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From facts to feelings: Navigating the complexities of COVID-19 restrictions, perceptions, and mental well-being

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ABSTRACT

Objectives of the present study were to 1) examine accuracy of COVID-19 public health restriction knowledge and the impact of information source, 2) assess the effect of *perceived* level of restriction on perceived infection risk of COVID-19 infection and level of compliance with restrictions, and 3) investigate the relationship between mental health outcomes and *perceived* as well as *actual* level of restriction. Canadians ($n = 5{,}051$) completed an online survey between December 2020 and March 2021 assessing public health restriction knowledge, accuracy of this knowledge, information sources about COVID-19, perceived infection risk, compliance with restrictions, loneliness, anxiety, and depressive symptoms. Approximately half of our sample had accurate knowledge of the restrictions in their region/province, which significantly differed by province. Individuals who perceived restriction levels to be higher than they were, reported significantly greater perceived infection risk, more compliance with restrictions, worse mental health, and greater loneliness. Individuals living under moderate restrictions had better mental health and experienced less loneliness compared to minor, significant and extreme restriction levels. Findings suggest that while restrictions are beneficial for compliance, stronger and clearer restrictions should be coupled with mental health supports to remediate the negative effects of restrictions and uncertainty on mental health and loneliness.

1. Introduction

COVID-19 is an infectious disease, with approximately 774 million confirmed cases worldwide and 7 million deaths as of February 2024 (World Health Organization, 2024). In Canada, there have been 4.9 million diagnosed cases and approximately 58,000 reported deaths (Government of Canada, 2024). To mitigate the spread of this virus, governments across the globe implemented public health restrictions focused on decreasing social contact, including regulation of travel and group gatherings, closing of non-essential businesses and schools, and mandated masks and vaccines (Kaimann and Tanneberg, 2021). Different levels of enforced restrictions resulted in unequal COVID-19 spread between countries. Of the G10 countries, Canada implemented the second most severe public health restrictions throughout the pandemic and had one of the lowest rates of COVID-19 infections (8270 per 100,000; Razak et al., 2022). However, little research has examined how knowledge about public health restrictions and perceived infection risk may have impacted compliance with restrictions.

Canadian studies demonstrated higher levels of compliance (e.g., practicing handwashing, physical distancing) early in the pandemic, but compliance declined by June of 2020 despite largely consistent restrictions (Lavoie et al., 2021). A key question is whether such changes reflect poor communication about ongoing restrictions or public fatigue. Supporting the former hypothesis, a study of Melbourne adults found that knowledge of local COVID-19 restrictions was not associated with individuals' intentions to follow the region's restrictions. However, individuals with greater knowledge of restrictions were less likely to report defying restrictions when provided specific examples of violations. Research also suggests many adults may have been unfamiliar with specific restrictions enacted in their region. For example, in

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April-May of 2020, only 62.9 % of surveyed German adults correctly identified whether their region had issued a stay-at-home order (Benke et al., 2020). Importantly, belief in the presence of a stay-at-home order, regardless of whether one was enacted, was associated with poorer mental health (Benke et al., 2020). However, little research has examined COVID-19 restriction knowledge in Canadian samples.

In previous studies, Canadians reported seeking information about the pandemic primarily from Canadian news sources (television, print media, or websites), followed by Canadian federal public health or government websites (Leigh et al., 2020). Most Canadians viewed social media skeptically, as a potential source of misinformation (Leigh et al., 2020). Prior studies showed an individual's total news consumption was positively associated with adherence to public health recommendations (Tukachinsky Forster and Vendemia, 2021). Additionally, individuals who relied on television news reported engaging in more recommended hygiene behaviours and social distancing. Those who relied on social media for their information reported more stockpiling and mask wearing (Tukachinsky Forster and Vendemia, 2021). Therefore, amount and source of COVID-19 information news and media consumption during the pandemic has had important implications for adherence to public health restrictions and recommendations.

In the context of the COVID-19 pandemic, perceived infection risk refers to how likely an individual believes they are to contract and transmit COVID-19 and how worried they are about the impacts of COVID-19 (Sjöberg et al., 2004). Two studies conducted in April-May 2020 found that 21.5 % to 53 % of Canadians felt at risk or concerned about contracting COVID-19 (Brankston et al., 2021; Leigh et al., 2020). Increased perceived infection risk has been shown to predict a greater likelihood of practicing COVID-19 protective behaviours (Duan et al., 2020). Additionally, more stringent public health restrictions are associated with increased perceived infection risk and compliance with public health orders. Longitudinal surveys of Australian adults have illustrated that perceived infection risks were positively associated with restriction severity, with ratings of perceived societal risk of COVID-19 decreasing with easing restrictions and rising following regional increases in restriction severity (Ayre et al., 2021). More severe restrictions could promote increased adherence to preventative behaviours. For instance, Götz et al. (2021) found that more stringent government COVID-19 restriction policy in a given country predicted increased rates of sheltering-in-place. As policymakers seek to promote protective behaviours and communicate the risks of future pandemics, the relationship between restriction severity, COVID-19 protective behaviours, and perceived infection risk is a salient concern.

Among Canadians, levels of anxiety, depression, and loneliness substantially increased during the COVID-19 pandemic (Bierman et al., 2021; Dozois and Mental Health Research Canada, 2021). One reason for this deterioration of mental health may be unintended consequences of public health restrictions, as most individuals reported being negatively impacted by such restrictions (Stolz et al., 2021). Individuals under stay-at-home orders reported more symptoms of anxiety, depression, stress, and loneliness than those not under this restriction (Gratz et al., 2020). Furthermore, the stringency of public health measures significantly predicted depressive symptoms in an international sample (Lee et al., 2021) and has been positively related to ratings of loneliness (Rathod et al., 2021).

More research is needed to illuminate factors that may have impacted compliance with public health restrictions in Canada, willingness to engage in COVID-19 protective behaviours, and the impact that restrictions had on Canadians' mental health. To address this, this study aimed to examine if:

(1a) Canadians were able to accurately identify the level of restriction in their region, and
(1b) the source that an individual used to obtain COVID-19 information as well as perceived knowledgeability was related to restriction level accuracy;
(2a) *perceived* level of restriction was associated with perceived infection risk and COVID-19 protective behaviours,
(2b) there was a relationship between perceived infection risk and COVID-19 protective behaviours; and
(3a) both *perceived* and *actual* levels of restrictions were associated with poorer mental health and greater loneliness, and
(3b) there were associations between perceived infection risk, COVID-19 protective behaviours, and mental health.

We hypothesized that individuals who reported feeling more knowledgeable about COVID-19 would be more accurate at reporting the current level of restriction, and that individuals who reported using social media as a news source would be less accurate at reporting the current level of restriction. Secondly, we hypothesized that perceived infection risk would be positively correlated with COVID-19 protective behaviours. Next, we hypothesized that individuals who *perceived* higher levels of restrictions would be more likely to report that their mental health had worsened since the start of the pandemic and would report higher levels of loneliness, anxiety and depression relative to those who perceived less restrictions. We predicted similar relationships between *actual* levels of restrictions and mental health, loneliness, anxiety and depression. Additionally, we hypothesized that there would be a positive relationship between perceived infection risk and anxiety, and negative relationships between COVID-19 protective behaviours and anxiety, depression, and loneliness.

2. Methods

2.1. Participants

A nation-wide online survey was administered to Canadians (n = 6472, 54.1 % female) between December 21, 2020 and March 30, 2021, in the context of a larger international study assessing the impacts of the COVID-19 pandemic on mental health functioning (Rathod et al., 2021).

Participants were recruited via social media advertising (i.e., Facebook and Twitter using unpaid, non-targeted posts; n = 782) and through a data services company (MARU/Blue; n = 5690). For participants recruited through MARU/Blue, we set quotas by age, sex, and province to match population proportions from the 2019 Canadian census. Participants were required to be (1) living in Canada at the time of the survey, (2) aged 17 years or older, and (3) able to complete the online survey in either official language (English or French).

2.2. Procedure

Participants accessed the survey via the Qualtrics XM Survey platform and reviewed the consent information. Consenting participants were then screened for eligibility, and eligible participants began the survey. The survey took approximately 15–20 minutes to complete and contained predominantly closed-ended, non-randomized items pertaining to demographics, mental health functioning, and emotional, social, living, and working circumstances.

Participants were compensated through either entry into a draw for various gift cards or MARU/Blue points for completing the survey. All aspects of the study for the Canadian cohort were approved by the institutional Human Research Ethics Board (Protocol #20–0320).

2.3. Measures

Brief descriptions of measures used are included here; please refer to Supplementary Appendix 1 for additional detail.

Participants were asked about the level of public health restrictions in their area (*perceived* level of restriction), and we were able to determine the accuracy of their responses based on published restrictions in their area at the time they completed the survey (*actual* level of restriction; Lawson et al., 2021). We compared their *perceived* level of

restriction to the *actual* level of restriction, coding participants as Accurate (perceived = actual), Underreported (perceived < actual) or Overreported (perceived > actual). Participants were also asked how knowledgeable they felt about local public health restrictions and what their top two sources of information about COVID-19 were.

To assess perceived infection risk, participants were asked how worried they felt regarding eleven different scenarios ranging from 'Getting coronavirus yourself' to 'Coronavirus impacting on society as a whole'. Items were summed together and divided by eleven to obtain an average perceived infection risk. To assess COVID-19 protective behaviours, participants were asked how well they had followed six different COVID-19 protective behaviours such as 'Staying at home except for essential journeys'. Items were summed together and divided by six to obtain an average level of compliance with protective behaviours. To account for perceived medical or personal risk, participants were asked whether they considered themselves vulnerable or high-risk with respect to COVID-19.

To assess mental health, participants were first asked if they had any diagnosed mental health conditions; participants who responded affirmatively were asked to rate how their mental health had changed since the start of the COVID-19 pandemic. All participants were also asked to complete the 9-item Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001) to assess severity of depressive symptoms (e.g., low mood, lack of interest or pleasure, fatigue) over the past 2 weeks, the 7-item Generalized Anxiety Disorder screener (GAD-7; Spitzer et al., 2006) to assess severity of anxiety symptoms (e.g., feeling nervous, anxious or on edge, trouble relaxing) over the past 2 weeks, and the UCLA 3-item Loneliness Scale (Hughes et al., 2004) to assess level of loneliness.

2.4. Data analyses

All analyses were conducted using IBM SPSS version 26. The data (n = 6472) were cleaned prior to study analyses to screen and remove potential duplicate responses, and incomplete or ineligible responses. A final sample size of n = 5920 was included in analyses. Pre-registered data cleaning procedures can be found on the Open Science Framework.[1]

Since Ontario had very specific regional restrictions, and our survey only divided Ontario into 5 broad regions, our information was only precise enough to determine the *actual* level of restriction for different regions in Ontario during the province-wide lockdown period (i.e., between December 26, 2020 – February 9, 2021). As such, for analyses involving *actual* level of restriction and/or accuracy of restriction perception, we only included Ontario participants who completed the survey during that lockdown period. Consequently, sample sizes differ by analyses for Aims 1, 2 and 3 (see Table 1).

2.4.1. Aim 1

To determine whether Canadians were able to accurately identify the level of restriction in their region (Aim 1a), we conducted chi-square analyses examining differences in accuracy of restriction perception (i.e., *perceived* compared to *actual*) between provinces. We then conducted two additional chi-square analyses to determine whether either (1) *perceived* or (2) *actual* restriction level in a participant's region affected accuracy (e.g., whether living in an area with higher restrictions resulted in more or less accuracy compared to other areas). Participants from Nunavut, the Northwest Territories and Yukon were excluded from these analyses due to small sample sizes.

To determine the relationship between news source, self-reported knowledgeability, and restriction level accuracy (Aim 1b), we used two chi-square analyses to examine (1) differences in restriction accuracy across different levels of self-reported knowledgeability about COVID-19, and (2) differences in restriction accuracy across different top two preferred news sources.

Table 1
Participant characteristics.

	Aim 1*	Aims 2	Aim 3
N	3605	5051	3948
Age Group (%)			
17–20	5.6	5.1	5.4
21–24	10.9	10.5	10.6
25–34	18.4	18.3	18.8
35–44	16.8	17.4	17.4
45–54	16.8	16.5	16.5
55–64	15.6	16.2	16
65+	15.8	15.9	15.2
Sex (% M/F)	46.1/53.9	44.9/55.1	45.6/54.4
White Ethnicity (%)	79.9	81.1	80.1
Education (%)			
Left before completing HS	2.2	2.2	2.3
Completed HS	16.7	15.6	15.5
Attended some PS or technical college	22.3	19.9	21
Completed 2-year PS degree	12.3	11.9	12.4
Completed 4-year PS degree	25.4	26.1	27
Completed post-grad degree	18	21.7	19.5
Other	2.1	1.9	1.9
Prefer not to say	0.8	0.5	0.5
Employment (%)			
Full-time	42.7	43.5	43.4
Part-time	11.8	10.8	11.2
Self-employed	5.9	6.6	6.4
Voluntary employment	0.3	0.3	0.3
Retired	19.1	19.3	18.7
Unemployed (receiving benefits)	5.5	5.7	5.9
Unemployed (not receiving benefits)	7	6.5	6.9
Home maker	3.4	3.2	3.2
Other	3.1	3.1	3
Prefer not to say	1.2	0.9	1
Vulnerable to COVID-19 (%)	33.6	34.2	33.8

* Excluding aim 1B (news source analyses; n = 3414). HS= high school; PS= post-secondary.

2.4.2. Aim 2

To determine whether *perceived* level of restriction was associated with perceived infection risk (Aim 2a), we conducted a one-way analysis of covariance (ANCOVA) between perceived infection risk and *perceived* level of restriction while controlling for ethnicity, age, sex and self-reported vulnerability to COVID-19. Tukey's HSD was used for pairwise post hoc comparisons when F was interpreted, and Games-Howell test was used when Welch's F was interpreted.

To determine whether *perceived* level of restriction was associated with compliance with COVID-19 protective behaviours (Aim 2a), we again conducted a one-way ANCOVA to examine whether *perceived* level of restriction predicted engagement in COVID-19 protective behaviours, while controlling for ethnicity, age, sex, and vulnerability to COVID-19. Post hoc procedures were the same as stated above.

To determine the relationship between perceived infection risk and level of engagement in COVID-19 protective behaviours (Aim 2b), we conducted a two-tailed Pearson correlation.

2.4.3. Aim 3

To determine the relationship between *perceived* as well as *actual* levels of restrictions and mental health (Aim 3a), two sets of chi-square analyses were used to examine (1) differences between *perceived* level of restriction and mental health functioning since the start of the pandemic, and (2) differences between *actual* level of restriction and mental health functioning since the start of the pandemic.

To further examine the relationship between *perceived* as well as *actual* levels of restrictions and mental health (Aim 3a), two series of one-way ANCOVAs were conducted. The first to examined differences

[1] To access our pre-registered data cleaning document, please visit https://osf.io/4d6tq and navigate to the Data Cleaning Journal documents with the Wave 2 folder.

across *perceived* level of restriction in (1) depression symptoms, (2) anxiety symptoms, and (3) loneliness while controlling for ethnicity, age, sex and vulnerability to COVID-19. The second ANCOVA similarly examined differences in these areas across *actual* level of restriction.

To explore associations between perceived infection risk, COVID-19 protective behaviours, and mental health, a series of Two-tailed Pearson correlations (*r*) were conducted between perceived infection risk and depression symptoms, anxiety symptoms and loneliness, and between COVID-19 protective behaviours and depression symptoms, anxiety symptoms and loneliness, respectively.

3. Results

3.1. Sample characteristics

The sample characteristics for Aims 1, 2 and 3 are displayed in Table 1.

3.2. Aim 1

3.2.1. Provincial comparison in accuracy of reported restrictions (Aim 1a)

Most respondents (58.4 %) accurately reported the current level of restriction in their region/province. Of the 41.6 % of individuals who were inaccurate, 39.1 % underreported the current restriction level (i.e., perceived lower restrictions than were in place) while 2.5 % over-reported the current restriction level. While no areas in Canada had absolutely no restrictions at the time of this study, over 100 individuals in our sample (2.8 %) inaccurately reported that this was the case.

Across provinces (Fig. 1), the highest proportion of accurate reports were in Manitoba, Ontario and Quebec, followed by New Brunswick and Saskatchewan, then Newfoundland and Labrador, British Columbia and Prince Edward Island, and finally Alberta and Nova Scotia ($\chi^2_{(9)}$= 695.39, Cramer's $V = 0.44$, $p <$. 001).

Looking at participants from all provinces, results revealed significantly higher proportions of accurate reports among individuals who *perceived* higher levels of restrictions ($\chi^2_{(3)} = 1485.74$, $p < .001$, Cramer's $V = 0.65$, see Table 2) as well as those who experienced *actual* higher levels of restrictions in their region ($\chi^2_{(3)} = 118.88$, $p < .001$, Cramer's $V = 0.18$).

3.2.2. Perceived knowledgeability and accuracy (Aim 1b)

Participants who reported feeling knowledgeable about COVID-19 and restrictions more accurately identified the level of restriction in their area compared to those who did not feel knowledgeable (47.4 %, $\chi^2_{(2)} = 21.35$, Cramer's $V = 0.08$, $p < .001$). Of those who accurately identified the level of restriction, 60.6 % rated themselves as "knowledgeable", and 52.8 % rated themselves as "somewhat knowledgeable".

Table 2
Accuracy by *actual* and *perceived* levels of restriction.

	Minor Restrictions	Some Restrictions	Significant Restrictions	Extreme Restrictions
***N* = 3512**	**287**	**822**	**1134**	**1269**
$N = 3605$	10	421	1360	1814
Accuracy	**1.4[a]**	**26.5[b]**	**58.6[c]**	**96.1[d]**
	40[a, b]	51.8[b]	48.8[b]	67.3[a]

Note. The first and third rows (in bold) contain results from analyses using *perceived* level of restrictions whereas the second and fourth rows contain results from analyses using *actual* level of restrictions. Accuracy is disaplyed in percentage. Cell size for 'minor restrictions' for *actual* level of restrictions was $N = 4$. The N is reduced for *perceived* level of restriction as 'no restrictions' were not included as the cell size for accuracy would have been $N = 0$.

3.2.3. Preferred news sources and accuracy (Aim 1b)

Analyses indicated that a majority of participants had accurate perceptions of restrictions in their region (vs. inaccurate perceptions) across groups reporting several news sources as among their top two sources for getting COVID-19 information: specifically those reporting either 1) 'TV and radio broadcasts or associated podcasts' ($\chi^2(1) = 6.93$, Cramer's V= 0.05, p< .01), 2) 'newspapers and magazines' ($\chi^2(1) = 23.81$, Cramer's $V = 0.08$, $p < .001$), 3) 'Twitter' ($\chi^2(1) = 5.52$, Cramer's $V = 0.04$, p< .05), or 4) 'friends and family' ($\chi^2(1) = 7.6$, Cramer's $V = 0.05$, $p < .01$) among their top two sources. However, analyses also indicated that, among those who did not report one of these four news mediums as among their top two sources, there was still a significantly higher proportion of participants who had accurate (vs. inaccurate) perceptions of restriction levels in their region.

By contrast, individuals who reported 'YouTube' as one of their primary news sources were less accurate in identifying the level of restriction in their area compared to respondents who did not endorse 'YouTube' as a primary news source ($\chi^2(1) = 19.1$, Cramer's $V = 0.08$, $p < .001$). There were no significant differences in accuracy within or between individuals who identified any of the other news sources as one of their primary sources.

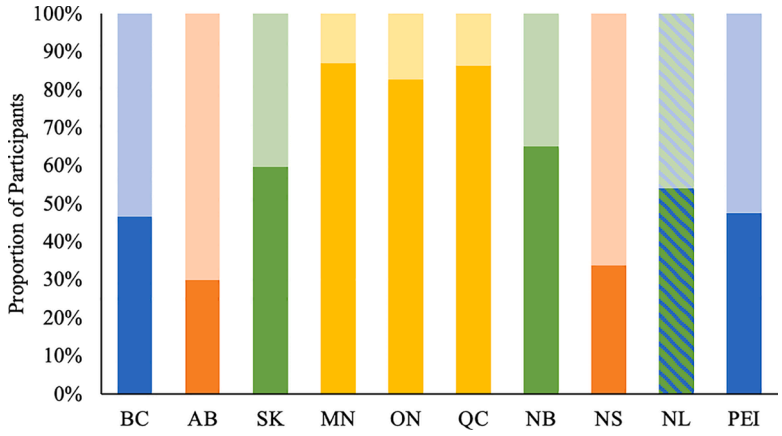

Fig. 1. Restriction accuracy across provinces.
Note. Darker proportions of each column indicate accuracy while lighter proportions indicate inaccuracy. BC= British Columbia; AB= Alberta; SK= Saskatchewan; MN= Manitoba; ON= Ontario; QC= Quebec; NB= New Brunswick; NS= Nova Scotia; NL= Newfoundland and Labrador; PEI= Prince Edward Island. Provinces with bars of the same color (see digital version) indicate that there were no significant differences in accuracy proportions. Specifically, there were no significant differences between BC and PEI (blue bars), AB and NS (orange bars), SK and NB (green bars), and MN, ON, and QC (yellow bars). In the case of NL (striped bar), there were no significant differences between NL, BC, & PEI (blue) and NL, SK, & NB (green), respectively.

3.3. Aim 2

3.3.1. Perceived infection risk & perceived restrictions (Aim 2a)

Perceived infection risk differed across *perceived* levels of restriction ($F(4, 5042) = 11.59$, $p < .001$, $\eta_p^2 = 0.009$). Individuals who reported higher levels of *perceived* restrictions ('significant' or 'lockdown/extreme') generally reported higher perceived risk, while those who perceived being subject to 'minor' or 'some' restrictions (p's < 0.01) reported lower perceived risk. Adjusted means are displayed in Fig. 2.

3.3.2. COVID-19 protective behaviours & perceived restrictions (Aim 2a)

Level of engagement in COVID-19 protective behaviours differed across *perceived* levels of restriction ($F(4, 5042) = 9.86$, $p < .001$, $\eta_p^2 = 0.008$). People who perceived themselves to be subject to 'minor' restrictions (adjusted mean (m_a) = 3.23) engaged in COVID-19 protective behaviours less often than those who perceived themselves to be subject to 'significant' ($m_a = 3.31$, $p = .008$) or 'extreme' restrictions ($m_a = 3.35$, $p < .001$). Moreover, those who perceived themselves to be subject to 'some' restrictions ($m_a = 3.23$) engaged in COVID-19 protective behaviours less often than those who perceived 'significant' ($p < .001$) or 'extreme' restrictions ($p < .001$).

Finally, individuals who perceived 'extreme' restrictions engaged in COVID-19 protective behaviours more often than those who perceived 'significant' restrictions ($p = .0498$). There were no significant differences in level of engagement in COVID-19 protective behaviours between those who perceived 'no' restrictions ($m_a = 3.32$) and any other perceived restriction levels.

3.3.3. Perceived infection risk & COVID-19 protective behaviours (Aim 2b)

Perceived infection risk was positively correlated with engagement in COVID-19 protective behaviours ($r = 0.13$, $p < .001$).

3.4. Aim 3

See Table 3 for complete results and post-hoc comparisons.

3.4.1. Change in mental health (Aim 3a)

Among respondents with pre-existing mental health concerns, there were significant differences in perceived changes in mental health since the start of the COVID-19 pandemic across *perceived* levels of restriction ($\chi^2(16) = 56.58$, $p < .001$, Cramer's $V = 0.06$). Individuals who perceived higher levels of restrictions were more likely to report their mental health had worsened (post-hoc p's < 0.05). Individuals who perceived themselves to be under 'no' restrictions were more likely to report that their mental health had stayed the same (post-hoc p's < 0.05).

There were also significant differences in perceived changes in mental health across *actual* levels of restriction ($\chi^2(12) = 30.61$, $p < .01$, Cramer's $V = 0.05$). Individuals living in areas imposing 'some' restrictions were more likely to report that their mental health had worsened or stayed the same, compared to all other levels of restrictions (post-hoc p's < 0.05).

3.4.2. Depressive symptoms (Aim 3a & 3b)

There were statistically significant differences in reported depressive symptoms across different *perceived* ($F(4, 3939) = 2.39$, $p < .05$, $\eta_p^2 = 0.002$) and *actual* levels of restriction ($F(3, 3940) = 4.74$, $p < .01$, $\eta_p^2 = 0.004$). Individuals who perceived 'no' restrictions reported fewer depressive symptoms compared to most other *perceived* restriction levels (post-hoc p's < 0.01). Individuals living in areas imposing 'minor' restrictions reported more depressive symptoms compared to most other *actual* restriction levels (post-hoc p's < 0.05). Depression symptoms and compliance were negatively correlated ($r = -.15$, $p < .001$).

3.4.3. Anxiety symptoms (Aim 3a & 3b)

There were no statistically significant differences in anxiety symptoms across *perceived* or *actual* levels of restriction ($F(4, 3939) = 1.88$, $p = .11$, $\eta_p^2 = 0.002$; $F(3, 3940) = 2.58$, $p = .052$, $\eta_p^2 = 0.002$, respectively). Anxiety symptoms were positively correlated with perceived infection risk ($r = 0.42$, $p < .001$), and negatively correlated with compliance ($r = -.099$, $p < .001$).

3.4.4. Loneliness (Aim 3a & 3b)

There were statistically significant differences in loneliness across *perceived* ($F(4, 3939) = 3.44$, $p < .01$, $\eta_p^2 = 0.003$) as well as *actual* ($F(3, 3940) = 3.16$, $p < .05$, $\eta_p^2 = 0.002$) levels of restriction. Individuals who perceived 'minor' or 'some' restrictions endorsed less loneliness compared to those perceiving 'significant' restrictions (post-hoc p's < 0.05). Individuals who perceived 'significant' or 'extreme' restrictions reported the highest levels of loneliness overall. Individuals living in areas imposing 'some' restrictions reported significantly less loneliness than individuals in areas imposing 'significant' or 'extreme' restrictions (post-hoc p's < 0.05).

Loneliness and compliance were negatively correlated ($r = -.089$, $p < .001$), while loneliness and perceived infection risk were positively correlated ($r = 0.27$, $p < .001$).

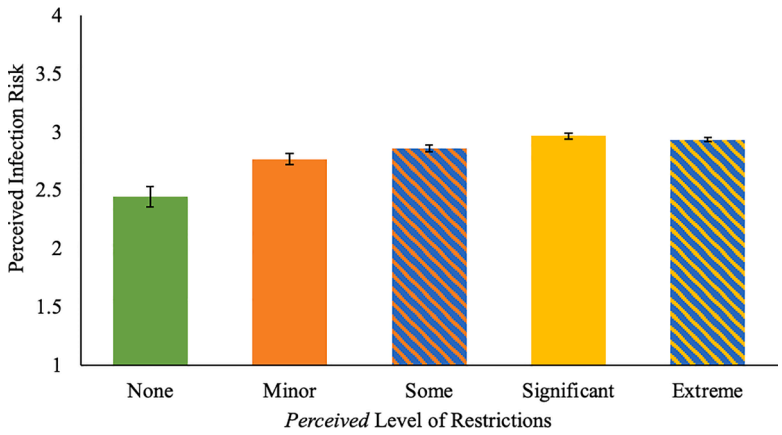

Fig. 2. Perceived infection risk across *perceived* level of COVID-19 restrictions.
Note. Bars display adjusted means (after controlling for age, sex, ethnicity and vulnerability to COVID-19). Bars of the same color indicate that there were no significant differences in perceived infection risk. Specifically, there were no significant differences between "Some" and "Extreme" Restrictions (blue striped bars in digital version), "Some" and "Minor" Restrictions (orange and orange striped bars), and 'Significant" and "Extreme" Restrictions (yellow and yellow striped bars). Error bars represent Standard Error.

Table 3
Change in mental health and loneliness across *perceived* and *actual* levels of restriction.

	No Restrictions	Minor Restrictions	Some Restrictions	Significant Restrictions	Extreme Restrictions
N	88	282	822	1173	1583
	–	70	374	1357	2147
Mental Health (%)					
Worsened	14.8[a]	24.8[a, b]	33.3[b, c]	39[c]	38.2[c]
	–	47.1[a]	25.9[b]	37.9[a]	36.1[a]
Improved	3.4[a]	7.4[a]	6.2[a]	5.5[a]	3.9[a]
	–	8.6[a]	4.5[a]	5.7[a]	4.8[a]
Stayed the Same	72.7[a]	58.5[a, b]	52.2[b, c]	48.9[c]	50.5[b, c]
	–	38.6[a]	59.4[b]	49.4[a]	51.8[a]
Not Sure	8[a]	8.5[a]	7.7[a]	6.4[a]	6.7[a]
	–	5.7[a]	9.6[a]	6.5[a]	6.8[a]
Prefer Not to Say	1.1[a]	0.7[a]	0.6[a]	0.2[a]	0.6[a]
	–	0[a]	0.5[a]	0.6[a]	0.5[a]
Loneliness	5[a, c] (0.21)	5.13[a] (0.12)	5.3[a, d] (0.07)	5.49[b, e] (0.06)	5.39[c, d, e] (0.05)
	–	5.61[a, b] (0.23)	5.12[b] (0.1)	5.45[a] (0.05)	5.36[a] (0.04)
Anxiety	3.86 (0.55)	4.85 (0.31)	5.16 (0.18)	5.08 (0.15)	4.81 (0.13)
	–	5.75 (0.62)	4.74 (0.27)	5.21 (0.14)	4.79 (0.11)
Depression	5.45[a] (0.66)	6.89[a, b] (0.37)	7.33[b] (0.22)	7.17[b] (0.18)	6.87[b] (0.16)
	–	8.76[a] (0.74)	6.92[b, c] (0.32)	7.38[a, c] (0.17)	6.76[b] (0.13)

Note. The top line of each row contains results from analyses using *perceived* level of restrictions whereas the second line of each row contains results from analyses using *actual* level of restrictions. Superscripts of different letters denote significant differences ($p < .05$). Values for loneliness, anxiety symptoms and depression symptoms are represented as estimated marginal mean (standard error). There are no post hoc comparisons for anxiety symptoms as the adjusted F-test was not significant.

4. Discussion

The past four years have underscored the importance of developing strategies to increase understanding of and compliance with public health orders. Results show that a majority of Canadians had accurate knowledge of current local public health restrictions. However, accuracy varied across provinces and depended on *actual* and *perceived* level of restriction, perceived knowledgeability about the pandemic, and preferred news sources. More restrictive public health orders were generally associated with greater perceived risk of infection and greater compliance. However, greater restrictions were also associated with poorer reported mental health. Below, we explore these findings.

Lack of accurate information is an obvious threat to compliance with public health orders (Sturman et al., 2020). A significant proportion of our sample (over 40 %) were inaccurate in reporting the restrictions that were in place in their region/territory; most underestimated rather than overestimated the current level of restriction. Consistent with a German study conducted earlier in the pandemic that found 37.1 % inaccuracy (Benke et al., 2020), these findings suggest a significant portion of the Canadian population was not fully informed of restrictions. Provincial differences in accuracy may reflect different regulation and communication strategies (e.g., local versus province-wide mandates), and different levels of restrictions. For instance, provinces with the most accuracy – Manitoba, Ontario, and Quebec – also had the highest levels of restrictions across our study period (December – March 2020): Manitoba was in lockdown (Level 5), the Ontario sample only contained individuals who completed the survey during the province-wide lockdown, and many highly populated areas in Quebec experienced lockdown during that period. These findings suggest that individuals in regions with consistently high levels of restrictions are more aware of these restrictions. Communication of restrictions also varied widely by province: some used colour-coded alerts (yellow, orange, red, etc.) or numbered systems (Level 1, 2, 3, etc.), while other provinces described specific mandates without indicating their relative "severity." Future work should further examine which systems might be the most effective and least ambiguous in communicating restriction levels to the public in the context of a pandemic.

Perceived knowledgeability about the pandemic and public health restrictions was associated with accuracy; however, our results identified a considerable proportion of participants who were inaccurate despite endorsing knowledgeability. It is unclear where this misplaced certainty arose from. However, one possible explanation, differences in preferred news sources, was borne out in our data. Respondents who identified YouTube as one of their top sources of information were less accurate in identifying the level of restriction in their area (i.e., a higher proportion of these individuals were not able to accurately identify the restrictions). Unlike traditional news sources, where information is fact-checked before presentation, many news items shared on social media are not, leading to issues such as misinformation and "fake news", as well as decreases in the quality and credibility of available information (Das et al., 2022). However, our findings showed that respondents who identified other social media sources (e.g., Facebook, Twitter) or informal news sources (e.g., non-media affiliated podcasts), were not less accurate in identifying restrictions in their area. It is unclear why this might be the case, as there is not much evidence to suggest differences in the amount of misinformation across social media platforms. It may be that some individuals have better social media literacy (Polanco-Levicán and Salvo-Garrido, 2022) and thus are able to better distinguish reliable information from misinformation. Additionally, there may be differences in social media algorithms which affect the degree to which people are exposed to more global versus local news content, a topic which, to our knowledge has yet to be addressed in the literature and may be worth further investigation.

It is worth noting that most respondents to this survey reported a preference for traditional news sources (TV, print media, radio). Thus, many individuals who reported a non-traditional news source as one of their top two news sources, likely reported a traditional source as well, which likely improved the overall quality of the news they received. As well, individuals who chose to participate in our survey may be more likely to be in politically liberal social media echo chambers (Jiang et al., 2021). However, we did not evaluate political beliefs or affiliations within our sample and therefore cannot comment on sampling bias. Future research should attempt to recruit participants across the political spectrum.

Similar to findings seen in previous literature, and in line with our hypothesis for Aim 2, our results indicate that people typically perceive more risk surrounding COVID-19 when under more severe public health restrictions. As well, individuals are more compliant with restrictions as restriction severity increases. The most likely interpretation of this relationship is that more severe restrictions signal greater public health risk, leading to the intended outcome of individuals perceiving greater risk, and thus being more inclined to comply with said restrictions.

However, the directionality of these results is unclear. Moreover, it is difficult to disentangle the effect of public health restrictions from the underlying dynamics of the pandemic itself (e.g., active cases, number of ICU beds in use), given their close association. It is also worth noting that, while significant, most differences in compliance between levels of restrictions were small. Other factors likely also play a role in determining an individual's level of compliance with public health guidance, such as personal opinions about the pandemic, compliance of family and friends (Galende et al., 2022), or personality (e.g., being less agreeable; Zajenkowski et al., 2020). In addition, our analysis involving engagement in COVID-19 protective behaviours controlled for subjective vulnerability to COVID-19, accounting for the fact that individuals who view themselves as more at-risk are likely to more cautiously follow guidelines.

Previous research has shown that stricter public health restrictions are associated with increased reported symptoms of depression (Lee et al., 2021), symptoms of anxiety, stress, and loneliness (Gratz et al., 2020; Marroquín et al., 2020). In line with this research and partially in line with our hypothesis for Aim 3, our results indicate that reported mental health outcomes generally worsened with higher *perceived* as well as *actual* levels of restrictions. However, there were some nuances within these findings. For instance, individuals living in areas imposing 'some' restrictions reported less loneliness than those living in areas imposing 'minor' restrictions *or* 'significant' or 'extreme' restrictions. A similar finding was revealed among those with pre-existing mental health concerns living in 'some' restrictions areas, who were less likely to report worsened mental health due to the pandemic compared to individuals living those areas previously listed.

A possible explanation may be that moderate ('some') restrictions still allow for social contact that maintains social connections while reducing uncertainty or stress that could result when public health restrictions do not match perceived risk, as may have been the case in some 'minor' restrictions areas. This explanation is supported by the fact that individuals living in areas imposing 'minor' restrictions reported more depressive symptoms compared to most other, higher levels of restrictions.

Our results also indicate that individuals with more anxiety symptoms were less compliant with public health restrictions. Directionality of this relationship is unknown; anxious individuals may be reaching out socially in an attempt to alleviate their symptoms, thereby reducing their protective behaviors. Conversely, poor compliance may increase anxiety symptoms due to increased potential for exposure and other negative consequences (e.g., public shaming or having to conceal behaviours from others). In contrast, depression symptoms and loneliness were negatively associated with compliance. However, due to our cross-sectional study design, it is undetermined whether individuals who are experiencing better mental health are more likely to comply with public health guidelines, or if complying with such guidelines results in better mental health. As well, loneliness was positively associated with perceived infection risk, suggesting that those who perceived more risk were also more likely to be socially isolated. As public health and government officials strive to increase compliance with public health restrictions, they may wish to investigate potential mental health supports to decrease loneliness, anxiety symptoms, and depressive symptoms.

The current study offers many strengths including a large sample that approximately matched the age, sex, and geographic distribution of the Canadian population, and examination of key mental health outcomes. However, several limitations exist. The data was cross-sectional, impeding any conclusions regarding the directionality of relationships between knowledgeability and accuracy, levels of restriction, perceived infection risk and compliance. Additionally, all measures were subjective, and to decrease burden on participants (i.e., time to complete) we did not always use pre-existing, validated and reliable scales. For example, we asked questions such as whether one's own mental health had changed. Thus, results should be interpreted with these caveats in mind. While we did use validated and reliable scales to measure depression symptoms, anxiety symptoms and loneliness, we do not have baseline measurements for a time period prior to the pandemic or implementation of public health restrictions. Therefore, it is difficult to determine what effect restrictions themselves may have had on mental health. Nonetheless, we were able to show differences in mental health across restriction levels.

As this data was collected at a single time point, these results represent only a specific window during the pandemic (December 2020 – March 2021) and therefore may not generalize to other time periods. However, our results provide valuable insights should restrictions be re-implemented. This survey is also specific to the Canadian federal and provincial public health guidelines and not only their initial announcement but also their subsequent reporting and dissemination. Nonetheless, we believe that these findings may be relevant to other countries when evaluating public health guidelines, perceived infection risk and potential mental health impacts. As well, our study was administered online. Although online administration permitted a larger sample size, it prevented our ability to collect data from marginalized groups without internet access. Further research should administer similar surveys that are more accessible. Lastly, compliance was operationalized as frequency of engagement in several COVID-19 protective behaviours which may or may not have been recommended in the participant's area. Therefore, it is difficult to determine whether compliance was accurately measuring compliance with COVID-19 protective behaviours recommended by an area's restriction level.

5. Conclusions

This study examined awareness and perception of COVID-19 related public health restrictions, as well as associations of these perceptions with perceived infection risk, compliance with public health guidance, and mental health. Our results suggest that public health policy should weigh the increased effectiveness of higher, uniform levels of restrictions across a large region, against the potential negative mental health consequences of these higher restrictions as well as the association of better mental health with restriction compliance. Future work should examine the involvement of other factors such as political ideology and available mental health supports in predicting restriction accuracy, compliance, and mental health during the pandemic. Further, longitudinal work may help to illuminate factors that influence accuracy and compliance across the course of a global pandemic.

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Declaration of competing interest

The authors declare no conflicts of interest.

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Supplementary materials

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