

The prevalence rate and demographic correlates of perceived stress in Alberta during the COVID-19 pandemic: A one-week cross-sectional study

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Abstract

Background

Coronavirus Disease 2019 (COVID-19) continues to have an unprecedented global effect on health and daily life, with many countries struggling to adapt to the adverse pandemic impact. While strict public health measures are necessary to slow the virus' spread, these measures may adversely affect individual mental health and wellbeing. Texting-based programs offer organizations a feasible and cost-effective option to deliver mental health supports and to collect population-level data. This study reports on the prevalence rate and demographic correlates of perceived stress on the one-week data obtained from Text4Hope enrollees during the COVID-19 pandemic.

Methods

This was a cross-sectional study that used the Perceived Stress Scale to determine the one-week prevalence for perceived stress in Alberta. Univariate and binomial logistic regression analysis were used to determine the demographic correlates (i.e., gender, age, ethnicity, educational attainment, employment status, relationship status, and housing status) of moderate/high perceived stress.

Results

One week after the program launch, 32,805 individuals were enrolled. 6,041 enrollees completed the baseline survey (18.4% response rate). 84.7% of respondents reported moderate/high stress. All demographic variables, except ethnicity, were significantly associated with moderate/high stress ($p < 0.001$). Females were 1.5 times more likely to report moderate/high stress (95% CI = 1.2–1.9) than males. Compared to respondents in the 26–40 years, 41–60 years, and > 60 years of age categories, those ≤ 25 years of age were 1.9 (95% CI = 1.1–3.4), 3.4 (95% CI = 1.9–6.3), and 5.3 (95% CI = 2.8–10.0) times more likely to report moderate/high stress, respectively. Unemployed individuals were 2.5 times more likely to report moderate/high stress (95% CI = 1.8–3.6) than employed individuals. Retirees were 1.6 times less likely to report moderate/high stress (95% CI = 1.1–2.2) than employed respondents. Respondents renting a home were 1.7 times more likely to report moderate/high stress (95% CI = 1.3–2.1) than home owners.

Conclusion

Prevalence rate for perceived stress during the COVID-19 pandemic is very high in Alberta, signaling detrimental pandemic impacts on mental health. Our demographic correlates of perceived stress align with research results from other jurisdictions.

Trail registration:

The study was approved by the University of Alberta Human Research Ethics Board (Pro00086163).

Background

Coronavirus Disease 2019 (COVID-19) is an acute respiratory disease with severe cases resulting in potential death due to massive alveolar damage and progressive respiratory failure.¹⁻² The first case of the virus was reported in Wuhan, China in December 2019 and has spread globally. The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020,³ and the virus continues to have unprecedented global impact on health and daily life, with many countries globally struggling to adapt to the adverse pandemic impact.

In early April 2020, Canada confirmed nearly 20,000 cases.⁴ As COVID-19 spreads, Canadians continue to experience severe economic and societal impacts. Unemployment reached 7.8% in March 2020 with an unprecedented 3.18 million Canadians applying for Federal jobless benefits and emergency income aid.^{5,6} Closing of schools, small and large businesses, and the effect of self-isolation or self-quarantine impose increasing population challenges. The implementation of physical distancing as a public health measure has resulted in unavoidable increase in relative social isolation on a national scale.⁷

The implementation of public health measures are necessary to slow the spread of COVID-19 and to “flatten the curve” of infection and death rates.⁸ Undoubtedly, these measures will have short- and long-term adverse consequences on the mental wellbeing of individuals. In a recent Canadian survey, the Mental Health Index dropped 12 points to 63, a score typically seen when people experience major life disruptions and mental health risks.⁹ A survey recently completed in China during January 31 to February 2, 2020, also indicated adverse psychological impact of the virus.¹⁰ Over half of respondents rated the psychological impact of COVID-19 as moderate or severe, with 29%, 17%, and 8%, respectively, reporting significant anxiety, depressive, and stress symptoms. This year, Nelson and colleagues reported that mental health symptoms for depression, anxiety, and stress were elevated across adults living in predominately English speaking countries.¹¹ They found that mental health symptoms were associated with loss of employment and being concerned about COVID-19. Another early pandemic response study examining stress levels of individuals in different countries around the world from March 17 to April 1, 2020, found that on average, individuals reported being moderately stressed.¹² Factors associated with significantly higher scores included identifying as female, young age, being a student, expressing concerns about virus contraction, and feeling susceptible to the coronavirus. Additionally, healthcare workers have reported more severe levels of anxiety, depression, insomnia, and somatization symptomologies during the COVID-19 pandemic.¹³⁻¹⁵

The mental health effects to date from the COVID-19 pandemic appear to resemble those observed in other large-scale disasters. As such, using evidence from large-scale disaster research may help further

our understanding of the mental health impact of the virus. Large-scale disasters are often accompanied by increases in depression, post-traumatic stress disorder (PTSD), substance-use disorder, a broad range of other mental and behavioural disorders, domestic violence, and child abuse.¹⁶ These psychological impacts are often immediate and long-term. Based on interviews of residents affected by Hurricane Ike in 2008, two to five months after the event, 6% and 5% met the criteria for PTSD and major depressive disorder, respectively.¹⁷ Similarly, 8% of New Yorkers showed signs of PTSD and approximately 10% displayed symptoms of depression in the month following the 9/11 terrorist attacks.¹⁸ Patients and clinicians during the Severe Acute Respiratory Syndrome (SARS) pandemic had reported significantly higher stress, depression, anxiety, and PTSD symptoms compared to controls, which were evident a year later.¹⁹

The natural disaster literature also provides information on risk factors that contribute to developing psychological conditions after a major incident. Risk factors can include the degree of exposure,²⁰⁻²⁴ gender,^{10,25-28} social stressors such as unemployment status²⁵ or low socioeconomic status,²⁶ and pre-existing physical and mental health conditions.^{10,26,29,30} Early evidence from China revealed that healthcare workers exhibited significant symptoms of depression, with close to half of individuals experiencing significant anxiety symptoms and one-third experiencing sleep-related issues.³¹ Correlates of symptomatology were related to exposure (e.g., working in Wuhan and working on the front line) and demographic factors, such as gender and occupation (i.e., identifying as female and being a nurse, respectively). Taken together, COVID-19 will likely have significant detrimental effects on mental wellness in the general population and may be more pronounced in certain groups (e.g., identifying as female, being socially stressed, being a frontline worker, or having a pre-existing mental disorder).

The Government of Alberta (GOA) released COVID-19 modelling on April 8, 2020.³² In three scenarios ranging from the probable, elevated, and extreme spread of the virus, Alberta is expecting between 800,000 to 1.6 million cases and 400 to 32,000 deaths in probable and extreme scenarios, respectively. Recent hospitalization and intensive care unit data released from the GOA on April 28, 2020, suggest that social distancing and other public health measures implemented by the province have had a positive impact of flattening the curve with current numbers being far lower than expected.³³

To maintain the province's positive momentum, mental health services can be provided to Albertans during the COVID-19 pandemic through mobile-based interventions. These interventions can be implemented quickly, are simple for people to join, cost-effective, and accessible. Texting-based programs are especially promising given that the vast majority of Canadians own a smartphone³⁴ and text-messaging is often free or low-cost to end-users, does not require technical skill for use, and does not require expensive data plans. This intervention option is also cost-effective to providers, costing pennies per message to deliver.

Several randomized control studies (RCTs) have demonstrated effectiveness of supportive text messages in reducing depressive symptoms, increasing abstinence duration in alcohol use disorder, and promoting

high user satisfaction. In two RCTs, patients with depression showed reduced symptoms on standardized self-report compared to patients not receiving messages (with large effect sizes: Cohen's $d=0.85$, Cohen's $d=0.67$).^{35,36} Small and moderate effects were found in another RCT evaluating an addiction-related supportive messaging mobile intervention.³⁷ The authors found that cumulative abstinence duration and the average number of days until the first drink was greater than twice the length for those receiving supportive addiction-related messages compared to controls (approximately 60 days versus 26 days, respectively). In two user satisfaction surveys, over 80% of subscribers reported that the texting-based program improved their mental health.^{36,37} Subscribers reported that text messages made them feel more hopeful about managing issues (82%), in charge of managing depression and anxiety (77%), connected to a support system (75%), and improved their overall mental wellbeing (83%).

The aim of this study is to demonstrate how mobile based interventions can be used to quickly and safely collect population-level data by reporting on the one-week prevalence rate and demographic correlates of perceived stress in Alberta during the COVID-19 pandemic. Quick access to data can help policy makers assess the healthcare needs of a population, rapidly disseminate information to the public, implement public health measures in a timely manner, and properly allocate resources during a pandemic.

Methods

Design

We conducted a cross-sectional study examining baseline survey data collected one-week after the Text4Hope program launch (March 23 to March 30, 2020). Text4Hope is a text-messaging program aimed at providing Albertans support during the COVID-19 pandemic. The program was endorsed by provincial government officials, including Alberta's Chief Medical Officer of Health and the Alberta Premier. Additionally, funders (see acknowledgements) actively promoted the program on social media platforms, websites, newsletters, and posters. Individuals self-subscribed to the program by texting "COVID19HOPE" to a short-code number. Once subscribed, individuals received one daily text message, at the same time each day, for 12 weeks. Messages were aligned with a cognitive behavioural framework, with content written by mental health therapists, psychologists, and psychiatrists.

The baseline survey was administered via Select Survey,³⁸ an online survey software, by Alberta Health Services (AHS). All Text4Hope subscribers were invited to complete the survey. Individuals were asked demographic questions about their identified gender, age, identified ethnicity, highest level of education completed, current employment status, current relationship status, and current housing status.

Individuals were also asked to complete the Perceive Stress Scale (PSS).³⁹ The PSS is a validated, 10-item scale that measures the degree to which situations in one's life are appraised as stressful. PSS scores between 0 and 13 were classified as "low stress," scores between 14 and 26 were classified as

“moderate stress,” and scores between 27 and 40 were classified as “high stress.” Individuals classified as moderate stress or high stress were collapsed together as moderate/high stress for analysis.

The study was approved by the University of Alberta Human Research Ethics Board (Pro00086163). Before starting the survey, participants had to read brief informative statements which included: “Completing the survey means that you are agreeing to take part in the evaluation.” Consent was therefore implied if the participants completed the 10 minute survey and submitted their responses. Since the population of Alberta is approximately 4.3 million people, the sample size needed to estimate the prevalence of stress levels with a confidence level of 99% and a 2% margin of error was 4,200 individuals. The expected response rate was 20%.³⁶

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 26.⁴⁰ Descriptive statistics for demographic and clinical characteristics are described in number and percentages. Cross-tabular univariate analyses with Chi-square or Fisher’s exact tests were used to explore the relationship between each categorical variable in the study and moderate/high stress. A total of 513 responses (8.5%) were excluded from analysis due to the PSS variable being incomplete (e.g., a participant left the PSS blank) or invalid (e.g., there were more than 1 PSS item responses missing). Variables with a statistically significant relationship ($p < 0.05$, two-tailed) and variables that trended toward significance ($0.05 \leq p \leq 0.10$, two-tailed) with the likelihood of moderate/high stress on univariate analysis were analysed using logistic regression modelling. Before performing the logistic regression analysis, correlation diagnostics were performed to ensure that high inter-correlations among the predictor variables were avoided. Odds ratios from the binary logistic regression analysis were examined to determine the association between each of the variables in the model and the likelihood of individuals reporting moderate/high stress, controlling for the other variables in the model.

Results

There were 32,805 individuals enrolled in Text4Hope one week after the program launched. The online survey received 6,041 responses (18.4% response rate). The prevalence rate for moderate/high stress in our sample was 84.7% ($n=5,528$).

Table 1 provides summaries for demographic and clinical characteristics of respondents. The most common respondent demographic characteristics reported were: 86.6% identified as female ($n=5,986$); 43.3% were between 41 and 60 years of age ($n=5,870$); 82.2% identified as Caucasian ($n=5,970$); 85.6% had post-secondary education ($n=5,983$); 72.1% were currently employed ($n=5,166$); 71.6% were married, common-law, or partnered ($n=5,889$); and 66.5% owned their own home ($n=5,982$).

Table 1: Demographic and clinical characteristics of respondents

Variables	Overall n (%)
Gender	
Male	740 (12.4)
Female	5185 (86.6)
Other Gender	61 (1.0)
Age (Years)	
≤ 25	640 (10.9)
26 - 40	2174 (37.0)
41 - 60	2539 (43.3)
> 60	517 (8.8)
Ethnicity	
Caucasian	4910 (82.2)
Indigenous	205 (3.4)
Asian	301 (5.0)
Other	554 (9.3)
Highest Level of Education	
Less than High School Diploma	218 (3.6)
High School Diploma	583 (9.7)
Post-secondary Education	5123 (85.6)
Other Education	59 (1.0)
Current Employment Status	
Employed	3726 (72.1)
Unemployed	719 (13.9)
Retired	399 (7.7)
Student	322 (6.2)
Current Relationship Status	
Married/Common-law/Partnered	4284 (71.6)
Separated/Divorced	438 (7.3)
Widowed	93 (1.5)
Single	1105 (18.5)
Other	62 (1.0)
Current Housing Status	
Own Home	3917 (66.5)
Living with Family	548 (9.3)
Renting	1355 (23.0)
Other	63 (1.1)
Perceived Stress Level	
Low Stress	839 (15.2)
Moderate/High Stress	4689 (84.8)

Table 2 illustrates the results from the Chi-square analysis and the likelihood of reporting moderate/high stress for the demographic variables. Univariate analyses indicated that all demographic characteristics, except ethnicity, were significantly related to moderate/high stress ($p < 0.001$). Moderate/high stress was associated with the following characteristics: identifying as other gender, being ≤ 25 years of age, having attained less than high school diploma, being unemployed, being single, and living with family.

Table 2: Chi-square and likelihood of moderate/high stress for the collected demographic variables

Variables	Moderate/high stress n (%)	Pvalue
Gender		< 0.001
Male	521 (79.2)	
Female	4115 (85.6)	
Other Gender	47 (90.4)	
Age (Years)		< 0.001
≤ 25	575 (96.2)	
26 - 40	1820 (90.2)	
41 - 60	1910 (81.2)	
> 60	321 (67.3)	
Ethnicity		0.066
Caucasian	3857 (84.4)	
Indigenous	174 (90.6)	
Asian	220 (84.3)	
Other	420 (86.8)	
Highest Level of Education		< 0.001
Less than High School Diploma	186 (95.4)	
High School Diploma	460 (88.8)	
Post-secondary Education	3993 (84.0)	
Other Education	44 (86.3)	
Current Employment Status		< 0.001
Employed	2881 (83.9)	
Unemployed	626 (94.4)	
Retired	235 (63.9)	
Student	290 (94.2)	
Current Relationship Status		< 0.001
Married/Common-law/Partnered	3347 (84.4)	
Separated/Divorced	340 (82.3)	
Widowed	68 (76.4)	
Single	889 (88.8)	
Other	39 (78.0)	
Current Housing Status		< 0.001
Own Home	2958 (81.1)	
Living with Family	489 (94.4)	
Renting	1154 (91.2)	
Other	47 (90.4)	

The full model containing all predictors was significant, $\chi^2 (21, N=6,041) = 308.02, p < 0.001$, indicating the model was able to distinguish between individuals who reported moderate/high stress versus those who reported low stress. The model explained between 6.4% (Cox and Snell R^2) and 11.2% (Nagelkerke R^2) of the variance. Additionally, 84.8% of all cases were correctly classified. As shown in Table 3, gender, age, current employment status, and current housing status made unique contributions to the model, with age making the largest contribution (Wald of 54.58).

Individuals who identified as female were 1.5 times more likely to report moderate/high stress than individuals who identified as male (95% CI=1.2 – 1.9). Individuals who identified as other gender were 2.1 times more likely to report moderate/high stress compared to those who identified as male (95% CI=0.58 – 7.21). However, this was not significant.

Individuals in the ≤ 25 years of age category were more likely to report moderate/high stress compared to individuals categorized in the 26 – 40 years, 41 – 60 years, and > 60 years age categories (i.e., 1.9 (95% CI=1.1 – 3.4), 3.4 (95% CI=1.9 – 6.3), and 5.3 times more likely (95% CI=2.8 – 10.0), respectively).

Those who were unemployed were 2.5 times more likely to report moderate/high stress than those who were employed (95% CI=1.8 – 3.6). Those who were retired were 1.6 times less likely to report moderate/high stress compared to those who were employed (95% CI=1.1 – 2.2). While students were 1.2 times more likely than those who were employed to report moderate/high stress (95% CI=0.7 – 2.1), this difference was not significant.

Renters were 1.7 times more likely to report moderate/high stress than homeowners (95% CI=1.3 – 2.1). Those who were living with family or identified their current housing status as “other” were more likely to report moderate/high stress than those who owned their own home; 1.3 (95% CI=0.8 – 2.2) and 3.5 times more likely (95% CI=0.8 – 15.1), respectively, but these differences were not significant.

Table 3: Binomial logistic regression model of the correlates of moderate/high stress

Predictor	B	SE	Wald	df	Pvalue	95% CI for OR		
						OR	Lower	Upper
Gender								
Male			13.67	2	0.00**			
Female	0.42	0.12	13.32	1	0.00***	1.52	1.22	1.91
Other Gender	0.72	0.64	1.24	1	0.27	2.05	0.58	7.21
Age								
≤ 25			54.58	3	0.00***			
26 - 40	-0.65	0.30	4.71	1	0.03*	0.52	0.29	0.94
41 - 60	-1.24	0.30	16.70	1	0.00***	0.29	0.16	0.53
> 60	-1.68	0.34	24.94	1	0.00***	0.19	0.10	0.36
Ethnicity								
Caucasian			2.91	3	0.41			
Indigenous	0.35	0.29	1.47	1	0.23	1.43	0.80	2.53
Asian	-0.24	0.21	1.29	1	0.26	0.79	0.53	1.19
Other	0.03	0.16	0.03	1	0.88	1.03	0.75	1.41
Highest Level of Education								
Less than High School Diploma			5.02	3	0.17			
High School Diploma	-0.22	0.42	0.28	1	0.60	0.80	0.35	1.82
Post-secondary Education	-0.52	0.39	1.75	1	0.19	0.60	0.28	1.28
Other Education	-0.74	0.62	1.43	1	0.23	0.48	0.14	1.61
Current Employment Status								
Employed			34.87	3	0.00***			
Unemployed	0.93	0.19	25.03	1	0.00***	2.53	1.76	3.64
Retired	-0.44	0.17	7.11	1	0.01**	0.64	0.46	0.89
Student	0.16	0.30	0.28	1	0.60	1.17	0.65	2.13
Current Relationship Status								
Married/Common-law/Partnered			5.88	4	0.21			
Separated/Divorced	-0.09	0.16	0.35	1	0.55	0.91	0.67	1.24
Widowed	0.02	0.30	0.01	1	0.94	1.02	0.57	1.85
Single	-0.08	0.13	0.42	1	0.52	0.92	0.72	1.18
Other	-1.07	0.46	5.43	1	0.02*	0.34	0.14	0.84
Current Housing Status								
Own Home			34.87	3	0.00***			
Living with Family	0.29	0.26	25.03	1	0.25	1.34	0.81	2.21
Renting	0.51	0.17	7.11	1	0.00***	1.66	1.29	2.14
Other	1.26	0.74	0.28	1	0.09	3.51	0.82	15.08

Abbreviations: SE, standard error; OR, odds ratio; and CI, confidence interval.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

Discussion

This is the first study that reports on the prevalence and demographic correlates of perceived stress during the COVID-19 pandemic within Canada. Text4Hope had 32,805 subscribers after the first week of launching the program. 6,041 respondents completed the baseline survey, giving a response rate of 18.4%. There were 5,528 respondents who completed the PSS; this sample size is well above what was

needed to have a 99% confidence level in our estimate. The prevalence rate of moderate/high stress in Alberta was determined to be 84.8%. Significant associations were found between all demographic variables, except ethnicity, with moderate/high stress. All variables were added to the binomial logistic regression model for analysis. Our model, identified gender (i.e., identifying as female), age (i.e., being ≤ 25), current employment status (i.e., being unemployed), and current housing status (i.e., renting) as significant demographic predictors for moderate/high stress.

Based on the 2014 Canadian Community Health Survey data, 23% of Canadians aged 15 years or older reported feeling “quite a bit” or “extremely stressed.”⁴¹ While the surveys are not directly comparable (i.e., individuals are asked to reflect on different timeframes), the prevalence rate from this study indicates that stress levels may be elevated compared relatively recent Canadian data. Our findings align with the literature, which suggest that elevated psychological stress is typical of epidemic and disease outbreaks.⁴²⁻⁴⁴ They also align with other evidence emerging from the COVID-19 pandemic.¹⁰⁻¹² Our prevalence rate is substantially higher than that reported by Wang et al. at 8.1% in the general Chinese population.¹⁰ We speculate that the discrepancy between prevalence rates is possibly attributable to differing survey times. In the Chinese study, data was collected from January 31 to February 2, 2020, a day after the WHO declared COVID-19 a public health emergency of international concern on January 30, 2020. At this point, there were 7,818 total confirmed cases worldwide.⁴⁵ Our study collected data from March 23 to March 30, 2020, which was shortly after the WHO had declared COVID-19 a pandemic on March 11, 2020. At that time, there were 118,319 confirmed cases globally,⁴⁶ a 15 time increase compared to January 30, 2020. Nevertheless, there are cultural and contextual differences that may also explain the difference.

In relation to correlates of perceived stress in the present sample, identifying as “other gender,” being ≤ 25 years of age, having attained less than a high school diploma, being unemployed, being single, and living with family were associated with significant stress. Several of these factors have been reported in association with higher rates of psychological stress during COVID-19 and natural disasters.^{10,25,26,31} Our data indicate that specific groups are at risk for greater levels of stress in response to public health emergencies and this represents an important focus for interventions during times of crisis. Overall, our findings are consistent with other studies examining the demographic correlates of stress.¹⁰⁻¹²

Our model identified gender as a predictor of moderate/high stress. Specifically, female identifying individuals were 1.5 times more likely to report moderate/high stress than male identifying individuals. This is comparable to prior results for the general population^{10,12} and for healthcare workers¹⁵ during the current pandemic. As proposed by others,¹² the greater likelihood of reporting moderate/high stress in female identifying individuals may be attributed to a number of factors. Several studies have suggested that females generally score higher on the PSS,^{47,48} report higher intensity of psychological symptoms,⁴⁹ and are exposed to a greater number of stressful life events compared to those identifying as male,⁵⁰ which may contribute to the higher prevalence estimate with female identifying participants.

The association between age and psychological stress in the literature is mixed. Some reports indicate an absence of an association while others observe a significant positive or negative correlations between age and stress.^{10,11,12} In agreement with others,^{12,51} we found a negative correlation between age category and moderate/high stress in our model. Specifically, individuals in the ≤ 25 year category were more likely to report on moderate/high stress levels compared to all other age categories. While COVID-19 symptoms are more severe and mortality rates are higher for older individuals,⁵² there is evidence to suggest that older individuals may generally score lower on the PSS compared to younger individuals, suggesting that stress perception naturally declines with age.⁴⁸ Additionally, older individuals have been found to have lower reactivity to stressful events, which may be related to greater resiliency or more effective emotional regulation abilities.⁵¹ Another explanation, based on research conducted during the SARS outbreak, is that younger individuals tend to have significant psychiatric morbidities, which has been shown to correlate with higher levels of stress.^{12,53} More research is needed to elucidate the effects of age on perceived stress for COVID-19.

Employment status contributed significantly to our model, with unemployed individuals having more than 2 times the likelihood to report moderate/high stress compared to those who were employed. Similarly, Nelson et al. reported that the loss of employment due to COVID-19 was related to increased psychological symptoms.¹¹ Periods of economic recession have been linked with degradation of mental health, negative coping strategies (e.g., alcohol and drug use), and suicide rates.^{54,55} These detriments may persist for long periods during financial recession. Given the unprecedented number of Canadians applying for Federal jobless benefits and emergency income aid, our findings are aligned with the reporting of current trends in the economy. Since we found age to be negatively correlated with moderate/high stress, it is not surprising that retirees were 1.6 times less likely to report moderate/high stress compared to those who were employed. Generally, older individuals are more likely to be retired. We found no statistical association between being a student and reporting moderate/high stress. This contrasts a positive association with being a student and reporting higher stress scores found by Wang et al.¹⁰ A reason for these differences could be related to how participants were sampled. In the Chinese study, the online survey link was initially disseminated to university students who were then encouraged to share the link with others. In this study, Text4Hope was endorsed by provincial government officials and presented as a service offered to the general public. As such, the sampling method in our study may be more reflective of a general population.

Finally, our model suggests that current housing status is a predictor for moderate/high stress. Similar to unemployment status, this finding may be linked to economic instability. There is evidence supporting the association of housing foreclosures with unemployment, poverty, and suicide rates.⁵⁵ In our study, renters were 1.7 times more likely to report moderate/high stress than home-owners. Although federal emergency funding and financial aids have been put in place throughout Canada, there are several stressors directly impacting renters. In a recent survey of 1,100 renters across Canada, around 70% of respondents reported that COVID-19 had impacted their financial situation and 42% stated that they did not qualify for employment insurance or federal emergency funding.⁵⁶ The report also indicated that 35% of

respondents did not have enough money to pay rent on May 1, 2020. In Alberta, this is the date where rent non-payment eviction can be enforced, which may have contributed to higher reporting of moderate/high stress in renters.

There are several limitations in this study. This is a report of a single cross-sectional sample, which limits the ability to track changes in perceived stress over time. Additionally, Text4Hope is an intervention to help reduce stress and anxiety due to the COVID-19 pandemic. It is possible that voluntary subscribers differ in marked ways from the general population of Alberta, which could systematically influenced the perceived stress prevalence rate. Specifically, individuals who have higher stress levels may be more likely to enrol in the Text4Hope program. Additionally, the current study was limited to a Canadian setting and was overwhelmingly represented by individuals who identified as Caucasian (82.2%), which may limit generalizability to other non-Western countries. Finally, this survey is unable to measure the direct effect of COVID-19 on persons with any confirmed mental disorder.

Despite the above limitations, our findings have clinical and policy implications. First, the results provide important information on demographic correlates of perceived stress in Alberta during the COVID-19 pandemic. This can help health authorities identify high-risk groups based on sociodemographic information for early psychological interventions. The results can also be used as a historical reference for future studies of mental health impacts of pandemics and other natural disasters. Notably, our findings may inform aspects of the development of mobile-based interventions intended to provide support and minimize negative psychological impact during pandemics and other disaster settings. In particular, we provide a framework on how mobile-based interventions can be a useful tool to provide mental health support and can be used to collect population-level data in a short timeframe. This approach may be a key strategic contribution to inform stakeholders for time sensitive policy decisions during pandemics and other disasters. The current results support the case for mobile-based interventions in planning how to allocate resources to meet the mental health needs of at risk populations in a disaster context.

The near- and longer-term psychological impacts of COVID-19 remain unknown. Longitudinal studies will be necessary for our attempts to understand any temporal effects occurring due to this pandemic. In particular, time series analysis should be conducted to determine the changes in psychological impacts in a population in this context. The Text4Hope study team intends to report on the 6- and 12-week Text4Hope data once they become available. The upcoming dataset will provide information on the effectiveness of daily supportive text messages during a pandemic. Additionally, we will be able to report on user satisfaction, changes in the severity of psychological stress, and self-reported changes in health utilization patterns against the current baseline reference data for prevalence estimation from this first-time sample.

Conclusion

The COVID-19 pandemic has brought economic and societal changes on a global scale. These changes are likely to contribute to detrimental short- and long-term psychological impacts. Results from this paper indicate that the virus has contributed to elevated levels of stress in Alberta, with 84.7% of respondents indicating moderate/high stress levels. Those identifying as female, are 25 years or younger, currently unemployed, and are currently renting are populations that are at heightened risk of psychological stress. The implementation of mobile-based interventions is potentially an effective and feasible solution to provide psychological support. Furthermore, the information gathered from the prevalence rate and demographic correlates of perceived stress can help policy makers identify and properly allocate resources to support the mental health needs of populations who are at higher risk of being negatively affected by COVID-19.

List Of Abbreviations

AHS: Alberta Health Services

COVID-19: Coronavirus Disease 2019

GOA: Government of Alberta

PSS: Perceived Stress Scale

RCTs: Randomized control studies

SPSS: Statistical Package for Social Sciences

Declarations

Ethics approval and consent to participate: The study was approved by the University of Alberta Human Research Ethics Board (Pro00086163). No written or verbal consent were obtained from participants. Consent was implied if the participants enrolled into Text4Hope by texting “COVID19HOPE” to a short code number and then submitted their response to a survey link sent at program enrollment.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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study; collection, management, analysis, and interpretation of the data; preparation, review or approval of the manuscript; and decision to submit the manuscript for publication.

Authors' contributions: The study was conceived by VIOA. WV drafted the initial manuscript. WV, AG, and SS contributed to data collection. WV, RS, and VIOA contributed to data analysis and interpretations. WV, AG, SS, RS, MH, KM, LU, AJG, XL, and VIOA contributed to the design of the work and critical revisions of the article. All authors have read and approved the manuscript.

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References

1. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *The Lancet*. 2020;395(10223):514-523. doi:10.1016/S0140-6736(20)30154-9
2. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*. 2020;395(10223):497-506. doi:10.1016/S0140-6736(20)30183-5
3. World Health Organization. *WHO characterizes COVID-19 as a pandemic*. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen> [Accessed 9th April, 2020].
4. Government of Canada. *Coronavirus disease (COVID-19): outbreak update*. Available from: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html?utm_campaign=gc-hc-sc-coronaviruspublicedu2021-2021-0001-9762248618&utm_medium=search&utm_source=google-ads-99837326356&utm_content=text-en-428935858540&utm_term=coronavirus%20canada%20cases [Accessed 8th April, 2020].
5. Statistics Canada. *Labour force characteristics by province, monthly, seasonally adjusted*. Available from: <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410028703#timeframe> [Accessed April 9th, 2020].
6. Lundy M, Parkinson D. More than three million apply for COVID-19 job benefits as virus crashes labour market. *The Globe and Mail* [Internet]. 2020 April 6 [cited 2020 April 9]. Available from: <https://www.theglobeandmail.com/business/article-more-than-three-million-apply-for-covid-19-job-benefits-as-virus/>
7. Government of Canada. *Physical distancing (Fact sheet)*. Available from: <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/social-distancing.html> [Accessed 12th April, 2020].
8. Prem K, Liu Y, Russell TW, Kucharski AJ, Eggo RM, Davies N, et al. The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study.

9. Morneau Shepell. (2020). *Canadians are feeling unprecedented levels of anxiety, according to Mental Health Index*. Available from: <http://morneaushepell.mediaroom.com/2020-04-02-Canadians-are-feeling-unprecedented-levels-of-anxiety-according-to-Mental-Health-Index> [Accessed 9th April, 2020].
10. Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Env Res Pub He*, 2020;17(5):1729. doi: 10.3390/ijerph17051729
11. Nelson B, Pettitt AK, Flannery J, Allen N. Psychological and epidemiological predictors of covid-19 concern and health-related behaviors. *PsyArXiv*. [Preprint] 2020. doi:10.31234/osf.io/jftze [Accessed 20th April, 2020].
12. Limcaoco RS, Mateos EM, Fernandez JM, Roncero C. Anxiety, worry and perceived stress in the world due to the COVID-19 pandemic, March 2020. Preliminary results. *medRxiv*. [Preprint] 2020. doi:10.1101/2020.04.03.20043992 [Accessed 20th April, 2020].
13. Lu, W., Wang, H., Lin, Y., Li, L. Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study. *Psychiat Res*, 2020;112936. doi: 10.1016/j.psychres.2020.112936
14. Mo Y, Deng L, Zhang L, Lang Q, Liao C, Wang N, et al. Work stress among Chinese nurses to support Wuhan for fighting against the COVID-19 epidemic. *J Nurs Manage*. 2020. doi:10.1111/jonm.13014
15. Zhang W, Wang K, Yin L, Zhao W, Xue Q, Peng M, et al. Mental health and psychosocial problems of medical health workers during the COVID-19 epidemic in China. *Psychother Psychosom*. 2020. doi:10.1159/000507639
16. Neria Y, Nandi A, Galea S. Post-traumatic stress disorder following disasters: a systematic review. *Psychol Med*. 2008;38(4):467-480. doi:10.1017/S0033291707001353
17. Tracy M, Norris FH, Galea S. Differences in the determinants of posttraumatic stress disorder and depression after a mass traumatic event. *Depress Anxiety*. 2011;28(8):666-675. doi:10.1002/da.20838
18. Galea S, Ahern J, Resnick H, Kilpatrick D, Bucuvalas M, Gold J, et al. Psychological sequelae of the September 11 terrorist attacks in New York City. *N Engl J Med*. 2002;346(13):982-987. doi:10.1056/NEJMsa013404
19. Lee AM, Wong JG, McAlonan GM, Cheung V, Cheung C, Sham PC, et al. Stress and psychological stress among SARS survivors 1 year after the outbreak. *Can J Psychiatry*. 2007;52(4):233-240. doi:10.1177/070674370705200405
20. Johannesson KB, Arinell H, Arnberg FK. Six years after the wave. Trajectories of posttraumatic stress following a natural disaster. *J Anxiety Disord*. 2015;36:15-24. doi:10.1016/j.janxdis.2015.07.007
21. Kar N, Bastia BK. Post-traumatic stress disorder, depression and generalised anxiety disorder in adolescents after a natural disaster: a study of comorbidity. *Clin Pract Epidemiol Ment Health*. 2006;2(1):17. doi:10.1186/1745-0179-2-17

22. Yelland C, Robinson P, Lock C, La Greca AM, Kokegei B, Ridgway V, et al. Bushfire impact on youth. *J Trauma Stress*. 2010;23(2):274-7. doi:10.1002/jts.20521
23. Marthoenis M, Ilyas A, Sofyan H, Schouler-Ocak M. Prevalence, comorbidity and predictors of post-traumatic stress disorder, depression, and anxiety in adolescents following an earthquake. *Asian J Psychiatry*. 2019;43:154-159. doi:10.1016/j.ajp.2019.05.030
24. Marshall GN, Schell TL, Elliott MN, Rayburn NR, Jaycox LH. Psychiatric disorders among adults seeking emergency disaster assistance after a wildland-urban interface fire. *Psychiatr Serv*. 2007;58(4):6. doi:10.1176/ps.2007.58.4.509
25. Aslam N, Kamal A. Stress, anxiety, depression, and posttraumatic stress disorder among general population affected by floods in Pakistan. *Pak J Med Res*. 2016;55(1):29-32.
26. Foa EB, Stein DJ, McFarlane AC. Symptomatology and psychopathology of mental health problems after disaster. *J Clin Psychiatry*. 2006;67(Suppl 2):15-25.
27. Geng F, Liang Y, Shi X, Fan F. A prospective study of psychiatric symptoms among adolescents after the Wenchuan earthquake: adolescent mental health after a natural disaster. *J Trauma Stress*. 2018;31(4):499-508. doi:10.1002/jts.22307
28. Farooqui M, Quadri SA, Suriya SS, Khan MA, Ovais M, Sohail Z, et al. Posttraumatic stress disorder: a serious post-earthquake complication. *Trends Psychiatry Psychother*. 2017;39(2):135-143. doi:10.1590/2237-6089-2016-0029
29. Fernandez A, Black J, Jones M, Wilson L, Salvador-Carulla L, Astell-Burt T, et al. Flooding and mental health: a systematic mapping review. *PLOS One*. 2015;10(4):e0119929. doi:10.1371/journal.pone.0119929
30. Hetherington E, McDonald S, Wu M, Tough S. Risk and protective factors for mental health and community cohesion after the 2013 Calgary flood. *Disaster Med Public Health Prep*. 2018;12(4):470-477. doi:10.1017/dmp.2017.91
31. Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to Coronavirus Disease 2019. *JAMA Netw Open*. 2020;3(3):e203976. doi:10.1001/jamanetworkopen.2020.3976
32. Government of Alberta. *COVID-19 modelling*. Available from: [ca/assets/documents/covid-19-case-modelling-projection.pdf](#) [Accessed 9th April, 2020].
33. Government of Alberta. *COVID-19 update*. Available from: <https://www.alberta.ca/assets/documents/covid-19-case-modelling-projection-april-28.pdf> [Accessed 29th April, 2020].
34. Canadian Radio-television and Telecommunications Commission. Communications services in Canadian households: subscriptions and expenditures 2012-2016. Available from: <https://crtc.gc.ca/eng/publications/reports/policymonitoring/2018/cmr1.htm#s10ii1> [Accessed 10th April, 2020].

35. Agyapong VIO, Ahern S, McLoughlin DM, Farren CK. Supportive text messaging for depression and comorbid alcohol use disorder: single-blind randomised trial. *J Affect Disord.* 2012;141(2-3):168-176. doi:10.1016/j.jad.2012.02.040
36. Agyapong VI, Mrklas K, Juhás M, Omeje J, Ohinmaa A, Dursun SM, et al. Cross-sectional survey evaluating Text4Mood: mobile health program to reduce psychological treatment gap in mental healthcare in Alberta through daily supportive text messages. *BMC Psychiatry.* 2016;16(1). doi:10.1186/s12888-016-1104-2
37. Agyapong VIO, Milnes J, McLoughlin DM, Farren CK. Perception of patients with alcohol use disorder and comorbid depression about the usefulness of supportive text messages. *Technol Health Care.* 2013;21(1):31-39. doi:10.3233/THC-120707
38. ClassApps Inc. Select Survey for Alberta Health Services, Version 4. Kansas City, MO: ClassApps Inc.
39. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* 1983;24:386-396. doi:10.2307/2136404
40. IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.
41. Statistics Canada. *Perceived life stress, 2014.* Available from: <https://www150.statcan.gc.ca/n1/pub/82-625-x/2015001/article/14188-eng.htm#archived> [Accessed April 19th, 2020]
42. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet.* 2020;8(2):912-920. doi:10.1016/S0140-6736(20)30460-8
43. Taylor MR, Agho KE, Stevens GJ, Raphael B. Factors influencing psychological stress during a disease epidemic: data from Australia's first outbreak of equine influenza. *BMC Public Health.* 2008;8(1):347. doi:10.1186/1471-2458-8-347
44. Chua SE, Cheung V, McAlonan GM, Cheung C, Wong JW, Cheung EP, et al. Stress and psychological impact on SARS patients during the outbreak. *Can J Psychiat.* 2004;49(6):385-390. doi:10.1177/070674370404900607
45. World Health Organization. *WHO Timeline - COVID-19.* Available from: <https://www.who.int/news-room/detail/27-04-2020-who-timeline—covid-19> [Accessed 30th April, 2020].
46. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report – 51. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_10 [Accessed 30th April, 2020]
47. Cohen S, Janicki-Deverts DE. Who's stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006, and 2009. *J Appl Soc Psychol.* 2012;42(6):1320-34. doi:10.1111/j.1559-1816.2012.00900.x
48. Remor E. Psychometric properties of a European Spanish version of the Perceived Stress Scale (PSS). *Span J Psychol.* 2006;9(1):86-93. doi:10.1017/S1138741600006004

49. Uhlenhuth EH, Paykel ES. Symptom intensity and life events. *Arch Gen Psychiat.* 1973;28(4):473-7. doi:10.1001/archpsyc.1973.01750340015002
50. Kendler KS, Thornton LM, Prescott CA. Gender differences in the rates of exposure to stressful life events and sensitivity to their depressogenic effects. *Am J Psychiat.* 2001;158(4):587-93. doi:10.1176/appi.ajp.158.4.587
51. Losada-Baltar A, Jiménez-Gonzalo L, Gallego-Alberto L, Pedroso-Chaparro MD, Fernandes-Pires J, Márquez-González M. "We're staying at home". Association of self-perceptions of aging, personal and family resources and loneliness with psychological stress during the lock-down period of COVID-19. *J Gerontol B-Psychol.* Forthcoming 2020. doi: 10.1093/geronb/gbaa048
52. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *The Lancet Resp Med.* Forthcoming 2020. doi:10.1016/S2213-2600(20)30079-5
53. Sim, K. Psychosocial and coping responses within the community health care setting towards a national outbreak of an infectious disease. *J Psychosom Res.* 2010;68:195–202. doi: 10.1016/j.jpsychores.2009.04.004
54. Forbes MK, Krueger RF. The Great recession and mental health in the United States. *Clinical Psychological Science.* 2019;7(5):900-913. doi:10.1177/2167702619859337
55. Kerr WC, Kaplan MS, Huguet N, Caetano R, Giesbrecht N, McFarland BH. Economic recession, alcohol, and suicide rates: comparative effects of poverty, foreclosure, and job loss. *Am J Prev Med.* 2017 Apr 1;52(4):469-75. doi:10.1016/j.amepre.2016.09.021
56. The Association of Community Organization for Reform Now. *State of renters during COVID-19: survey report.* Available from: https://acorncanada.org/sites/default/files//State%20of%20renters%20survey%20during%20COVID-19_English_0.pdf [Accessed 30th April, 2020].