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## Associations between periods of COVID-19 quarantine and mental health in Canada

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### ABSTRACT

Since the onset of the COVID-19 pandemic, many jurisdictions, including Canada, have made use of public health measures such as COVID-19 quarantine to reduce the transmission of the virus. To examine associations between these periods of quarantine and mental health, including suicidal ideation and deliberate self-harm, we examined data from a national survey of 3000 Canadian adults distributed between May 14-29, 2020. Notably, participants provided the reason(s) for quarantine. When pooling all reasons for quarantine together, this experience was associated with higher odds of suicidal ideation and deliberate self-harm in the two weeks preceding the survey. These associations remained even after controlling for age, household income, having a pre-existing mental health condition, being unemployed due to the pandemic, and living alone. However, the associations with mental health differed across reasons for quarantine; those who were self-isolating specifically due to recent travel were not found to have higher odds of suicidal ideation or deliberate self-harm. Our research suggests the importance of accounting for the reason(s) for quarantine in the implementation of this critical public health measure to reduce the mental health impacts of this experience.

### 1. Introduction

As a result of the novel coronavirus (COVID-19) pandemic, an estimated 91% of the world's population lives in a country that has imposed public health measures, including travel restrictions, to reduce the spread of the virus (Connor, 2020). Many nations have implemented population-wide restrictions including shelter-in-place, lockdown, and physical distancing mandates. Further, quarantine or isolation restrictions have been placed on individuals who present a known risk (e. g., potential exposure, symptoms of COVID-19). While various terms have been used to describe quarantine and isolation measures – the absence or presence of symptoms, respectively (Government of Canada, 2020a) – the language of “COVID-19 quarantine” will be used throughout this paper to refer to public health orders of quarantine, isolation, and related experiences in the COVID-19 pandemic context.

In Canada, COVID-19 quarantine mandates have been imposed in various ways, ranging from “recommended” (voluntary and largely self-managed) through to “mandatory” (legally enforceable) (Government of

Canada, 2020a). Grounds for quarantine in Canada include, having a confirmed COVID-19 infection, having symptoms in the absence of a confirmed infection, having been exposed to others with symptoms or confirmed illness, returning to Canada from international travel, or in some cases, inter-provincial travel (Government of Canada, 2020a). The duration and criteria for these quarantine orders vary by region, but often range from 10-14 days and include directives to remain at home, or another location such as a hotel, and to avoid contact with individuals outside or even those within the household (British Columbia Ministry of Health, 2020; Government of Canada, 2020b; Government of Canada, 2020c; Ministère de la Santé et des Services Sociaux, 2020; Public Health Ontario, 2020).

In the context of COVID-19, the prevalence of psychological distress, depression, anxiety, and post-traumatic stress symptoms among the general population has been found to be significantly higher compared to pre-pandemic levels (Authors, 2020; McGinty et al., 2020; Salari et al., 2020; Twenge and Joiner, 2020; Xiong et al., 2020). Moreover, certain risk factors for adverse mental health outcomes are starting to

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emerge, including the experience of COVID-19 quarantine. Indeed, while COVID-19 quarantine and other restrictions represent crucial public health measures needed to control the spread of the virus, quarantine is associated with significant mental health consequences. For example, people who have experienced a period of COVID-19 quarantine report multiple negative psychological effects, including fear, anger, loneliness, and despair (Gan et al., 2020; Luo et al., 2020). Research from previous virus outbreaks has also identified significant negative mental health effects of quarantine, including depression, post-traumatic stress, and low self-esteem, with many of these effects persisting beyond the initial quarantine period (Brooks et al., 2020; Hawryluck et al., 2004; Hossain et al., 2020; Reynolds et al., 2008). Emerging data from the COVID-19 pandemic similarly suggests that individuals who have quarantined have even higher rates of depression, anxiety, and post-traumatic stress than the general public (Lei et al., 2020; Tang et al., 2020). The risk for adverse mental health impacts has been found to be greater for those who test positive for COVID-19 (Guo et al., 2020), as well as those who report “extreme fear” of contamination and who live in “worst-hit” areas (Tang et al., 2020). Individuals who undertake COVID-19 quarantine due to exposure have also been found to experience stigma related to potential infection and fears of both contracting and spreading the virus (Fawaz and Samaha, 2020). Although fear of COVID-19 exposure and health anxiety related to experiencing symptoms are known risk factors for poor mental health among the general population (Forte et al., 2020; Mazza et al., 2020), few researchers have examined the extent to which mental health consequences may vary across reasons for quarantine.

In addition to widespread depression, anxiety, and other negative mental health impacts of the pandemic, there are growing concerns about increased suicide rates globally, particularly related to the economic consequences of lockdown, including unemployment and uncertain future career prospects (Kawohl and Nordt, 2020; McIntyre and Lee, 2020). Over and above predicted increases in suicide among the general population, periods of quarantine may be an additional risk factor for self-harm, suicidal ideation, and death by suicide. Research from SARS outbreaks in Taiwan and South Korea in the early 2000s indicates that quarantine is associated with increased deaths by suicide, which was related to fear of illness and loss of social contact and support (Barbisch et al., 2015; Cheung et al., 2008). While research remains limited on suicide related to COVID-19 quarantine, Xin and colleagues (2020) identified that people who have experienced COVID-19 quarantine are five times as likely to have had *thoughts* of self-harm and/or suicide compared to those who have not quarantined. Further, in an analysis of media reports of COVID-19 related suicides in India, Dsouza et al. (2020) found that multiple deaths by suicide were related to the experience of quarantine or social pressure to quarantine.

As the pandemic continues with ongoing virus spread, a significant number of people worldwide will continue to experience periods of quarantine, with heightened risk for adverse mental health consequences. Evidence is needed to inform responses to the mental health impacts of quarantine, particularly in the context of the increased risk for suicide during and after quarantine. As such, the aims of this paper are two-fold: firstly, to examine the relationships between COVID-19 quarantine and mental health, including suicidal ideation, and self-harm; and secondly, to explore whether mental health outcomes differ depending on the specific reason for quarantine.

## 2. Methods

Data are drawn from the first wave of a multi-wave national monitoring study of the mental health impacts of COVID-19 among those who live in Canada, aged 18 years and older. This study is being conducted in partnership with the Canadian Mental Health Association (CMHA) and the Mental Health Foundation in the United Kingdom. Survey questions were informed by a previous multi-wave survey developed by the Mental Health Foundation using a citizens’ jury participatory

methodology process with people who have lived experience of a mental health condition(s) (Kousoulis et al., 2020). Adaptations to the survey were made to ensure questions reflected the Canadian context and data needs. Online surveys were distributed by Maru/Matchbox, a national polling vendor, that maintains the Maru Voice Canada panel consisting of approximately 125,000 Canadian adults from all provinces and territories. Measures are taken to increase recruitment of panel participants from traditionally under-represented population sub-groups, such as older adults and racialized populations. Trusted researchers are provided with access to this panel to facilitate participant recruitment and sample integrity.

Members of the panel were randomly invited by Maru/Matchbox to participate in the survey. To ensure a nationally representative sample, Maru/Matchbox used Canadian national census informed stratifications defined by sociodemographic characteristics (i.e., age, gender, household income and region) with adjustments for response propensity. The survey was distributed between May 14–29, 2020. This period was approximately one month after the initial peak of the COVID-19 pandemic in Canada and coincides with the time during which many jurisdictions began their initial phases of “re-opening”, following approximately two months of widespread restrictions (Vogel, 2020). The survey was anonymous, administered online, and available in Canada’s two official languages – English and French.

### 2.1. Variables of interest

While this paper uses the term ‘COVID-19 quarantine’ to reference both quarantine and isolation measures in the context of COVID-19, the survey itself used the term ‘self-isolation’. This term is most commonly used in public health messaging across Canada and is widely understood to involve any individual quarantine/isolation measure undertaken regardless of reason, symptoms, or diagnosis. To assess COVID-19 quarantine, participants were asked whether they/their household had ‘self-isolated’ since the start of the pandemic due to any of the following reasons, which were not mutually exclusive, presented in randomized order along with other pandemic-related items:

- “I have self-isolated with symptoms of COVID-19”
- “My household has self-isolated because someone else had symptoms of COVID-19”
- “My household has self-isolated due to contact with someone else who had symptoms of COVID-19”
- “My household has self-isolated due to recent travel”

Demographic information, including age, household income, ethnicity and gender identity were also collected. The primary outcomes of interest were perceived change in mental health (since the onset of the pandemic and related restrictions), suicidal ideation, and self-harm. Perceived change in mental health was assessed by asking participants: “Compared to before the COVID-19 pandemic and related restrictions in Canada, how would you say your mental health is now?” For this item responses were “Significantly worse now”, “Slightly worse now”, “About the same”, “Slightly better now”, “Significantly better now”, and “Prefer not to answer”. Response options “slightly worse now” and “significantly worse now” were combined into our primary outcome measure, “worse mental health.” Suicidal ideation and self-harm were assessed by asking participants, “as a result of the COVID-19 pandemic, in the previous two weeks” had they “Experienced suicidal thoughts/feelings?” or “Deliberately hurt myself?”.

### 2.2. Data analysis

Descriptive, univariate, and multivariate analysis was used to explore relationships of interest. Odds ratios were used to compare the odds of reporting worse mental health, suicidal ideation, and self-harm between those who did and did not report a period of COVID-19

quarantine. Similar comparisons were made between each of the four reasons for quarantine and those who did not quarantine. Comparisons between proportions were done using a Chi-square test (where expected cell count assumptions were met) and a two-sided Fisher's Exact test (when more than 20% of expected cell counts were less than five). Those who selected "Prefer not to answer", "Don't know" or "Prefer not to say" for perceived change in mental health, suicidal ideation, deliberate self-harm or items related to quarantine and confounders, were excluded from analysis to allow direct comparisons between those explicitly endorsing or not endorsing these experiences. A  $p$ -value  $< 0.05$  was considered significant. Binomial logistic regression was used to control for the impact of likely confounders/covariates on the associations between COVID-19 quarantine and mental health outcomes. These confounders were age, household income, living alone, being unemployed due to the COVID-19 pandemic, and having a pre-existing mental health condition, and were selected a priori based on previous research suggesting their links to mental health and suicidality (Gili et al., 2019; Jacob et al., 2019; Liu et al., 2020; McIntyre and Lee, 2020). Multicollinearity was assessed by examining tolerance/variance inflation factor (VIF) values; all VIF values were found to be  $< 2.5$ . Data were analyzed in IBM SPSS version 27.0.0.

### 2.3. Ethics

Ethical approval was provided by the University of British Columbia Behavioural Research Ethics Board (H20-01273). Participants consented online and were offered information about accessing mental health supports if needed. Maru/Matchbox provided participants with a small honorarium for completing the survey.

### 3. Results

In total, 3558 individuals were selected at random from the Maru Voice Canada panel and invited by Maru/Matchbox to complete the survey via unique email invitations, to reach 3000 total respondents (84% invitation-to-response rate). Just over half of the respondents (50.6%;  $n=1519$ ) identified as female, 83.9% ( $n=2516$ ) were living in an urban setting, and 7.8% ( $n=234$ ) reported a household income of less than \$25,000 CAD. Regarding ethnicity, 2.9% ( $n=87$ ) identified as Indigenous and 13.0% ( $n=389$ ) were classified as being a visible minority. Additionally, 7.0% ( $n=210$ ) identified as LGBT2Q+, 10.5% ( $n=316$ ) reported having a disability, and 18.2% ( $n=546$ ) reported having a pre-existing mental health condition. Detailed demographic characteristics of the 3000 participants are provided in Table 1.

The following tables present characteristics of the sample related to key survey items. Within the overall sample, 11.9% ( $n=357$ ) reported having experienced a period of COVID-19 quarantine since the start of the pandemic, 87.3% ( $n=2620$ ) reported they had not experienced COVID-19 quarantine, and 0.8% ( $n=23$ ) selected "Don't know" or "Prefer not to answer." The most widely reported reason for COVID-19 quarantine was recent travel, for 7.2% ( $n=215$ ) of the sample. The reasons were not mutually exclusive; 26 individuals reported two of the available reasons for COVID-19 quarantine, four reported three of the reasons and two reported all four reasons. The COVID-19 quarantine data are presented in Table 2, including the reported reasons.

The overall mental health status of the sample is presented in Table 3. Notably, 37.4% ( $n=1121$ ) of the sample reported that their mental health was worse at the time of survey compared to before the pandemic and related restrictions. Furthermore, 5.9% ( $n=176$ ) of the entire sample reported thoughts/feeling of suicide and 1.6% ( $n=48$ ) reported deliberate self-harm in the preceding two weeks as a result of the COVID-19 pandemic.

Table 4 presents comparisons in mental health outcomes between those who did and did not report having undertaken COVID-19 quarantine. The proportion of participants reporting worse mental health among those who reported COVID-19 quarantine was 41.9% ( $n=149$ ),

**Table 1**  
Socio-demographic characteristics of the sample.

	%	n
<b>Province</b>		
Alberta	11.1%	333
British Columbia/territories	14.7%	440
Manitoba	3.3%	98
New Brunswick	2.4%	71
Newfoundland and Labrador	1.4%	41
Nova Scotia	3.7%	111
Ontario	38.0%	1140
Prince Edward Island	0.4%	12
Quebec	21.9%	658
Saskatchewan	3.2%	96
<b>Age</b>		
18-34	17.8%	534
35-54	38.6%	1157
55+	43.6%	1309
<b>Household Income (Canadian dollars)</b>		
< \$25,000	7.8%	234
\$25,000 to < \$50,000	16.8%	504
\$50,000 to < \$100,000	33.1%	992
\$100,000 to \$250,000	40.0%	1200
> \$250,000	2.3%	70
<b>Gender Identity</b>		
Man	48.7%	1460
Woman	50.6%	1519
Chose a different descriptor <sup>a</sup>	0.7%	21
<b>Ethnicity</b>		
Indigenous (for example, First Nations, Inuit, Métis)	2.9%	87
Visible minority <sup>b</sup>	13.0%	389
<b>Identifies as LGBT2Q+</b>		
Yes	7.0%	210
No	91.5%	2746
Unsure	0.9%	28
Prefers not to answer	0.5%	15
<b>Self-reports as having a disability</b>		
Yes	10.5%	316
No	88.6%	2657
Prefer not to answer	0.9%	27
<b>Self-reports as having a pre-existing mental health condition</b>		
Yes	18.2%	546
No	80.8%	2423
Prefer not to answer	1.0%	31
<b>Urban vs rural geography</b>		
Urban	83.9%	2516
Rural	16.1%	484
<b>Unemployed (due to COVID-19)</b>		
Yes	9.5%	284
No	90.4%	2712
Prefer not to answer	0.1%	4
<b>Living alone</b>		
Yes	20.5%	615
No	79.3%	2378
Prefer not to answer	0.2%	7

<sup>a</sup> Includes Transgender woman/trans woman, Transgender man/trans man, Non-binary, Two-Spirit, Not listed and Prefer not to answer

<sup>b</sup> Visible minority category was constructed by the research team based on participants' self-reported ethnicity (e.g. South Asian, Middle Eastern, African).

**Table 2**  
COVID-19 quarantine characteristics of the sample.

Reported quarantine status	%	n
Did not quarantine	87.3%	2620
Quarantined (any reason) <sup>a</sup>	11.9%	357
"I have self-isolated with symptoms of COVID-19"	3.1%	93
"My household has self-isolated because someone else had symptoms of COVID-19"	1.6%	47
"My household has self-isolated due to contact with someone else who had symptoms of COVID-19"	1.4%	43
"My household has self-isolated due to recent travel"	7.2%	215
Prefer not to say/Don't know	0.8%	23

<sup>a</sup> Reasons for COVID-19 quarantine were not mutually exclusive, and participants could select multiple

**Table 3**  
Overall mental health characteristic of the sample.

Mental health outcome	%	n
Change in mental health since the start of the pandemic and related restrictions		
Worse now	37.4%	1121
Significantly worse now	6.5%	195
Slightly worse now	30.9%	926
About the same	54.5%	1635
Better now	8.0%	239
Significantly better now	5.8%	175
Slightly better now	2.1%	64
Prefer not to answer	0.2%	5
Experienced suicidal thoughts/feelings as a result of the COVID-19 pandemic in the previous two weeks		
Yes	5.9%	176
No	93.1%	2792
Prefer not to say	1.1%	32
Deliberately hurt myself as a result of the COVID-19 pandemic in the previous two weeks		
Yes	1.6%	48
No	97.9%	2936
Prefer not to say	0.5%	16

compared to 36.9% (n=966) among those who did not; this difference was not statistically significant at  $p = 0.071$ . However, there was a statistically significant difference in the proportion of individuals reporting “*significantly worse*” mental health at the time of the survey between those who did COVID-19 quarantine (10.4%; n=37) and those who did not quarantine (5.9%; n=155). Of note, those who COVID-19 quarantined for any reason were more likely to report experiencing suicidal ideation (11.1%; n=39) and deliberate self-harm (3.7%; n=13) within the two weeks prior to completing the survey compared to those who did not COVID-19 quarantine (5.1%; n=133 and 1.3%; n=34, respectively).

Those who reported COVID-19 quarantine due to recent travel were found to have the same odds of worse mental health, suicidal ideation, and deliberate self-harm compared to those who did not COVID-19 quarantine; this contrasts with those who quarantined with symptoms of COVID-19. Furthermore, in light of the comparatively lower rates of worsened mental health among those reporting COVID-19 quarantine in the context of recent travel, an analysis was run comparing the prevalence of worse mental health among those who did and did not quarantine, while, excluding those who quarantined because of recent travel. Exclusion of this group resulted in a statistically significant difference in the prevalence of worse mental health among those who experienced a period of quarantine (51.1%; n=72) and those who did not (35.9%; n=966),  $p = 0.001$ .

Finally, logistic regression was used to adjust for potential confounding by a priori specified variables: age, household income over \$25,000 per year, self-reported pre-existing mental health condition, unemployment due to COVID-19, and living alone. This resulted in 15 discrete models. Results from this analysis are presented in Tables 5-7 with statistically significant odds ratios shown in bold text. Table 5 shows the models related to the outcome “worse mental health since the start of the pandemic”. As can be seen, after controlling for covariates, only one of the COVID-19 quarantine reasons remained statistically significant. Across all reasons, having a pre-existing mental health condition was associated with increased odds of reporting worsening mental health.

Table 6 shows the models related to suicidal ideation in the previous two weeks as a result of the COVID-19 pandemic. COVID-19 quarantine for any reason was associated with an increase in the odds of suicidal ideation, along with COVID-19 quarantine due to experiencing symptoms of COVID-19 or due to contact with someone with symptoms of COVID-19. Having a pre-existing mental health condition as well as living alone were associated with increased odds of suicidal ideation. When modelling specific reasons for COVID-19 quarantine, a household

**Table 4**  
Comparison of mental health characteristics between those who did and did not COVID-19 quarantine.

Mental health outcome	%	n	Odds Ratio <sup>a</sup>	95% Confidence Interval
<b>Worse mental health compared to before the pandemic</b>				
Did not quarantine	36.9%	966	—	—
Quarantined (any reason) <sup>b</sup>	41.9%	149	1.23	0.98-1.54
“I have self-isolated with symptoms of COVID-19” <sup>*</sup>	53.8%	50	<b>1.99</b>	1.31-3.01
“My household has self-isolated because someone else had symptoms of COVID-19” <sup>*</sup>	57.4%	27	<b>2.31</b>	1.29-4.12
“My household has self-isolated due to contact with someone else who had symptoms of COVID-19”	48.8%	20	1.63	0.88-3.02
“My household has self-isolated due to recent travel”	35.8%	77	0.95	0.71-1.27
<b>Suicidal ideation in the past 2 weeks</b>				
Did not quarantine	5.1%	133	—	—
Quarantined (any reason) <sup>*</sup>	11.1%	39	<b>2.31</b>	1.59-3.36
“I have self-isolated with symptoms of COVID-19” <sup>*</sup>	22.0%	20	<b>5.22</b>	3.08-8.83
“My household has self-isolated because someone else had symptoms of COVID-19” <sup>*F</sup>	13.3%	6	<b>2.85</b>	1.19-6.85
“My household has self-isolated due to contact with someone else who had symptoms of COVID-19” <sup>*F</sup>	27.5%	11	<b>7.03</b>	3.44-14.37
“My household has self-isolated due to recent travel”	5.1%	11	1.00	0.53-1.88
<b>Deliberate self-harm in the past 2 weeks</b>				
Did not quarantine	1.3%	34	—	—
Quarantined (any reason) <sup>*</sup>	3.7%	13	<b>2.89</b>	1.51-5.53
“I have self-isolated with symptoms of COVID-19” <sup>*F</sup>	8.7%	8	<b>7.22</b>	3.24-16.10
“My household has self-isolated because someone else had symptoms of COVID-19”	4.4%	2	3.52	0.82-15.14
“My household has self-isolated due to contact with someone else who had symptoms of COVID-19” <sup>*F</sup>	7.3%	3	<b>5.98</b>	1.76-20.32
“My household has self-isolated due to recent travel”	0.9%	2	0.71	0.17-2.98

<sup>a</sup>Odds ratios always compared against those who did not COVID-19 self-isolate for any reason and are bolded when significant ( $p < 0.05$ )

<sup>b</sup>Reasons for quarantine were not mutually exclusive

<sup>\*</sup>Difference in proportions, compared to those who did not COVID-19 quarantine for any reason, significant ( $p < 0.05$ ) using a Chi-Square test

<sup>\*F</sup>: Difference in proportions, compared to those who did not COVID-19 quarantine for any reason, significant ( $p < 0.05$ ) using two-sided Fisher’s Exact test

income greater than \$25,000 per year was also associated with lower odds of suicidal ideation.

Finally, Table 7 shows the models related to the outcome of deliberate self-harm in the previous two weeks as a result of the COVID-19 pandemic. While COVID-19 quarantine for all reasons aggregated was associated with increased odds of deliberate self-harm, reporting COVID-19 quarantine due to recent travel was not. Furthermore, having a pre-existing mental health condition(s) was associated with increased odds of deliberate self-harm across all reasons for COVID-19 quarantine.

**Table 5**

Logistic regression of the association between COVID-19 quarantine and worse mental health since the start of the pandemic and related restrictions, after controlling for potential covariates.

Covariates		Reported reason for COVID-19 quarantine				
		Model 1a: Quarantined for any reason	Model 1b: "I have self-isolated with symptoms of COVID-19"	Model 1c: "My household has self-isolated because someone else had symptoms of COVID-19"	Model 1d: "My household has self-isolated due to contact with someone else who had symptoms of COVID-19"	Model 1e: "My household has self-isolated due to recent travel"
Reason for COVID-19 quarantine	OR (95% CI)	1.23 (0.97-1.55)	1.48 (0.96-2.30)	<b>2.02</b> (1.10-3.69)	1.41 (0.75-2.68)	1.11 (0.82-1.50)
	p	0.082	0.076	0.023	0.286	0.509
Household income (\$25k+ CAD)	OR (95% CI)	1.03 (0.77-1.40)	1.00 (0.74-1.36)	1.00 (0.73-1.37)	1.00 (0.73-1.36)	1.00 (0.73-1.36)
	p	0.830	0.990	0.989	0.979	0.998
Age (years)	OR (95% CI)	<b>0.99</b> (0.98-0.99)	<b>0.98</b> (0.98-0.99)	<b>0.98</b> (0.98-0.99)	<b>0.98</b> (0.98-0.99)	<b>0.99</b> (0.98-0.99)
	p	<0.001	<0.001	<0.001	<0.001	<0.001
Pre-existing mental health condition	OR (95% CI)	<b>2.59</b> (2.13-3.15)	<b>2.53</b> (2.06-3.10)	<b>2.62</b> (2.13-3.23)	<b>2.60</b> (2.11-3.20)	<b>2.65</b> (2.16-3.26)
	p	<0.001	<0.001	<0.001	<0.001	<0.001
Unemployed due to COVID-19	OR (95% CI)	1.23 (0.95-1.60)	1.24 (0.94-1.64)	1.16 (0.88-1.54)	1.20 (0.91-1.59)	1.20 (0.91-1.58)
	p	0.118	0.124	0.289	0.197	0.192
Living alone	OR (95% CI)	1.07 (0.88-1.30)	1.07 (0.88-1.31)	1.04 (0.85-1.28)	1.05 (0.85-1.29)	1.04 (0.85-1.27)
	p	0.509	0.520	0.703	0.653	0.709

Odds Ratios (OR) that are statistically significant at p < 0.05 are bolded

**Table 6**

Logistic regression of the association between COVID-19 quarantine and suicidal thoughts/feelings as a result of the COVID-19 pandemic in the previous two weeks, after controlling for potential covariates.

Covariates		Reported reason for COVID-19 quarantine				
		Model 2a: Quarantined for any reason	Model 2b: "I have self-isolated with symptoms of COVID-19"	Model 2c: "My household has self-isolated because someone else had symptoms of COVID-19"	Model 2d: "My household has self-isolated due to contact with someone else who had symptoms of COVID-19"	Model 2e: "My household has self-isolated due to recent travel"
Reason for COVID-19 quarantine	OR (95% CI)	<b>2.47</b> (1.65-3.71)	<b>3.04</b> (1.71-5.44)	2.40 (0.92-6.26)	<b>7.91</b> (3.56-17.61)	1.58 (0.81-3.07)
	p	<0.001	<0.001	0.075	<0.001	0.180
Household income (\$25k+ CAD)	OR (95% CI)	0.63 (0.40-1.01)	<b>0.56</b> (0.35-0.90)	<b>0.54</b> (0.33-0.89)	<b>0.54</b> (0.33-0.89)	<b>0.53</b> (0.32-0.86)
	p	0.057	0.017	0.015	0.015	0.010
Age (years)	OR (95% CI)	<b>0.97</b> (0.96-0.98)	<b>0.98</b> (0.97-0.990)	<b>0.98</b> (0.97-0.99)	<b>0.98</b> (0.97-0.99)	<b>0.98</b> (0.96-0.99)
	p	<0.001	0.002	0.001	0.002	<0.001
Pre-existing mental health condition	OR (95% CI)	<b>4.90</b> (3.51-6.85)	<b>5.10</b> (3.57-7.28)	<b>5.28</b> (3.65-7.63)	<b>5.20</b> (3.60-7.50)	<b>5.35</b> (3.72-7.70)
	p	<0.001	<0.001	<0.001	<0.001	<0.001
Unemployed due to COVID-19	OR (95% CI)	1.45 (0.91-2.31)	1.54 (0.94-2.52)	1.38 (0.82-2.34)	1.39 (0.82-2.34)	1.43 (0.85-2.40)
	p	0.116	0.090	0.230	0.222	0.179
Living alone	OR (95% CI)	<b>1.91</b> (1.32-2.77)	<b>1.79</b> (1.21-2.64)	<b>1.91</b> (1.28-2.85)	<b>1.94</b> (1.30-2.88)	<b>1.91</b> (1.29-2.85)
	p	0.001	0.003	0.002	0.001	<0.001

Odds Ratios (OR) that are statistically significant at p < 0.05 are bolded

**4. Discussion**

**4.1. Key Findings**

This paper presents results from a national survey of adults living in

Canada (n=3000) on the impacts of COVID-19 quarantine on mental health, suicidal ideation, and deliberate self-harm. Our findings identify that those who have undertaken COVID-19 quarantine as a result of the pandemic are more likely than those who have not to experience suicidal ideation and deliberate self-harm, even after controlling for potential

**Table 7**

Logistic regression of the association between COVID-19 quarantine and deliberate self-harm as a result of the COVID-19 pandemic in the previous two weeks, after controlling for potential covariates.

Covariates		Reported reason for COVID-19 quarantine				
		Model 3a: Quarantined for any reason	Model 3b: "I have self-isolated with symptoms of COVID-19"	Model 3c: "My household has self-isolated because someone else had symptoms of COVID-19"	Model 3d: "My household has self-isolated due to contact with someone else who had symptoms of COVID-19"	Model 3e: "My household has self-isolated due to recent travel"
Reason for COVID-19 quarantine	OR (95% CI)	<b>2.90</b> (1.49-5.65)	<b>4.65</b> (1.99-10.89)	2.82 (0.63-12.66)	<b>4.41</b> (1.25-15.59)	0.94 (0.22-4.00)
	P	0.002	<0.001	0.175	0.021	0.930
Household income (\$25k+ CAD)	OR (95% CI)	2.22 (0.66-7.58)	2.18 (0.63-7.56)	2.21 (0.51-9.61)	2.14 (0.50-9.27)	2.18 (0.50-9.43)
	P	0.199	0.219	0.289	0.308	0.298
Age (years)	OR (95% CI)	<b>0.94</b> (0.92-0.96)	<b>0.95</b> (0.93-0.97)	<b>0.95</b> (0.93-0.98)	<b>0.95</b> (0.93-0.98)	<b>0.95</b> (0.93-0.98)
	P	<0.001	<0.001	<0.001	<0.001	<0.001
Pre-existing mental health condition	OR (95% CI)	<b>2.59</b> (1.41-4.78)	<b>2.83</b> (1.47-5.43)	<b>3.13</b> (1.57-6.25)	<b>2.68</b> (1.35-5.34)	<b>3.14</b> (1.57-6.27)
	P	0.002	0.002	0.001	0.005	0.001
Unemployed due to COVID-19	OR (95% CI)	0.74 (0.28-1.96)	0.80 (0.29-2.18)	0.61 (0.18-2.07)	0.62 (0.18-2.08)	0.67 (0.20-2.26)
	P	0.546	0.664	0.425	0.437	0.522
Living alone	OR (95% CI)	1.60 (0.80-3.20)	1.39 (0.67-2.90)	1.25 (0.55-2.84)	1.21 (0.54-2.71)	1.27 (0.56-2.87)
	P	0.181	0.378	0.587	0.652	0.565

Odds Ratios (OR) that are statistically significant at  $p < 0.05$  are bolded

covariates (i.e., age, pre-existing mental health condition, living alone, unemployed due to COVID-19, or household income over \$25,000). These data contribute to existing research from previous virus outbreaks and emerging data from the COVID-19 pandemic, which has illuminated the significant impact of quarantine on mental health. In the present pandemic, modelling studies demonstrate that COVID-19 quarantine in high-transmission areas and following exposure or travel is a crucial public health measure, averting 44-81% of cases and 31-63% of deaths in a virus outbreak or pandemic context (Nussbaumer-Streit et al., 2020). Yet, despite the importance of this approach to reducing virus transmission, individuals who COVID-19 quarantine are at higher risk for depression, anxiety, post-traumatic stress, and suicidal ideation, and experience high levels of fear, worry, and despair (Gan et al., 2020; Luo et al., 2020; Xin et al., 2020). Further, quarantine in the context of COVID-19 can potentially contribute to income and/or job loss, separation from social supports, food insecurity, and fears of contracting and spreading illness, all compounding mental health impacts during and beyond the quarantine period (Chan et al., 2006; Fawaz and Samaha, 2020; Nicola et al., 2020). However, even in light of the known mental health consequences of COVID-19 quarantine, limited research has examined its relationship to suicidal ideation and self-harm. This paper contributes evidence that supports the recognition of quarantine as a risk factor for suicidal thoughts and deliberate self-harm.

Further, to our knowledge, this paper is among the first to examine mental health outcomes for individuals who have experienced a COVID-19 quarantine period, while differentiating between reasons for quarantine, including recent travel. Our findings illustrate that there are important distinctions to be made based on the reason for quarantine, as these reasons are not uniformly associated with adverse mental health outcomes. While overlapping odds ratios preclude comparison between reasons for quarantine, findings from this analysis demonstrate that individuals who have quarantined due to COVID-19 symptoms or contact with someone with symptoms are more likely to have worse mental health outcomes, specifically suicidal thoughts and self-harm behaviours. However, those who have quarantined due to recent travel are no more likely than those who have not quarantined to report worse mental

health, suicidal ideation, or self-harm. This may be explained in that this group may have more access to financial and other resources and may not have reason to believe that they have been exposed to the virus, which could increase experiences of challenging emotions, such as fear. Indeed, existing literature supports that fear of COVID-19 exposure is associated with both negative mental health consequences (Tang et al., 2020) and suicide (Dsouza et al., 2020), and may contribute to adverse mental health outcomes, as seen in the subsample of our study participants who quarantined due to exposure and/or symptoms. Additionally, individuals who quarantine after travel may experience an increased ability to anticipate and prepare logistically and emotionally for the quarantine period. These data illustrate the importance of nuanced explorations into the mental health consequences of COVID-19, including across reasons for COVID-19 quarantine. This is particularly critical given that some research has failed to identify mental health impacts when simply aggregating data across quarantine reasons (Zhu et al., 2020).

#### 4.2. Policy and public health implications

Data from our study suggest an association between COVID-19 quarantine and suicide and self-harm, particularly for those who self-isolate due to experiencing symptoms or potential exposure. It is important to note that while those who have experienced a period of COVID-19 quarantine following recent travel did not have higher odds of suicidal ideation compared to those who did not COVID-19 quarantine (5.1% for both groups), the rates of suicidal ideation still appear to be elevated over pre-pandemic levels when the past year prevalence of suicidal thoughts was 2.5% among Canadians aged 15 and older (Statistics Canada, 2019).

Globally, researchers and public health officials have expressed great concern about the likelihood of increased suicides related to the pandemic (Moser et al., 2020; Sher, 2020). In the Canadian context, McIntyre and Lee (2020) predict an excess of 2000 suicides in 2020-2021 as a result of increased unemployment due to COVID-19 alone. Public health measures must be responsive to the risks for

mental health deterioration, including increased rates of suicidal ideation and self-harm among those who COVID-19 quarantine and develop appropriate supports to mitigate potential harms. For example, there have been calls for strengthening virtual mental health resources and providing mental telehealth services to those in quarantine in response to the significant mental health burden of the pandemic (Holmes et al., 2020; S. Liu et al., 2020; Zhou et al., 2020). In light of our findings, we suggest that these supports be offered proactively – rather than passively or reactively – and should not necessitate individuals in crisis to mobilize and reach out themselves for supports, such as with suicide crisis lines. As such, referrals to mental health resources and supports should be built into surveillance measures, including the initial COVID-19 quarantine instructions. During COVID-19 quarantine, follow-up phone calls or visits from public health professionals should include appropriate mental health checks, as opposed to being used solely to monitor adherence to isolation. Further, based on a review of quarantine during previous virus outbreaks, Brooks et al. (2020) suggest providing households with basic supplies, such as food and medications, and ensuring that individuals have mechanisms to contact public health professionals should questions or concerns arise, as ways to mitigate mental health impacts of quarantine. An example of this can be seen in Chicago, Illinois, where contact tracers with Howard Brown Health respond to questions about COVID-19 while also providing food deliveries, and in some cases cash aid, to reduce the barriers that some individuals (particularly those with low incomes or experiencing other structural vulnerabilities) face in following public health orders (Schneider and Pollack, 2020). Appropriate mental health supports for those in COVID-19 quarantine may further serve to support compliance with quarantine orders, as the literature has suggested that cooperation is variable (Bodas & Peleg, 2020). This may have significant public health implications for virus transmission; however, further research is needed to assess the potential impacts of adverse mental health outcomes on quarantine compliance.

In addition to supports provided during the COVID-19 quarantine period itself, it is also important to build responsive programming that addresses mental health consequences that may persist beyond the quarantine period (Brooks et al., 2020; Jeong et al., 2016). This could involve clinician's "flagging" those who have experienced a period of COVID-19 quarantine and conducting further assessment and follow up. Furthermore, the impacts of quarantine, as well as the other challenges to population mental health related to the pandemic, will necessitate an expansion and adaptation of accessible mental health systems and services (Moreno et al., 2020). This need for services growth comes against a wider backdrop of pre-pandemic calls to expand and strengthen mental health systems both in Canada (Urbanoski et al., 2017) and globally (Jack et al., 2014; Patel et al., 2018) due to the rising prevalence of adverse mental health outcomes at the population level (Lang et al., 2018; Rehm and Shield, 2019).

#### 4.3. Study limitations and future research priorities

While this paper presents data from a large and robust sample of adults living in Canada, there are limitations to consider. Firstly, this study examined self-reported reasons for COVID-19 quarantine, including experiencing symptoms and recent exposure to someone with symptoms. As testing becomes increasingly available, further research may benefit from examining the differential impacts of quarantine in the context of a positive COVID-19 diagnosis or exposure to someone confirmed positive, compared to those who suspect they have or may become infected.

Future research would also benefit from examining additional potential confounders, such as specific occupations that may have higher risks of exposure. Survey measures captured self-harm and suicidal ideation in the previous two weeks, while quarantine was evaluated from the beginning of the pandemic. Findings thus do not necessarily reflect self-harm or suicidal ideation exclusively *during* the COVID-19

quarantine period but may also reflect those experiencing lasting mental health impacts sometime after having ended COVID-19 quarantine. Likewise, participants were specifically asked about suicidal ideation and self-harm attributed to the COVID-19 pandemic. While we consider this a strength of the present analysis, as it focuses on the impacts of the pandemic itself, it is possible that it results in an underestimate of the overall prevalence of these phenomena in the sample. Further research can additionally guide public health responses by examining population sub-groups who may be at higher risk for suicidal ideation or self-harm related to COVID-19 quarantine, and how particular aspects of COVID-19 quarantine such as loneliness, fear, or financial worries may contribute to greater risks for poor mental health. Future research would benefit from analysis examining the impacts of repeated periods of quarantine as well as the impact of the number of days spent quarantining.

Additionally, while the recruitment and sampling strategy used by Maru/Matchbox contributed to a study sample that was nationally representative of the Canadian population by age, gender, region, and income, there are limitations in the representativeness across other variables. In particular, the sample was not representative of the ethnic origins of the Canadian population, and some groups were underrepresented in our sample, including Indigenous peoples (Statistics Canada, 2018). Further, while attempts were made to mitigate technology barriers, the online survey format may have led to underrepresentation of individuals with limited access to technology. Future research may benefit from adopting additional measures to sample among these populations, particularly given the disproportionate mental health impacts of the COVID-19 pandemic on individuals who experience structural vulnerability ([Authors, 2020]).

## 5. Conclusions

In summary, this paper confirms previous findings that individuals who experience a period of COVID-19 quarantine are at increased risk for adverse mental health impacts, including suicidal ideation, compared to those who have not. Further, in this paper, we present novel findings about increases in deliberate self-harm among those who COVID-19 quarantine. Critically, however, those who have COVID-19 quarantined are not a homogenous group: the reason for COVID-19 quarantine is associated with the prevalence of worsening mental health, suicidal ideation, and deliberate self-harm. In particular, those who have undertaken COVID-19 quarantine due to recent travel do not appear more likely to have experienced self-reported worsening mental health, suicidal ideation, or self-harm than those who have not COVID-19 quarantined. Given the importance of COVID-19 quarantine as a public health tool, these data point to an immediate need for an evidence-based public health response to mitigate the risks for mental health deterioration, including suicidality, among those who undertake COVID-19 quarantine.

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## Author's contributions

EJ, CM, and AG co-led the conceptualization of the study. EJ directed the project administration and contributed to analysis and writing – original draft. ZD led the analysis and writing – original draft. AS contributed to writing – original draft. CR and TS contributed to analysis and writing – original draft. CM and AG further contributed to writing of this manuscript – review and editing. SH and KT contributed to the writing of this manuscript – review and editing.



## Declaration of Competing Interest

CR reports receiving personal fees from the University of British Columbia during the conduct of this study. All other authors report no competing interests. The CMHA funded Maru/Matchbox data collection. CMHA had no further role in data collection, analysis, or interpretation related to this manuscript.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2020.113631](https://doi.org/10.1016/j.psychres.2020.113631).

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