

What drives resistance to Public Health measures in Canada's COVID-19 pandemic? An online survey of Canadians' knowledge, attitudes, and practices

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Abstract

Background: The ongoing COVID-19 pandemic has spread across 188 countries and claimed over 300,000 lives so far. Despite strong public health messaging and strict community restrictions in Canada, misconceptions and high-risk behaviours such as mass public gatherings have contributed to its spread across the country. Local data on the knowledge, attitudes, and practices from high-case areas could inform public health messaging during the current unprecedented pandemic.

Study Objective: To collate and describe the knowledge, attitudes, and practices of highly affected Canadian communities related to the COVID-19 pandemic and to evaluate factors associated with risky behaviours in order to inform public health policies and communication.

Methods and Study Design: Information on COVID-19 knowledge, attitudes, and practices was collected via online convenience sampling from 1,593 Canadians between 6 to 26 April, 2020. The high outbreak provinces of Alberta and Ontario were targeted.

Findings: While knowledge of COVID-19 transmission and prevention was high (mean knowledge score of 10.5/12 (88%)), a significant minority of respondents (32%) expressed at least one attitude resistant to public messaging that could hamper containment efforts: visiting crowded places other than grocery stores or pharmacies, close encounters with non-household members, and intention not to isolate if having mild flu symptoms, or known COVID-19 exposure. Factors associated with these risky behaviours included low COVID-19 knowledge (OR 1.2 (95% CI 1.1-1.3), $p=0.0057$), feeling not worried (OR 2.9 (95% CI 2.2-3.9), $p<0.001$), and feeling uninformed about the pandemic (OR 1.6 (95% CI 1.1-2.3), $p=0.030$). Respondents reported high acceptance of a potential vaccine (93%) and endorsed a wide-spread vaccination strategy (81%).

Interpretation: Low levels of knowledge and worry regarding COVID-19 may be key contributors to resistance against public health messaging. A potential vaccine, if made available to the general public, would likely be widely accepted.

Introduction

Background

The first case of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 2019 (COVID-19), was documented in December, 2019, in Wuhan, China.¹ Being highly infectious, the virus has spread rapidly across the world and consequently has spurred a pandemic as declared by the World Health Organization on March 11, 2020. In Canada, COVID-19 was first documented in January, 2020 and

now has spread to all provinces, bringing the country to a total of 327,313 cases and 10,187 deaths, as of this writing.^{2,3} Throughout Canada's response to the pandemic, public health officials have regularly implored citizens to practice physical distancing, which refers to keeping a physical distance of at least two meters apart.⁴ Many other intensive control strategies have taken place across the country as well, including the closure of public spaces and non-essential services, community containment, timely case detection, thorough contact tracing and management, isolation for infected and suspected cases, and mandatory masks in enclosed public spaces.^{5,6} In response to lower caseloads, public health authorities have relaxed certain measures such as opening up many public spaces, restaurants, bars, and gyms, and consequently, case load numbers have risen steadily since.^{7,8}

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Despite strong health messaging efforts throughout the pandemic, there have been many reports of people not adhering to their province's public measures, which furthers the risk of disease spread in communities.^{9,10} To better understand this resistance to messaging, data on community-wide knowledge, attitudes, and practices (KAP) pertaining to COVID-19 could prove insightful.¹¹⁻¹³ For example, during the 2003 SARS outbreak, surveys found that people were more likely to take extra protective measures against infection if they had a higher perceived risk of infection.¹⁴ Additionally, a KAP study focusing on China during the initial COVID outbreak demonstrated that higher levels of knowledge were associated with both greater protective practices and optimism.¹¹ As of now, there is no effective treatment or vaccine against COVID-19, which highlights the extreme importance of public awareness and compliance to infection control strategies. This may be even more important in the low-resource regions of Canada that may lack the capacity and essential healthcare resources necessary for an efficient and effective response to the pandemic.¹⁵

Study Objective

The rapid spread of COVID-19 demonstrates the need for swift assessment of the Canadian public's KAP pertaining to the disease. Our objective was to describe the KAP of Canadian communities highly affected by the COVID-19 pandemic and to evaluate factors associated with risky behaviours. This was accomplished via an online survey questionnaire targeting Alberta and Ontario, two of Canada's most affected provinces, between April 6 and 26, 2020.⁷ Findings from this study will be able to inform health communication efforts and streamline Canada's pandemic response.

Methods

Study Design

A cross-sectional survey was designed for the study and adhered to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement. Due to the rapid spread of the disease and public health measures put in place during the pandemic, it was not possible to conduct a community-based national sampling survey. We therefore used rapid open online surveys with convenience sampling to reach across large geographic areas with no face-to-face interaction. The survey adhered to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) checklist (Appendix A).¹⁶ The study was approved by the Health Research Ethics Board of the University of Alberta.

Participants

To recruit respondents, we relied on the authors' networks to distribute the survey using a one-page poster that was posted and shared on various social media platforms including Facebook, Twitter, and Instagram. The survey was also featured on the websites and Twitter pages of local news media companies. As such, the response rate is unknown. A total of 1593 individuals (1118 female) responded and completed the survey between April 6 and 26, 2020. The survey was purposively targeted to residents of Alberta (n=997) and Ontario (n=434), the most affected English-speaking provinces, via the aforementioned distribution networks.

However, residents from other provinces and territories were also eligible to respond (n=161). Respondents were required to speak English and be above the age 16 to participate.

Survey Questionnaire

A 43 item questionnaire was developed based on a COVID-19 KAP questionnaire used in China and an Ebola KAP study in the Democratic Republic of the Congo.^{11,17} Respondents were required to provide informed consent via a click box prior to beginning the voluntary survey. In addition to participant demographics, questions focused on several key constructs relevant to public messaging with respect to COVID-19:

1. *Knowledge.* To assess knowledge of COVID-19, participants were asked 12 questions pertaining to the presentation, transmission, and treatment of COVID-19 adapted from a previous KAP survey.¹¹ A cumulative knowledge score was computed by assigning one point for each answer in agreement with current scientific knowledge, and no point assigned for an incorrect answer or for answer "I don't know".

2. *Attitudes.* The overall perception of COVID-19 risk was assessed by the question "are you worried about COVID-19?"¹⁷ Two questions assessed optimism regarding the control of the COVID-19 pandemic globally, and within Canada.¹¹

3. *Practices.* Seven items were included that related to precautionary practices adopted since the onset of the pandemic and intentions for if one were to get ill or be exposed to an infected individual.^{11,17} Four of these items identified risky behaviours and participants were determined to be "resistant" to public health messaging by identifying with any of the four behaviours: visiting crowded places, close encounters with non-household members, and intention to not isolate if having mild flu symptoms or if had known exposure to COVID-19.

4. *Interest and attitude toward potential COVID-19 vaccine.* We included two items adapted from a previous survey.¹⁷ Vaccine acceptance was operationally defined as an affirmative response to "A vaccine against COVID-19 is needed in Canada".

Statistical Analysis

GraphPad Prism version 6 (GraphPad Software Inc., La Jolla, CA, USA, 2012), and R (version 3.6.3, R core team, 2020) were used for data analyses. We examined associations between dichotomous variables using the two-tailed Pearson Chi-Square or Fisher's exact test, as appropriate. Associations between knowledge and demographics were evaluated with one-way analysis of variance (ANOVA) and multivariable linear analysis, while binary logistic regression analysis was used to examine associations with attitudes and practices.

Results

A total of 1593 participants were surveyed in Canada between 6 and 26 April, 2020. The participants' demographics and associated mean knowledge scores are shown in Table 1. Participants' KAP pertaining to COVID-19 are shown in Table 2.

The mean COVID-19-related knowledge score was 10.5/12 (88%) with a standard deviation of 1.1. Knowledge scores significantly differed across sex (p=0.0017), marital status (p<0.001), and number of co-habitants living in a residence (p=0.0039) (Table

1). In particular, of all the demographics evaluated, multiple linear regression analysis demonstrated lower levels of knowledge scores in males (versus females, β : -0.212 (95% CI -0.089 - -0.335), $p < 0.001$), those who are single (versus married or common law, β : -0.257 (95% CI -0.112 - -0.402), $p < 0.001$), as well as an ordinal relationship of decreasing mean knowledge scores (10.52, 10.52, 10.49, 10.43, 10.35, and 10.13) with an increasing amount of co-habitants in the residence ranging from none, one, two, three, four, and five or more co-habitants in the residence, respectively (β : -0.065 (95% CI -0.021 - -0.110), $p = 0.0039$). Additionally, COVID-19 knowledge was positively associated with the affective response of "worried" (β : 0.188 (95% CI 0.039 - 0.336), $p = 0.013$), and negatively associated with the response "I don't know" (β : -0.320 (95% CI -0.037 - -0.603), $p = 0.027$), in relation to the question asking if worried about the COVID-19 pandemic.

Regarding preventive practices implemented since the COVID-19 outbreak, participants with higher knowledge scores were more likely to report avoiding crowded places (β : 0.290 (95% CI 0.097 - 0.482), $p = 0.0032$), not meeting up with non-household members within 1 meter (β : 0.178 (95% CI 0.049 - 0.307), $p = 0.0071$), avoiding physical contact with others (β : 0.524 (95% CI 0.190 - 0.857), $p = 0.0021$), and washing hands more frequently (β : 0.266 (95% CI 0.023 - 0.509), $p = 0.032$). Additionally, participants with higher knowledge scores were less likely to wear a mask (β : -0.125 (95% CI -0.001 - -0.248), $p = 0.048$) or gloves (β : -0.157 (95% CI -0.043 - -0.271), $p = 0.0069$) as a protective measure. COVID-19 knowledge scores were also positively associated with feeling informed about the pandemic (β : 0.597 (95% CI 0.401 - 0.794), $p < 0.001$). A majority of participants felt informed (80%)

Table 1. Demographics of cohort and associated knowledge scores pertaining to COVID-19

	n (%)	Knowledge score (mean +/- standard deviation)	p-value
Sex			0.002
Male	455 (29)	10.3 ± 1.2	
Female	1118 (70)	10.5 ± 1.1	
Other	13 (1)	10.1 ± 2.1	
Age group (years)			0.38
16 - 29	825 (52)	10.4 ± 1.0	
30 - 49	424 (27)	10.5 ± 1.1	
50+	341 (21)	10.5 ± 1.2	
Marital Status			0.001
Married or common law	689 (44)	10.6 ± 1.1	
Single	828 (52)	10.4 ± 1.1	
Other	65 (4)	10.3 ± 1.3	
Education			0.18
High School and below	208 (13)	10.4 ± 1.1	
Bachelor's degree (in process of or completed)	882 (56)	10.4 ± 1.1	
Post-graduate degree (in process of or completed)	489 (31)	10.5 ± 1.2	
Occupation			0.17
Student	568 (38)	10.4 ± 1.1	
Total Non-Student	942 (62)	10.5 ± 1.1	
Province			0.30
Alberta	997 (63)	10.5 ± 1.1	
Ontario	434 (27)	10.5 ± 1.1	
Other	161 (10)	10.3 ± 1.2	
Place of residence			0.43
Urban	1340 (85)	10.5 ± 1.1	
Rural	243 (15)	10.4 ± 1.2	
# of co-habitants			0.004
Alone	197 (12)	10.5 ± 1.1	
1 co-habitant	571 (36)	10.5 ± 1.1	
2 co-habitants	288 (18)	10.5 ± 1.1	
3 co-habitants	341 (21)	10.4 ± 1.1	
4 co-habitants	122 (8)	10.4 ± 1.1	
5+ co-habitants	71 (4)	10.1 ± 1.3	

Table 2. Knowledge, attitudes, and practices related to COVID-19 transmission, prevention, and treatment

	Response n (%):		
	Yes	Don't know	No
Knowledge about COVID-19 prevention and treatment			
Main clinical symptoms are fever, fatigue, dry cough, and muscle aches	1492 (94)	17 (1)	83 (5)
Unlike the common cold, stuffy nose, runny nose, and sneezing are less common	1193 (75)	200 (13)	197 (12)
Currently there is no effective cure, but early supportive treatment can help most patients recover	1449 (91)	81 (5)	69 (4)
People who are elderly or have chronic illnesses are more likely to have severe cases	1578 (99)	6 (0)	9 (1)
Those fully recovered from COVID-19 infection are still infectious and can transmit the virus to others	269 (17)	591 (37)	732 (46)
Animals, such as pets and livestock, can transmit COVID-19 to people	316 (20)	428 (27)	847 (53)
People without symptoms can still transmit COVID-19 to others	1564 (98)	11 (1)	14 (1)
The virus spreads most commonly via respiratory droplets of infected individuals	1556 (98)	12 (1)	23 (1)
It is not necessary for children and young adults to take measures to prevent infection of COVID-19	43 (3)	7 (0)	1540 (97)
To prevent infection, individuals should avoid going to crowded places and taking public transportation	1574 (99)	3 (0)	11 (1)
Isolation and treatment of people who are infected with COVID-19 are effective ways to reduce spread	1569 (99)	10 (1)	12 (1)
People should be immediately isolated after having contact with someone infected with COVID-19. In general, the observation period is 14 days.	1576 (99)	6 (0)	9 (1)
People can wear general medical masks to prevent the infection of COVID-19*	736 (46)	183 (12)	668 (42)
Attitudes toward COVID-19			
Worried about COVID-19	1257 (79)	75 (5)	252 (16)
Agreement COVID-19 will eventually be controlled	1228 (77)	293 (18)	65 (4)
Confidence Canada will eradicate COVID-19	849 (54)	417 (26)	318 (20)
Protective practices (since the onset of the pandemic, frequency of participants who...)			
Wear a mask when leaving home	421 (27)	5 (0)	1151 (73)
Wear gloves as protection when leaving home	557 (35)	8 (1)	1012 (64)
Avoid physical contact with other people	1525 (97)	10 (1)	43 (3)
Wash their hands more often	1487 (94)	6 (0)	83 (5)
Visit crowded places other than grocery store, pharmacy, or gas station	138 (9)	0 (0)	1441 (77)
Meet up with non-household friends/family within 1 meter distance	364 (23)	4 (0)	1210 (77)
Intentions of participant...			
	Self-isolate for 14 days	Don't know	Go about activities as normal
If had mild symptoms of flu, would...	1399 (89)	103 (7)	75 (5)
If had known exposure to someone infected with COVID-19, would...	1505 (95)	48 (3)	26 (2)

*This question was not included in the knowledge score as there was conflicting information on the protective efficacy of wearing a mask during the survey period

Primary Research

What drives resistance to Public Health measures in Canada's COVID-19 pandemic? An online survey of Canadians' knowledge, attitudes, and practices

Table 3. Factors associated with resistance versus compliance, based on grouping four putative indices of resistance to COVID-19 public messaging

	Response, n (%): ¹			
	Resistant ² (n=502)	Compliant (n=1088)	OR (95% CI) ³	p-value
Male vs female sex	166 (33)	282 (26)	1.4 (1.1-1.7)	0.0071
16 - 29 years old vs 30+ years old	286 (57)	530 (49)	1.4 (1.1-1.7)	0.0066
Single vs Married/common law	283 (56)	536 (49)	1.4 (1.1-1.7)	0.0046
High School and below vs some university & above	62 (12)	146 (13)	0.9 (0.66-1.2)	0.58
Student vs Non-student	197 (39)	366 (34)	1.3 (1.0-1.6)	0.046
Alberta vs Ontario	349 (70)	640 (59)	1.5 (1.2-2.0)	<0.001
Urban vs Rural	426 (85)	902 (83)	1.0 (0.78-1.4)	0.82
Alone vs 1+ co-habitant	76 (15)	121 (11)	1.4 (1.0-1.9)	0.029
Not worried about COVID-19 vs worried	133 (26)	118 (11)	2.9 (2.2-3.8)	<0.001
Feel not informed about COVID-19 vs informed	54 (11)	74 (7)	1.7 (1.1-2.4)	0.01
COVID-19 knowledge score (mean ± standard deviation)	10.3 ± 1.2	10.5 ± 1.1	..	<0.001

¹All response values are in reference to the bolded demographic or characteristic only, including the percentage of total responses which is indicated in brackets. The non-bolded demographic or characteristic is shown only to indicate the comparison cohort used to calculate p-values

²Respondents were classified as "resistant" if they answered "yes" to visiting crowded places other than grocery stores, pharmacies, or gas stations, or to meeting up with non-household family and friends within one meter. Respondents were also classified as "resistant" if they responded "go about activities as normal" in response to intentions if respondent had mild symptoms of cold or flu, or if respondent were exposed to someone known to be infected with COVID-19.

³The Odds Ratio is comparing the bolded demographic or characteristic with the corresponding non-bolded demographic or characteristic

and reported public health authorities (1218/1593, 85%), media (1218/1593, 76%), and family and friends (443/1593, 28%) as main sources of public health information during the pandemic.

A considerable minority of participants (32%) engaged in or supported at least one behaviour that was considered to be "resistant" to public health messaging: visiting crowded places, close encounters with non-household members, and intention to not isolate if having mild flu symptoms or if known exposure to COVID-19 (Table 3). Key demographics and attitudes associated with these risky behaviours are shown in Table 3.

Table 4 shows the factors that are associated with each risky behaviour. Most notably, participants "not worried" about COVID-19 was associated with all four risky behaviours (p<0.001).

A binary logistic regression analysis of significant factors associated with behaviours resistant to public messaging is shown in Table 5.

Our survey was primarily targeted at residents of Alberta and Ontario (Table 2), two of the three most affected provinces in Canada. Ontarians were more likely to report a perceived personal risk of being infected with COVID-19 if at work or school (OR 1.3 (95% CI 1.0-1.7), p=0.038) or when using public transit (OR 1.5 (95% CI 1.1-2.0), p=0.012), while also more likely to wear masks in public (OR 2.1 (95% CI 1.7-2.7), p<0.001). Interestingly, Albertans were significantly more likely to endorse meeting up with non-household member (OR 2.0 (95% CI 1.5-2.7), p<0.001). Our survey

Table 4. Factors associated with the four putative indices of resistance to COVID-19 public messaging

	Response n (%): ¹			
	Visit crowded places		Meet with non-household within 1 m	
	Yes (n=138) ²	No (n=1441)	Yes (n=364)	No (n=1210)
Male vs female sex	49 (36)	400 (28)	121 (33)*	327 (27)
16 - 29 years old vs 30+ years old	83 (60)	734 (51)	210 (58)*	604 (50)
Single vs Married/common law	81 (59)	740 (51)	202 (55)*	615 (51)
Student vs Non-student	59 (43)	504 (35)	140 (38)	421 (35)
Alberta vs Ontario	92 (67)	899 (62)	270 (74)***	718 (59)
Alone vs 1+ co-habitant	25 (18)*	171 (12)	59 (16)*	136 (11)
Not worried about COVID-19 vs worried	44 (32)***	207 (14)	99 (27)***	152 (13)
Feel not informed about COVID-19 vs informed	13 (9)	115 (8)	34 (9)	94 (8)
Lower COVID-19 knowledge score (mean ± standard deviation)	10.2 ± 1.2**	10.5 ± 1.1	10.3 ± 1.2**	10.5 ± 1.1
	If had mild symptoms of flu, would...		If had known exposure to COVID-19, would...	
	Go about activities as normal (n=75)	Self-Isolate for 14 days (n=1339)	Go about activities as normal (n=26)	Self-Isolate for 14 days (n=1505)
Male vs female sex	34 (45)***	380 (28)	13 (50)*	419 (28)
16 - 29 years old vs 30+ years old	32 (43)	729 (54)	9 (35)	781 (52)
Single vs Married/common law	37 (49)	727 (54)	12 (46)	779 (52)
Student vs Non-student	24 (32)	503 (38)	6 (23)	541 (36)
Alberta vs Ontario	41 (55)	891 (67)	14 (54)	949 (63)
Alone vs 1+ co-habitant	9 (12)	172 (13)	5 (19)	181 (12)
Not worried about COVID-19 vs worried	30 (40)***	204(15)	15 (58)***	223 (15)
Feel not informed about COVID-19 vs informed	11 (15)	108 (8)	2 (8)	119 (8)
Lower COVID-19 knowledge score (mean ± standard deviation)	10.2 ± 1.4	10.5 ± 1.1	9.7 ± 1.6***	10.5 ± 1.1

¹All response values are in reference to the bolded demographic or characteristic only, including the percentage of total responses indicated in brackets. The non-bolded demographic or characteristic is shown only to indicate the comparison cohort used to calculate p-values

²P-values were obtained for each comparison of the bolded demographic or characteristic with the corresponding non-bolded demographic or characteristic

*p<0.05, **p<0.01, ***p<0.001

Table 5. Binary logistic regression analysis of significant factors associated with behaviours resistant to public messaging

	OR (95% CI) ¹	p-value
16 - 29 years old vs 30+ years old	1.3 (1.0-1.9)	0.046
Alberta vs Ontario	1.6 (1.3-2.1)	<0.001
Alberta vs other provinces	1.7 (1.1-2.5)	0.010
Not worried about COVID-19 vs worried	2.9 (2.2-3.9)	<0.001
Not worried about COVID-19 vs unsure if worried	3.4 (1.9-6.2)	<0.001
Feel not informed about COVID-19 vs informed	1.6 (1.1-2.3)	0.030
Lower COVID-19 knowledge score	1.2 (1.1-1.3)	0.0057

¹The Odds Ratio is comparing the bolded demographic or characteristic with the corresponding non-bolded demographic or character

also included 1340 (85%) urban participants and 243 (15%) rural participants but found no significant differences between their attitudes or practices ($p>0.05$ for all comparisons).

Vaccine acceptance was universally high (93%) and did not differ significantly by sex, age, marital status, education, occupation, or location ($p>0.05$ for all comparisons). Alternatively, vaccine acceptance was significantly associated with higher knowledge scores ($p<0.001$), being worried about COVID-19 (OR 20.4 (95% CI 8.4-49.5), $p<0.001$), optimism in controlling the pandemic (OR 8.1 (95% CI 3.4-19.7), $p<0.001$), and feeling informed regarding COVID-19 (OR 3.9 (95% CI 1.7-9.3), $p=0.0049$). Participants supported a wide-base vaccination strategy (81%).

Discussion

Contemporaneously with the unfolding COVID-19 pandemic in Canada, we collected data on community KAP related to COVID-19 to improve public health messaging and response. To the best of our knowledge, this is the first study evaluating the KAP of Canadians regarding COVID-19, as well as the most extensive KAP study examining potential determinants of risky practices that could further exacerbate infection spread. Our survey results indicated that a substantial minority of participants (32%) endorsed one of four behaviours reflecting "resistance" to public health measures: visiting crowded places, close encounters with non-household members, and intention not to isolate if having mild flu symptoms, or known exposure to COVID-19. Factors associated with resistance included male sex, 16-29 years old age group, a single relationship status, the occupation of "student", residing in Alberta, living alone, being "not worried" about COVID-19, feeling uninformed on the pandemic, and having a low level of knowledge about COVID-19.

In agreement with findings from China, being male, being a student, and having a low level of knowledge about COVID-19 were the factors that were significantly associated with risky behaviour.¹¹ These results may be explained by previous studies which documented increased risky behaviour in males and with younger age.^{18,19} Therefore, special attention towards improving COVID-19 education in these targeted populations may be beneficial in preventing outbreaks. This may be especially important for post-secondary institutions that return from online classes to in-person studies. Studies from the 2002-2004 SARS outbreak demonstrated that a higher perceived risk of infection was associated with an increase in preventative infection measures.¹⁴ This is consistent with our findings that the participants who were "worried" about COVID-19 were significantly more likely to wear masks and gloves in public, avoid physical contact, and increase their frequency of hand washing. Additionally, this group was significantly less likely to endorse risky behaviours in all four survey questions evaluating social resistance. While 79% of respondents were "worried" about COVID-19, a Liberian Ebola study suggests that the public's level of worry will decrease in step with the number of regional cases.²⁰ This phenomenon may have explained the spike in Canadians ignoring mandated public health measures, including the outright protesting of such measures, as regional infection rates declined.^{9,10,21} Prompt and effective reporting of outbreaks may encourage community members to maintain compliance with public health measures.

Our survey found a high knowledge level regarding COVID-19 in our respondent group, as indicated by a mean knowledge score of 10.5/12 (88%), which is similar to findings in China (90%)¹¹ but higher than a comparable USA KAP study (80%).¹³ Our data suggest that female sex, being married or being in a common law relationship, and living with less co-habitants are factors that are associated with higher levels of knowledge pertaining to COVID-19. As females were overrepresented in our sample (70%), this may overestimate our COVID-19 knowledge findings. Interestingly, unlike other studies, we found that a higher education level was not associated with greater mean knowledge scores.¹¹⁻¹³ Knowledge of avoiding crowded places and proper isolation protocol after exposure to COVID-19 were both $>97%$ in our group and in China.¹¹ Despite this, 9% of our respondents (versus 3.6% in China) had recently visited crowded places other than grocery stores and pharmacies, suggesting that a substantial minority of Canadians might endorse this risky behaviour.¹¹ This finding may further the understanding of why community transmission in Canada has been primarily driven by event-specific outbreaks with large gatherings.²²

As KAP studies can be powerful informants for outbreak response teams, further evaluation is needed in Canada with a random nationally representative sample. The COVID-19 pandemic, and in turn the public health response, is ever evolving necessitating periodic assessment of the population's KAP to maximize public health measure adherence. Special attention should also be paid to low socioeconomic populations as they have been identified as a risky demographic in several international studies.¹¹⁻¹³ As was done in China, further subgroup analysis within identified risk-seeking demographics, such as males and those who are single, may be beneficial.²³ Finally, the utility of KAP data would be maximized by assessing the preferred means of communication for specific demographics.

The findings in this study are subject to several limitations. While we adapted survey questionnaire items from previous studies, the instrument has not been extensively validated in different contexts.^{11,17} Knowledge regarding COVID-19 transmission and prevention is a moving target and may change as the pandemic proceeds. Due to time constraints and the need to conduct the survey as the pandemic evolves, the comprehension of survey questions in French or other languages was not evaluated. The survey was not a random nationally representative sample, but rather an online sample that intentionally targeted high frequency outbreak provinces. As with much of online sampling, self-selection bias may have leaned preference to high-knowledge individuals, disadvantaging individuals in remote communities and those without access to the internet.

Despite these limitations, the findings from this report suggest that residents with low levels of knowledge and worry regarding COVID-19 are more likely to resist public health messaging. Given the high infection rate of the current pandemic, the resistance of a minority of the population, as demonstrated by engagement in risky behaviours, could result in a significant spike in cases. This spike could be especially devastating in communities that have low healthcare resources. Health education initiatives targeting demographics associated with low knowledge, such as males and those who are single, could therefore facilitate adherence to public health measures.

Author's Contributions

JGU conceived and designed the study, conducted the data collection, wrote and critically reviewed the manuscript. PB conducted the data collection, wrote and critically reviewed the manuscript. DR performed the data analysis and critically reviewed the manuscript. TH supervised the study, wrote and critically reviewed the manuscript.

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