

# The impact of provincial lockdown policies and COVID-19 case and mortality rates on anxiety in Canada

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**Aim:** COVID-19 has had significant mental health impacts internationally and anxiety rates are estimated to have tripled during the pandemic, but the specific causes remain underexplored. This study's purpose was to investigate the associations of sociodemographic factors, COVID-19-related policies, and COVID-19 case/mortality rates with levels of anxiety among Canadians during the pandemic.

**Methods:** This study used linear regression models populated with three integrated sources of data: a repeated cross-sectional survey ( $n = 7008$ ), Oxford COVID-19 Government Response Tracker data, and COVID-19 case/mortality rates. Sociodemographic factors included were age, gender, race, province, income, education, rurality, household composition, and factors related to employment.

**Results:** Local COVID-19 case and mortality rates and stay-at-home orders were positively associated with anxiety symptom severity. Anxiety was most severe among those

who: were female, Indigenous, or Middle Eastern; had post-secondary education; lived with others; and became unemployed or had working hours altered during the pandemic. Anxiety was less severe among: older adults; male, Caucasians, and black individuals; those with high incomes, and; those for whom employment did not change during the pandemic.

**Conclusion:** Anxiety was primarily driven by socioeconomic factors among Canadians during the COVID-19 pandemic. Policies that alleviate socioeconomic uncertainty for groups that are most vulnerable may reduce the long-term harm of the pandemic and associated lockdown policies.

**Keywords:** anxiety, anxiety disorders, COVID-19, SARS-CoV-2, policy making.

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Global rates of anxiety during the COVID-19 pandemic are estimated to have tripled,<sup>1</sup> but the specific causes of this increase in anxiety remain underexplored. The pandemic has strained healthcare systems and actions taken to limit its spread have resulted in temporary and permanent job loss,<sup>2</sup> bankruptcies,<sup>3</sup> school closures,<sup>4</sup> disruptions to healthcare delivery,<sup>5</sup> and significant restrictions on social gatherings.<sup>6</sup> Symptoms of anxiety during the pandemic have been linked to these factors as well as fear of infection,<sup>7</sup> socioeconomic uncertainty,<sup>8</sup> sociodemographic factors,<sup>9</sup> and inability to access social supports.<sup>10</sup> A recent international study found that experiencing physical symptoms that resemble COVID-19, which was associated with a need for health information, is a risk factor for adverse mental health outcomes.<sup>11</sup> The extent to which anxiety symptoms are exacerbated by fear of infection or by the downstream effects of restrictive policies meant to limit the spread of the virus remains unclear. Many studies have studied the moderating impact of government policies during COVID-19 on depressive symptoms – a systematic review and meta-analysis found more stringent policies to be associated with lower depression prevalence – but less is known about anxiety.<sup>12</sup> Elucidating the unique roles of policy, pandemic, and sociodemographic factors on anxiety could better equip governments to respond to public health crises while minimizing the mental health impacts of restrictive policies.

Much of the existing research about the effects of the COVID-19 pandemic on anxiety focusses on sociodemographic factors, with comparatively little work exploring the role of specific restrictive policies on anxiety. Some factors that have been found to contribute to

the level of psychological distress during the COVID-19 pandemic include gender (higher distress among women), socioeconomic status (higher distress among those with lower education and/or income), and household composition (higher distress among those living alone).<sup>9,13,14</sup> Understanding the causes of psychological distress is of particular importance, given its links to clinical outcomes such as suicidal behavior which are notoriously difficult for healthcare professionals to predict.<sup>15</sup>

This research draws from two existing frameworks: the social and economic determinants of mental health (SEDMH)<sup>16</sup> and the social identity disturbance, job uncertainty and psychological well-being model.<sup>17</sup> Key determinants of mental health include social inclusion, freedom from discrimination and violence (including physical security, self-determination and control of one's life), and economic participation,<sup>18</sup> COVID-19 policies (e.g., social distancing, business closures) may have limited social inclusion and economic participation, while the risk of COVID-19 infection threatened physical security. The social identity, uncertainty, and well-being model proposed by Godinic *et al.* (2020) complements the SEDMH while focusing on the role of economic uncertainty during COVID-19. Godinic *et al.* hypothesize that economic uncertainty brought on by the COVID-19 pandemic negatively impacted psychological well-being, and this positively correlates with job uncertainty and social identity disturbance (e.g., fear that financial hardships will cause one to lose status among their peers).

The purpose of this study is to identify the key policy, pandemic, and socioeconomic factors that are associated with higher levels of

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anxiety among Canadians during the COVID-19 pandemic. Based on our conceptual framework, we hypothesize that symptoms of anxiety will be higher among sociodemographic groups that are most vulnerable to social and economic exclusion and uncertainty (either in association with restrictive COVID-19 policies or factors existing prior to the pandemic) and groups who experienced the greatest COVID-19 exposure risk (e.g., due to high local mortality or infection rates).

## Methods

Data were obtained from the Centre for Addictions and Mental Health (CAMH) and Methodify by Delvinia (an automated research platform) study, *Examining the Impact of COVID-19 on Mental Health and Substance Use among Canadians*.<sup>19</sup> For this study, a unique set of approximately 1000 Canadians aged 18 and older were surveyed online at seven time points between May 2020 and March 2021, for a total of 7021 individuals sampled. Each data collection period lasted approximately 2 days. This sample was derived from a web-based panel and quota sampling by age, gender, and region was used to mirror the Canadian English-speaking population. The survey included demographic questions, as well as questions about COVID-19 related behaviors and the pandemic's impact on employment and finances, coping behaviors, and mental health symptoms. Informed consent was obtained electronically, and the study received ethics approval from CAMH. The data were collected at various points in time throughout the pandemic to enable an examination of changes in COVID-19-related stressors over time.

### Main outcome: symptoms of anxiety

The data used to represent the outcome variable (i.e., severity of anxiety symptoms) were survey respondents' GAD-7 (Generalized Anxiety Disorder) scores. The GAD-7 is a commonly used diagnostic tool used by clinicians to diagnose generalized anxiety disorder.<sup>20</sup> It includes seven items: feeling nervous, anxious or on edge; not being able to stop or control worrying; worrying too much about different things; trouble relaxing; being restless; becoming easily annoyed or irritable, and; feeling afraid as if something awful may happen. The patient indicates to what extent each symptom has impacted them in the prior 2 weeks: not at all (scored as 0), several days (scored as 1), more than half the days (scored as 2), or nearly every day (scored as 3). The resulting GAD-7 score ranges between 0–21 and scores of 10+ are generally recognized as clinically significant.<sup>20,21</sup> The CAMH survey included the seven questions used to diagnose Generalized Anxiety Disorder. Respondents' answers to these questions were tallied to create the GAD-7 score, which was coded as a continuous variable, and square root transformed to account for right skewness. The square root transformation improved the goodness of fit of the model (adjusted  $R^2 = 0.144$  transformed *versus* 0.129 untransformed) and resulted in a closer to normal distribution of residuals, more so than other transformations (e.g., logarithmic). Using this transformed GAD-7 score, the range of values shrinks from 1 to 21, to  $\sqrt{1}$  to  $\sqrt{21}$  (i.e., 1 to 4.58).

### Main independent variables: provincial COVID-19 policies and case/mortality rates

Three independent variables were of interest for this study: COVID-19 policy, COVID-19 case rates, and COVID-19 mortality rates. Since these variables are causally related to each other, three separate models were run, each controlling for the same sociodemographic factors.

Policy data were also obtained from the Oxford COVID-19 Government Response Tracker (OxCGRT),<sup>22,23</sup> which records international data representing national and provincial-level government responses to COVID-19. The publicly accessible OxCGRT dataset captures data from more than 180 countries starting 1 January 2020. These data are continually expanding and a team of more than 400 volunteers affiliated with Oxford University and its partners have collected and coded the data in real time.<sup>23</sup> The OxCGRT contains

19 indicators of government response, including policies related to containment and the closure of facilities or spaces (e.g., school closures, workplace closing, cancellation of public events, restriction on gatherings, public transportation, stay-at-home orders, restrictions on internal movement, and international travel controls), economic support (income support, debt/contract relief for households (e.g., stopping loan repayments, banning evictions), and fiscal measures), and health (public information campaigns, testing policy, contact tracing, investment in vaccines, emergency investment in healthcare, facial coverings, and vaccination policy). Indicators are reported in monotonic ordinal scales, representing the stringency or degree of each policy response. The dataset also contains four composite indices that combine scores across the four domains listed above and indicators for geographic scope for some policies.<sup>23</sup>

Policy data corresponding to the first dates of each of the seven periods of survey data collection were extracted. The policies included in the analysis were: school closures, workplace closing, cancellation of public events, restricted gatherings, stay-at-home orders, restricted internal travel, and debt/contract relief for households. Income support was not included since this value was uniform across provinces due to federal supports, and the remaining OxCGRT policies were excluded as they were not deemed relevant to anxiety, the Canadian context, or the time of data collection. These policies were tested for multicollinearity using variance inflation factors and were found not to be collinear with each other or with the other variables included in the policy model.

Two additional models included COVID-19 case ("Case Rate Model") and mortality ("Mortality Model") rate data, as reported by provincial health ministries. COVID-19 case rate data was calculated by province and CAMH survey data collection period. For each survey data collection period, the means of daily new cases and deaths for the 7 days prior to the initiation of data collection were calculated.

**Table 1.** Sample characteristics

Variable	n (%)
Age	
18–29	857 (12.2)
30–39	1872 (26.7)
40–49	998 (14.2)
50–59	1146 (16.4)
60–69	1299 (18.5)
70+	836 (11.9)
Gender	
Male	3477 (49.6)
Female	3478 (49.6)
Missing	53 (0.8)
Education	
High school (HS)	813 (11.6)
Some post-HS	1069 (15.3)
College	1395 (19.9)
University	3671 (52.4)
Missing	60 (0.9)
Race	
White	4862 (69.4)
Asian	1317 (18.8)
Black	138 (2.0)
Indigenous	91 (1.3)
Latin American	65 (0.9)
Middle Eastern	95 (1.4)
Mixed Heritage	109 (1.6)
Missing	331 (4.7)

**Table 2.** Regression results. Response variable is square rooted GAD-7 score

Variable	Model		
	Policy	Case rate	Mortality
Intercept	2.36*** (0.19)	2.30*** (0.12)	2.30*** (0.12)
<b>Policy</b>			
Restricted Internal Travel (ref: less stringent)			
More stringent	-0.06 (0.04)		
Stay-at-home Order (ref: less stringent)			
More stringent	0.07** (0.03)		
Restricted Gatherings (ref: less stringent)			
More stringent	0.06 (0.10)		
Public Events Canceled (ref: less stringent)			
More stringent	0.05 (0.05)		
Business Closures (ref: less stringent)			
More stringent	-0.04 (0.09)		
School Closures (ref: less stringent)			
More stringent	-0.06 (0.06)		
Debt/contract Relief (ref: less generous)			
More generous	-0.02 (0.06)		
COVID-19 case rates			
Across time (log transformed)		0.06*** (0.01)	
Across provinces		0.01 (0.00)	
COVID-19 mortality			
Across time			0.25** (0.10)
Employment			
Employment during pandemic (ref: laid off)			
Changes	-0.24*** (0.07)	-0.24*** (0.07)	-0.24*** (0.07)
No changes	-0.49*** (0.06)	-0.50*** (0.06)	-0.49*** (0.06)
Hours during pandemic (ref: same)			
Increased	0.43*** (0.05)	0.43*** (0.05)	0.44*** (0.05)
Decreased	0.39*** (0.05)	0.39*** (0.05)	0.39*** (0.05)
Not employed	0.26*** (0.05)	0.27*** (0.05)	0.25*** (0.05)
Income (ref: <\$40 000)			
\$40-79k	-0.14*** (0.05)	-0.14*** (0.05)	-0.14*** (0.05)
\$80-119k	-0.26*** (0.05)	-0.26*** (0.05)	-0.26*** (0.05)
\$120k+	-0.38*** (0.06)	-0.39*** (0.06)	-0.39*** (0.06)
Demographics			
Ethnicity (ref: White)			
Asian	0.04 (0.04)	0.04 (0.04)	0.04 (0.04)
Black	-0.23** (0.11)	-0.23** (0.11)	-0.23** (0.11)
Indigenous	0.37*** (0.13)	0.37*** (0.13)	0.38*** (0.13)
Latin American	0.10 (0.15)	0.10 (0.15)	0.11 (0.15)
Middle Eastern	0.27** (0.13)	0.27** (0.13)	0.28** (0.13)
Mixed Heritage	0.14(0.12)	0.14 (0.12)	0.14 (0.12)
Gender (ref: male)			
Female	0.32*** (0.03)	0.32*** (0.03)	0.32*** (0.03)
Household (ref: alone)			
With others	0.11** (0.05)	0.12** (0.05)	0.12** (0.05)
Children (ref: children)			
No children	-0.10** (0.04)	-0.10** (0.04)	-0.09** (0.04)
Education (ref: high school)			
Some post-HS	0.22*** (0.06)	0.22*** (0.06)	0.22*** (0.06)
College	0.20*** (0.06)	0.20*** (0.06)	0.20*** (0.06)
University	0.15*** (0.05)	0.15*** (0.05)	0.15*** (0.05)
Marital status (ref: partner)			
No partner	0.05 (0.04)	0.05 (0.04)	0.05 (0.04)
Rurality (ref: urban)			
Suburban	-0.05 (0.03)	-0.05 (0.03)	-0.05 (0.03)
Rural	-0.09* (0.05)	-0.08* (0.05)	-0.09 (0.05)

**Table 2.** (Continued)

Variable	Model		
	Policy	Case rate	Mortality
Age (ref: 18–29)			
30–39	–0.09 (0.05)	–0.09* (0.05)	–0.08 (0.05)
40–49	–0.22*** (0.06)	–0.22*** (0.06)	–0.22*** (0.06)
50–59	–0.37*** (0.06)	–0.37*** (0.06)	–0.37*** (0.06)
60–69	–0.70*** (0.06)	–0.70*** (0.06)	–0.69*** (0.06)
70+	–0.97*** (0.07)	–0.98*** (0.07)	–0.97*** (0.07)
Model details			
$R^2/R^2$ adjusted	0.146 / 0.142	0.146 / 0.143	0.145 / 0.142
Residual standard error	1.266	1.265	1.266
Degrees of freedom	6972	6977	6978
Observations	7008	7008	7008

Format: Coefficient<sup>significance</sup> (standard error). Significance codes: ‘\*\*\*’ 0.01 ‘\*\*’ 0.05 ‘\*’ 0.1.

These values were then adjusted for the provincial or federal population (average new cases per day per 100 000).

The COVID-19 case rate data were divided into their time-variant and province-variant characteristics. To create the time-variant case rate variable, means were taken for each of the seven survey waves. To create the province-variant case rate variable, differences between the survey wave mean and the province of each participant were taken. A logarithmic transformation was conducted on the time-variant variable, as the data were skewed, and the transformation improved the goodness of fit of the model. Only the time-variant component (i.e., federal level mortality rates per survey wave) of mortality data was included in the model, since many provinces recorded zero COVID-19 deaths in the relevant time periods.

### Covariates

Other data collected in the CAMH surveys were included as covariates. This included age, ethnicity, gender, household composition, children under 18, marital/partner status, education, income, and rurality. Survey respondents also reported the impact of the COVID-19 pandemic on their employment, including whether they were laid off or experienced a change to their work location or hours. This data was also included to control for work-related effects of the pandemic. Missing covariate data were imputed using multivariate imputation by chained equations.<sup>24</sup>

### Analysis

All data were imported into R<sup>25</sup> for analysis. Since the response variable was continuous, we used linear regression models. The case rate model was rerun with age category (18–29, 30–39, 40–49, 50–59, 60–69, 70+) included as an interaction term with all other variables, so that differences in variable effects between age groups could be estimated. The use of interaction terms is a commonly used technique in applied research that investigates the multiplicative effect of two explanatory variables on an outcome variable.<sup>26</sup>

In addition to these models, logistic and mixed effects models were run to test for robustness of the original model and to explore differences in estimates between the models. The mixed effects model included time (i.e., survey waves) as a random effect, but its effect size was very minor indicating that the passage of time was not in itself a strong predictor of anxiety levels. The logistic regression model split the outcome variable into clinically significant symptoms (GAD-7 score of 10+) and clinically insignificant symptoms (GAD-7 < 10).

### Diagnostics

The models were tested for autocorrelation, influential observations, multicollinearity, homoscedasticity, normality of errors, and omitted variable bias. The models performed well in all tests, but some kurtosis was detected.

### Results

The sample included 7008 individuals, of whom 1519 (21.7%) reported clinically significant symptoms of generalized anxiety disorder (GAD-7 score of 10+). A large proportion of respondents were white (69.4%) and held a university degree (52.4%) (Table 1).

Higher provincial *per capita* rates of COVID-19 cases and deaths were associated with significantly higher rates of anxiety. Additionally, the effect of case rates on anxiety was present both across time ( $\beta = 0.06$ ,  $P < 0.01$ ), but not across provinces ( $\beta = 0.01$ ,  $P > 0.1$ ) (Table 2). Given that the case rate across time variable was log-transformed, the coefficient 0.06 can be interpreted as a 0.06 increase on the square-root transformed GAD-7 scale for every doubling (i.e., 100% increase) of case rates. The effect of case rates was most pronounced among those aged 18–29 ( $\beta = 0.15$ ,  $P < 0.01$ ), and to a lesser extent among those aged 50–59 ( $\beta = 0.07$ ,  $P < 0.05$ ) and 70+ ( $\beta = 0.09$ ,  $P < 0.05$ ) (Table 3).

Only one policy variable was significant: the stringency of stay-at-home orders ( $\beta = 0.07$ ,  $P < 0.05$ ) – more stringent stay-at-home policies were associated with higher levels of anxiety.

The factors that were most associated with anxiety during COVID-19 in all models were age, gender, income, changes to employment or work hours, education, and race. Predicted anxiety severity decreased as age increased, with the largest difference in GAD-7 score between those aged 18–29 and those aged 70+. The severity of anxiety for women was higher than that for men for all age groups, but most pronounced for those aged 60–69, according to the model with age interaction terms (Table 3). Higher income was significantly correlated with lower anxiety, particularly for those aged 40–69. Those who experienced changes to employment reported lower anxiety than those who were laid off during the pandemic, especially for those aged 60–69 ( $\beta = -0.44$ ,  $P < 0.01$ ). Those whose employment status was not impacted reported lower anxiety than those who were laid off. Both increases and decreases to working hours (among those who were employed) were associated with increased anxiety compared to those whose working hours did not change. Higher education was associated with higher anxiety. Compared to those with only high school education, individuals with some

**Table 3.** Regression results for case rate model with age interaction terms. Response variable is square rooted GAD-7 score

Variable	By age group					
	18–29	30–39	40–49	50–59	60–69	70+
Intercept	2.02*** (0.12)					
COVID-19 case rate						
Within survey waves	–0.01 (0.02)	0.01* (0.01)	–0.00 (0.01)	–0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Between survey waves (log transformed)	0.15*** (0.05)	0.04 (0.03)	0.02 (0.04)	0.07* (0.04)	0.04 (0.03)	0.09** (0.04)
Employment						
Employment during pandemic (ref: laid off)						
Changes	0.07 (0.16)	–0.08 (0.12)	–0.12 (0.16)	–0.27* (0.14)	–0.44*** (0.17)	0.11 (0.31)
No changes	–0.35** (0.14)	–0.24** (0.11)	–0.38*** (0.14)	–0.63*** (0.12)	–0.61*** (0.12)	–0.53*** (0.20)
Hours during pandemic (ref: same)						
Increased	0.39*** (0.13)	0.41*** (0.08)	0.61*** (0.11)	0.43*** (0.11)	0.14 (0.16)	0.09 (0.44)
Decreased	0.42*** (0.12)	0.48*** (0.09)	0.45*** (0.11)	0.30** (0.12)	0.32** (0.13)	0.15 (0.23)
Not employed	0.47*** (0.14)	0.44*** (0.11)	0.41*** (0.13)	0.29*** (0.11)	0.15 (0.10)	0.08 (0.15)
Income (ref: <\$40 000)						
\$40 000–\$79 000	–0.15 (0.12)	0.07 (0.11)	–0.36*** (0.14)	–0.22* (0.13)	–0.27** (0.11)	0.04 (0.13)
\$80 000–\$119 000	–0.18 (0.14)	–0.16 (0.11)	–0.45*** (0.14)	–0.37*** (0.13)	–0.38*** (0.12)	–0.18 (0.15)
\$120 000+	–0.27* (0.14)	–0.25** (0.11)	–0.62*** (0.15)	–0.56*** (0.14)	–0.39*** (0.13)	–0.29* (0.16)
Demographics						
Ethnicity (ref: White)						
Asian	–0.05 (0.10)	0.06 (0.07)	–0.09 (0.10)	0.18* (0.11)	–0.00 (0.14)	0.13 (0.19)
Black	–0.37 (0.24)	–0.3** (0.165)	0.23 (0.24)	–0.22 (0.33)	–0.63 (0.52)	–0.39 (0.64)
Indigenous	0.65* (0.38)	0.33 (0.24)	0.17 (0.31)	0.39 (0.29)	0.38 (0.33)	0.04 (0.66)
Latin American	-	-	-	-	-	-
Middle Eastern	0.20 (0.28)	0.44** (0.21)	0.16 (0.29)	–0.30 (0.43)	–0.70 (0.74)	1.06* (0.64)
Mixed Heritage	–0.12 (0.25)	0.00 (0.21)	0.28 (0.30)	0.63** (0.29)	–0.28 (0.40)	1.22 (0.91)
Gender (ref: male)						
Female	0.40*** (0.09)	0.29*** (0.06)	0.21** (0.08)	0.35*** (0.08)	0.47*** (0.07)	0.23** (0.09)
Household (ref: alone)						
With others	–0.05 (0.12)	–0.03 (0.09)	0.33*** (0.13)	0.20* (0.12)	0.14 (0.12)	0.05 (0.17)
Children (ref: children)						
No children	0.13 (0.11)	–0.11* (0.07)	–0.07 (0.09)	–0.17* (0.09)	–0.39*** (0.15)	–0.63** (0.26)
Education (ref: high school)						
Some post-HS	–0.01 (0.16)	0.30** (0.14)	0.38** (0.18)	0.37*** (0.14)	0.20* (0.12)	0.08 (0.14)
College	0.29* (0.17)	0.21* (0.12)	0.13 (0.16)	0.27** (0.13)	0.20* (0.12)	0.19 (0.15)
University	–0.00 (0.15)	0.24** (0.11)	0.13 (0.15)	0.20* (0.12)	0.12 (0.11)	0.16 (0.13)
Marital (ref: partner)						
No partner	0.03 (0.10)	–0.04 (0.08)	0.19* (0.11)	0.07 (0.10)	0.06 (0.11)	–0.06 (0.17)
Rurality (ref: urban)						
Suburban	–0.01 (0.07)	–0.13* (0.07)	–0.14 (0.09)	–0.05 (0.09)	0.06 (0.08)	0.06 (0.10)
Rural	–0.22 (0.16)	–0.14 (0.10)	–0.14 (0.12)	–0.16 (0.11)	0.10 (0.10)	–0.03 (0.12)
Model details						
R <sup>2</sup> /Adjusted R <sup>2</sup>	0.162/0.144					
Residual standard error	1.264					
Degrees of freedom	6792					
Observations	6988					

Format: Coefficient <sup>significance</sup> (standard error). Significance codes: ‘\*\*\*’ 0.01 ‘\*\*’ 0.05 ‘\*’ 0.1.

post-secondary education reported the greatest relative anxiety, and this difference was most pronounced in those aged 40–59. Higher severity of anxiety was reported among indigenous and middle

eastern individuals, compared to whites, and less severity was reported by blacks. Those who lived with others were more anxious, especially those aged 40–49 ( $\beta = 0.33, P < 0.01$ ). Those living



without children under the age of 18 reported slightly lower anxiety symptoms than those living with children, and those aged 60–69 reported the lowest anxiety levels relative to other age groups ( $\beta = -0.63$ ,  $P < 0.05$ ). Not having a long-term partner was associated with higher anxiety among those aged 40–49 ( $\beta = 0.19$ ,  $P < 0.10$ ). Those living in rural areas were slightly less anxious than their urban counterparts. See Tables 2 and 3 for full results.

## Discussion

Our findings suggest that sociodemographic and employment related factors are associated with higher anxiety symptom severity during the COVID-19 pandemic. Local rates of COVID-19 infection and mortality are also associated with greater severity. Only one COVID-19 policy had a significant association with anxiety (stay-at-home orders).

To our knowledge there have been few, if any, other studies that have directly analyzed the relationship between anxiety and provincial policies and COVID-19 case and mortality rates. It is noteworthy that sociodemographic and employment factors seemed no less, and sometimes more, important in explaining anxiety levels than any of the COVID-19-specific variables included in the models.

Our results showed significance among all employment-related factors, including income, changes to employment location, and changes to working hours, which is consistent with our conceptual framework. Higher incomes were associated with lower anxiety, which aligns with the idea that increased financial means enables easier adaptation during an economic shock (e.g., ability to temporarily rely on savings, or to relocate to a larger living space), and that higher-paying management positions are associated with less COVID-19 exposure risk than lower-paying work.<sup>27</sup> Both increases and decreases to working hours were associated with higher anxiety compared to those whose hours remained the same. Working additional hours may have been associated with increased COVID-19 exposure risk for those in frontline essential services, thus resulting in increased fear of infection.

Other socioeconomic factors that were associated with increased anxiety during the COVID-19 pandemic were race, gender, household composition, and education. Indigenous and Middle Eastern individuals reported the highest anxiety, while black and Caucasian individuals reported the lowest. However, given existing research that shows that black communities experience disproportionately higher COVID-19 case rates and deaths<sup>28,29</sup> and that racially motivated attacks against Asians have increased during the pandemic,<sup>30</sup> it is surprising that neither of these groups reported significantly higher anxiety relative to other racial groups. It does align with findings from a study that compared the mental health of Iranians and Chinese during COVID-19, and found Iranians reported higher anxiety than Chinese.<sup>31</sup> These differences were attributed mainly to differences in access to healthcare services and government responses to the pandemic, but our study was conducted in Canada where Middle Eastern and Asian individuals were subject to the same policies. The authors suggest that religion may play a role in how some respond to the pandemic as the Islamic faith encourages endurance of hardship and resolution of stress, explaining why in Iran physical symptoms and contact history did not correlate with psychological impact.<sup>31</sup> This warrants further research.

Gender-related findings were consistent with existing literature that shows that women tend to report higher anxiety than men.<sup>32</sup> Our finding related to education indicated higher anxiety among those with higher education during the pandemic, contrary to other research that has shown the opposite.<sup>1</sup> One reason for this may be that many of the workers responsible for the pandemic response held post-secondary degrees, however more research is needed.

These findings are largely consistent with existing literature about differences in mental health impacts of the COVID-19 pandemic, especially those related to gender, income, and employment status.<sup>1</sup> Findings related to age, race, and education were less

consistent. While it may be expected that older individuals, who are at greatest risk of adverse COVID-19-related health outcomes, would also be the most anxious during the pandemic, a few studies have found the opposite to be the case. For example, Gambin *et al.*<sup>10</sup> found that young people (age 18–44) were more likely to experience both anxiety and depressive symptoms than their older counterparts (age 45–85).

These findings have important policy implications. Given that socioeconomic factors were the most correlated with high anxiety during the COVID-19 pandemic, policymakers could consider implementing targeted measures that address the stressors experienced by the most affected groups. This may include initiatives that improve conditions for women, such as providing publicly funded childcare (as childcare responsibilities are disproportionately taken on by women) and implementing policies that protect job security. More robust income supports may reduce anxieties for lower income individuals. Given the high rates of anxiety among younger adults, policymakers may consider policies that reduce stress during this phase of life, such as making postsecondary education and housing more accessible and affordable.

## Limitations

These results may lack generalizability to non-Canadian populations, as well as populations that lack internet access or were under the age of 18, as these groups were not represented in our sample. Another limitation to this research is the inability to control for pre-pandemic rates of anxiety among Canadians. This research cannot separate anxiety-inducing factors unique to the pandemic from pre-existing differences in rates of anxiety in the population. A further limitation is the potential endogeneity in the model caused by including both COVID-19 rates and COVID-19 policies as explanatory variables. Endogeneity could arise in the models due to missing variables (e.g., unobservable characteristics such as levels of uncertainty) or a relationship between the outcome variable and a key explanatory variable. A further limitation is a lack of accounting in the model for the duration of policies, that is, whether at the time of survey data collection a policy had just been implemented or had been in place for some time such that individuals may have had time to adapt. We did find however that a mixed effects model with time-based random effects did not improve the model, suggesting that the duration of the pandemic, and related policies, was likely not a significant factor in predicting anxiety levels.

## Conclusion

This study showed that sociodemographic and employment-related factors were significantly correlated with elevated anxiety symptom severity among Canadians during the COVID-19 pandemic. This suggests that some groups, especially young people, those with low incomes, women, Indigenous people, and those living with children, may be more vulnerable to the COVID-19 pandemic and associated policies adopted. It would be advisable for policy makers to consider the needs of groups most vulnerable to the negative mental health impacts of socioeconomic uncertainty and hardship, particularly during adverse circumstances like a global pandemic. This may include targeted policies that protect groups that are most vulnerable to adverse COVID-19-related health events, while causing minimal disruptions to the lives of those most vulnerable to adverse mental health outcomes.

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## Disclosure statement

The authors declare no conflict of interest.

### Author contributions

DP, PP, and PC contributed to the conception and design of the study and reviewing and editing of the manuscript. DP and PP contributed to the analysis of data. DP acquired the data and drafted the manuscript.

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