcultural Psychiatry*, *57*(2), 250–262. https://doi.org/10.1177/1363461519885702

Gonzalez, J. S., Safren, S. A., Delahanty, L. M., Cagliero, E., Wexler, D. J., Meigs, J. B., & Grant, R. W. (2008). Symptoms of depression prospectively predict poorer self-care in patients with type 2 Diabetes. *Diabetic Medicine*, *25*(9), 1102–1107. https://doi.org/10.1111/j.1464-5491.2008.02535.x

Grigoriadis, S., & Robinson, G. E. (2007). Gender issues in depression. *Annals of Clinical Psychiatry*, *19*(4), 247–255. https://doi.org/10.1080/10401230701653294

Gupta, S., McColl, M. A., Guilcher, S. J., & Smith, K. (2018). Cost-related nonadherence to prescription medications in Canada: A scoping review. *Patient Preference and Adherence*, *12*, 1699–1715. https://doi.org/10.2147/PPA.S170417

Heflin, C. M., & Iceland, J. (2009). Poverty, material hardship, and Depression*. *Social Science Quarterly*, *90*(5), 1051–1071. https://doi.org/10.1111/j.1540-6237.2009.00645.x

Holbrook, A. M., Wang, M., Lee, M., Chen, Z., Garcia, M., Nguyen, L., & Law, M. R. (2021). Cost-related medication nonadherence in Canada: A systematic review of prevalence, predictors, and clinical impact. *Systematic Reviews*, *10*(1), 11. https://doi.org/10.1186/s13643-020-01558-5

Kang, H., Lobo, J. M., Kim, S., & Sohn, M. W. (2018). Cost-related medication non-adherence among U.S. adults with Diabetes. *Diabetes Research and Clinical Practice*, *143*, 24–33. https://doi.org/10.1016/j.diabres.2018.06.016

Kennedy, S. H., Lam, R. W., McIntyre, R. S., Tourjman, S. V., Bhat, V., Blier, P., & Group, C. D. W. (2016). Canadian Network for Mood and anxiety treatments (CANMAT) 2016 clinical guidelines for the management of adults with major depressive disorder: Sect. 3. Pharmacological treatments. *Canadian Journal of Psychiatry Revue canadienne de psychiatrie*, *61*(9), 540–560. https://doi.org/10.1177/0706743716659417

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Law, M. R., Cheng, L., Dhalla, I. A., Heard, D., & Morgan, S. G. (2012). The effect of cost on adherence to prescription medications in Canada. *Cmaj*, *184*(3), 297–302. https://doi.org/10.1503/cmaj.111270

Law, M. R., Cheng, L., Kolhatkar, A., Goldsmith, L. J., Morgan, S. G., Holbrook, A. M., & Dhalla, I. A. (2018). The consequences of patient charges for prescription Drugs in Canada: A cross-sectional survey. *CMAJ Open*, *6*(1), E63–e70. https://doi.org/10.9778/cmajo.20180008

Morgan, S. G., & Boothe, K. (2016). Universal prescription drug coverage in Canada: Long-promised yet undelivered. *Healthc Manage Forum*, *29*(6), 247–254. https://doi.org/10.1177/0840470416658907

National Health Expenditure Trends, 2019. Series G: Expenditure on drugs (2019). Retrieved from Ottawa: https://www.cihi.ca/en/national-health-expenditure-trends

Patel, J. S., Oh, Y., Rand, K. L., Wu, W., Cyders, M. A., Kroenke, K., & Stewart, J. C. (2019). Measurement invariance of the patient health questionnaire-9 (PHQ-9) depression screener in U.S. adults across sex, race/ethnicity, and education level: NHANES

2005–2016. *Depression and Anxiety*, *36*(9), 813–823. https://doi.org/10.1002/da.22940

Patten, S. B., Williams, J. V., Lavorato, D. H., Wang, J. L., McDonald, K., & Bulloch, A. G. (2015). Descriptive epidemiology of major depressive disorder in Canada in 2012. *Canadian Journal of Psychiatry*, *60*(1), 23–30. https://doi.org/10.1177/070674371506000106

Piette, J. D., Beard, A., Rosland, A. M., & McHorney, C. A. (2011). Beliefs that influence cost-related medication non-adherence among the haves and have nots with chronic Diseases. *Patient Preference and Adherence*, *5*, 389–396. https://doi.org/10.2147/PPA.S23111

Public Health Agency of Canada (2014). Mental health promotion: promoting mental health means promoting the best of ourselves. Retrieved from https://www.canada.ca/en/public-health/services/health-promotion/mental-health/mental-health-promotion.html

Ridley, M., Rao, G., Schilbach, F., & Patel, V. (2020). Poverty, depression, and anxiety: Causal evidence and mechanisms. *Science*, *370*(6522), https://doi.org/10.1126/science.aay0214

Statistics Canada (2020). Canadian Community Health Survey — Annual Component (CCHS). Retrieved from https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=1263799

Statistics Canada (2018). *Canadian Community Health Survey: Public Use Microdata File, 2015/2016* [Survey data]. Retrieved from: https://hdl.handle.net/11272.1/AB2/VXU9UQ

Tamblyn, R., Eguale, T., Huang, A., Winslade, N., & Doran, P. (2014). The incidence and determinants of primary nonadherence with prescribed medication in primary care: A cohort study. *Annals of Internal Medicine*, *160*(7), 441–450. https://doi.org/10.7326/m13-1705

Tang, K. L., Ghali, W. A., & Manns, B. J. (2014). Addressing cost-related barriers to prescription drug use in Canada. *Canadian Medical Association Journal*, *186*(4), 276–280. https://doi.org/10.1503/cmaj.121637

Thomas, S., & Wannell, B. (2009). Combining cycles of the Canadian Community Health Survey. *Health Reports*, *20*(1), 53–58.

Watterson, R. A., Williams, J. V., Lavorato, D. H., & Patten, S. B. (2017). Descriptive epidemiology of generalized anxiety disorder in Canada. *Canadian Journal of Psychiatry*, *62*(1), 24–29. https://doi.org/10.1177/0706743716645304

Wu, Z., Noh, S., Kaspar, V., & Schimmele, C. M. (2003). Race, ethnicity, and depression in Canadian society. *Journal of Health and Social Behavior*, *44*(3), 426–441.

Zhang, J. X., Bhaumik, D., Huang, E. S., & Meltzer, D. O. (2018). Change in insurance status and cost-related Medication non-adherence among older U.S. adults with Diabetes from 2010 to 2014. *J Health Med Econ*, *4*(2), https://doi.org/10.21767/2471-9927.100040

Zhong, H. (2007). Equity in Pharmaceutical utilization in Ontario: A cross-section and over Time Analysis. *Canadian Public Policy*, *33*(4), 487–507. https://doi.org/10.3138/cpp.33.4.487