Anxiety disorders, COVID-19 fear, and vaccine hesitancy☆

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ABSTRACT

Development of the COVID-19 vaccines unfolded in real-time, lending a sense that they were developed more rapidly than other vaccines. Long-term data on their safety and effectiveness is not yet available. Thus, people may have greater uncertainty about the COVID-19 vaccines than other vaccines. We know that people high in anxiety have greater intolerance of uncertainty (IUS) and may have greater fears of adverse effects and concerns about the vaccine failing to prevent COVID-19. Ultimately, people with anxiety disorders may have greater COVID-19 vaccine hesitancy (VH). This study examined the degree of VH in people with ($n = 96$) and without ($n = 52$) anxiety disorders, whether anxiety status has an additive effect on factors known to predict hesitancy, and whether reasons for VH differed across groups. Groups did not differ in VH, but IUS was associated with greater hesitancy in those without anxiety but with less hesitancy in those with anxiety. Both groups' strongest predictors of hesitancy were influenza vaccine history, conspiracy beliefs, individualism, and trust. The top reasons for VH were concerns about adverse effects and efficacy, and the top reasons to get the vaccine were to protect others and self. Implications for reducing VH are discussed.

1. Introduction

1.1. Anxiety disorders in the context of COVID-19

Anxiety disorders are the sixth leading cause of disability worldwide (Baxter et al., 2014), and the COVID-19 pandemic has introduced an unprecedented level of stress related to uncertainty and safety concerns. Although the specific symptoms of anxiety disorders differ between diagnoses, there are important transdiagnostic features that characterize anxiety disorders including overestimating threat, intolerance of uncertainty (Ferreri et al., 2011), and underestimating one's ability to cope (Schwartz & Maric, 2015). Asmundson et al. (2020) found that individuals with pre-existing anxiety or mood disorders experienced greater levels of COVID-19 related stress when compared to those without mental illness. This demonstrates the disproportionate impact that COVID-19 is having on individuals with pre-existing mental health conditions. Given that people with anxiety disorders overestimate the possibility of threat and harm (Ferreri et al., 2011), it makes sense that individuals with anxiety would interpret a stressor such as COVID-19, which poses a real and imminent threat to one's health and the health

of those around them, as particularly stressful.

Intolerance of uncertainty is characterized by a need for predictability, which is often accompanied by excessive information seeking, as well as difficulties with decision-making (Birrell et al., 2011). In the context of COVID-19, intolerance of uncertainty has been shown to have a direct negative relationship on mental wellbeing, and this relationship is exacerbated by rumination and COVID-19 fear (Satici et al., 2020). Intolerance of uncertainty is also associated with the amount of time people spend seeking health-related information about potential threats (Rosen et al., 2007), and this is particularly problematic because greater exposure to COVID-19 related news is directly associated with negative psychological outcomes (Chao et al., 2020).

Although our understanding of COVID-19 has grown considerably since the World Health Organization declared the pandemic on March 11th, 2020 (Cucinotta & Vanelli, 2020), the situation is constantly evolving with the emergence of variants of concern (Public Health Ontario, 2021) and changing safety restrictions (Government of Ontario, 2021). As a result, even seeking out reliable and accurate information can fail to provide reassurance. For individuals with anxiety disorders, the constantly changing information could promote compulsive

checking, and past research has shown that checking behaviors can increase one's perception of the probability of harm and increase feelings of personal responsibility for preventing harm (Rachman, 2002). Additionally, an inability to achieve perfect certainty that harm has been averted can increase feelings of distress (Rachman, 2002). As a result, it makes sense that COVID-19 stress is higher among people with anxiety disorders (Asmundson et al., 2020).

1.2. Vaccine hesitancy and COVID-19

Social distancing, mask-wearing, and hand hygiene have proven to be successful in mitigating the spread of the COVID-19 virus (Chiu et al., 2020). However, eradicating the virus, which involves permanently reducing the incidence of the disease to zero cases worldwide (Chen, 2010), can only be achieved through vaccine acceptance and ultimately establishing herd immunity (D'Souza & Dowdy, 2021). The percentage of people who need to be vaccinated to reach herd immunity ranges from 50% to 90%, depending on the infectious agent (D'Souza & Dowdy, 2021). Estimates predict that 70% of people must be vaccinated globally to achieve COVID-19 herd immunity; however, that number may increase in response to the more contagious variants that are emerging (D'Souza & Dowdy, 2021). The COVID-19 vaccine is now widely available. For example, all Canadian residents over the age of five now have the option to be immunized with the COVID-19 vaccine (Government of Canada, 2021). Now that Canada has a sufficient supply of vaccines, the next step towards eliminating the virus nationally is promoting vaccine uptake, which requires addressing vaccine hesitancy. This is particularly important given the rising levels of vaccine refusal in the United States (Hotez et al., 2021). During summer 2021 in Canada, hesitancy was also a mounting concern because of delays in Pfizer shipments, which required Canadians to mix mRNA vaccines and receive Moderna as a second dose, and approval for mixing these vaccines was very new (TVC22 Rockland, 2021).

The World Health Organization SAGE Working Group defines Vaccine hesitancy as the refusal or delay in receiving vaccines, despite a sufficient supply available (SAGE Working Group, 2014). Levels of vaccine hesitancy can vary between different vaccines and change over time, and a range of reasons exist for vaccine hesitancy (MacDonald, 2015). Common reasons for hesitancy include a lack of confidence or trust in the effectiveness or safety of the vaccine or concern about the competence or motivation of healthcare providers or policymakers (MacDonald, 2015). Alternatively, complacency results when individuals don't perceive the infectious disease as particularly threatening and see the vaccine as unnecessary as a result (MacDonald, 2015). Finally, convenience also plays a crucial role in vaccine hesitancy, and vaccines must be accessible and affordable worldwide to promote uptake (MacDonald, 2015).

Prior research has found that specific psychological constructs are associated with vaccine hesitancy. Hornsey et al. (2018) assessed the psychological roots of vaccine hesitancy across 24 countries. The most common predictors of vaccine hesitancy were conspiratorial thinking, adverse reaction to constraints on freedoms (psychological reactance), and individualistic and hierarchical world views (Hornsey et al., 2018). This study found no relationship between demographic variables and vaccine hesitancy (Hornsey et al., 2018). To our knowledge, no studies have examined the relationship between anxiety and vaccine hesitancy.

Recent studies have started to examine what predicts COVID-19 vaccine hesitancy specifically. Jennings et al. (2021) found similar predictors of COVID-19 vaccine hesitancy to the predictors of hesitancy for older vaccines, such as lack of trust in the government and healthcare system, conspiratorial thinking, and engaging with unregulated information about the COVID-19 vaccine through social media. As well, Murphy et al. (2021) found that vaccine hesitant individuals were less likely to access reliable information.

1.3. Anxiety disorders and vaccine hesitancy

Intolerance of uncertainty can increase anticipatory anxiety regarding a perceived threat (Oglesby & Schmidt, 2017) and people high in intolerance of uncertainty also often have difficulties making decisions (Birrell et al., 2011). The COVID-19 vaccine is now widely available in Canada (Government of Canada, 2021), and Canadians must decide whether to be vaccinated. Betsch et al. (2018) found that the more vaccine related information-seeking that a person engages in the more vaccine hesitant they become. Given that anxiety predicts COVID-19 related information seeking (Ebrahim et al., 2020) people with anxiety disorders may be higher in vaccine hesitancy. Furthermore, because individuals with anxiety disorders tend to overestimate threat (Ferreri et al., 2011) and have greater intolerance of uncertainty they may be more hesitant than people without anxiety difficulties. However, we also know that people with anxiety disorders report greater COVID-19 stress than people without anxiety (Asmundson et al., 2020), and therefore vaccine-related fears may be outweighed by the possibility of decreasing COVID-19 stress and returning to a pre-COVID-19 way of life. Finally, people with anxiety and related disorders may have unique fears about the vaccine, such as fears of contamination, needles, having an adverse emotional reaction (e.g., panic attack), or that the vaccine will make them too complacent about hygiene and lead to COVID-19 infection.

1.4. Research questions and hypotheses

This study explores (1) whether people with anxiety disorders differ from non-anxious controls in COVID-19 vaccine hesitancy scale scores and in stated intention to get the vaccine; (2) whether psychological factors associated with anxiety and factors known to be associated with vaccine hesitancy (world view, trust, and psychological reactance) predict COVID-19 vaccine hesitancy, and whether they do so to the same extent and in the same way across groups; (3) self-reported reasons for getting the COVID-19 vaccine and reasons for hesitating to get it across people with and without anxiety difficulties.

We expected that group status would moderate the relationship of vaccine hesitancy to intolerance of uncertainty, COVID-19 Stress, disgust, and time spent researching COVID-19, being stronger in the Anxious group. Based on research on hesitancy to vaccines pre-dating COVID-19 we hypothesized that participants higher in psychological reactance, individualism, and conspiratorial thinking and lower in trust would report greater vaccine hesitancy in both groups. We had no basis for a hypothesis about whether the relationships would be stronger in the anxious group; it is possible that these factors are related to anxiety, but on the other hand there is no evidence that people with anxiety disorders hold these beliefs more strongly. Finally, we hypothesized that the anxious group would report both common and unique reasons for their hesitancy about and motivators for getting the COVID-19 vaccine.

2. Method

2.1. Procedure

Participants were recruited through the Anxiety Studies (AS) database at the University of Waterloo. The AS database is composed of community members aged 18 and older, both with and without anxiety disorders. Recruitment has been ongoing for over ten years, and the database is comprised of participants spanning a variety of life stages ($M_{age} = 29.16$). interested participants are contacted over the phone and complete the Mini-International Neuropsychiatric Interview (MINI) screening questions (Sheehan et al., 1998). Participants who do not endorse any of the screening questions are grouped as 'controls.' Participants who report anxiety symptoms based on the screening questions (i.e., generalized anxiety disorder, social anxiety disorder, obsessive compulsive disorder, panic disorder, or agoraphobia) and who do not

endorse mania, psychosis, or active suicidal ideation, are administered the complete MINI (Sheehan et al., 1998). Those who meet criteria for one or more of the above listed anxiety diagnoses are grouped as "anxious". Control and clinical participants complete a battery of self-report questionnaires and receive $20 and $40 Amazon gift cards for their time, respectively. Consent is obtained to contact participants about future study opportunities. Those who agree are added to a recruitment database, which forms a pool of participants available to graduate students when recruiting for their individual studies (e.g., thesis, dissertation). See Moscovitch et al. (2015) for a detailed description of recruitment procedures.

All participants in the present study were recruited from the AS database. Participants in the anxious group were first screened to confirm the status of their principal diagnosis, via the question: "to what extent do these [anxious] feelings currently interfere with or cause distress in your life?" Participants who responded, "moderately disturbing or disabling", "severely disturbing or disabling", or "very severely disturbing or disabling," were invited to participate. Participants in the Control group were eligible if they answered 'no' to all screening questions, or 'yes' without impairment ("slightly disturbing or disabling" or "not at all disturbing or disabling"). Participants whose group status changed from their initial assessment were not eligible to be included in the study.

2.2. Participants

A total of 219 participants responded to the invitation to participate in the study. Of those, 7 were excluded because they entered and invalid participant ID, 16 participants were excluded due to incomplete data, and 48 participants excluded because their diagnostic group status changed since their initial assessment. With respect to the latter, 36 control participants were excluded because they now endorsed one or more mental health concern on the MINI screener, and 12 clinical participants were excluded because they no longer endorsed clinically significant anxiety symptoms. The AS database includes participants who were recruited and assessed on a rolling basis. The final sample included 52 control participants with an average age of 30.72 ($SD = 12.24$) and 77.1% of the group being female, and 96 clinical participants with an average of 37.21 ($SD = 14.63$) and 71.2% of the group was female. An additional 8 control participants only completed the qualitative, open response portion of the study, rather than the full questionnaire package. These participants are included in the qualitative content analysis only.

An independent t-test revealed a significant difference between groups on age $t(127) = 2.64$, $p = .009$. The most frequent ethnicity reported by the sample was white/Caucasian (70.27%) followed by South Asian (9.46%) and East Asian (8.12%). Chi-squared tests revealed no significant differences between groups on ethnicity X^2 (10, $N = 148$) = 12.71, $p = .241$ or gender X^2 (4, $N = 148$) = 6.13, $p = .190$, although both groups consisted of primarily woman. Within the clinical group, 35 participants had a principal diagnosis of social anxiety disorder, 21 had a principal diagnosis of generalized anxiety disorder, 16 had a principal diagnosis of obsessive-compulsive disorder, 7 had a principal diagnosis of panic disorder or agoraphobia, 2 had a principal diagnosis of a specific phobia, and 1 had a principal diagnosis of illness anxiety disorder. An additional 11 participants had a principal mood disorder diagnosis and 3 had a principal eating disorder diagnosis, with secondary diagnoses of an anxiety disorder.

2.3. Measures

2.3.1. Vaccine hesitancy scale

The vaccine hesitancy scale (VHS; Shapiro et al., 2018) is a nine-item scale revised from the ten-item vaccine hesitancy survey tool developed by the SAGE working group on vaccine hesitancy (Larson et al., 2015). This validated scale has strong psychometric properties including

construct and criterion validity. The original scale assesses parental attitudes about childhood vaccines, and we adapted the questions such that anyone could answer. Additionally, the items were modified to relate specifically to the COVID-19 vaccine (e.g., 'Childhood vaccines are important for my child's health' became 'The COVID-19 vaccine will be important for my health'). Participants rated their agreement with nine statements on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The scale was coded such that higher scores on the scale reflect higher levels of vaccine hesitancy. Chronbach's α in our sample was.95 ($M = 20.44$, $SD = 9.14$).

2.3.2. COVID stress scale

The COVID Stress Scales (CSS; Taylor et al., 2020) are self-report measures that assess COVID-19 fear across a variety of dimensions including danger and contamination, fear of socioeconomic consequences, traumatic stress symptoms, compulsive checking, and xenophobia. All scales performed well on various assessments of reliability and validity (Taylor et al., 2020). We did not include the xenophobia scale as we did not expect it to be related to vaccine hesitancy and the questions are highly sensitive. Each dimension consists of six items, except for the danger and contamination subscale which consists of twelve, and participants rate each item on a Likert scale from 0 ('never'; 'not at all') to 4 ('almost always'; 'extremely'). Chronbach's α in our sample was.94 ($M = 29.25$, $SD = 19.79$).

2.3.3. Cultural cognition worldview scale individualism-communitarianism

The Cultural Cognition Worldview Individualism-Communitarianism subscale (CCWS; Kahan, 2008) is a self-report measure composed of 18 items to assess participants' worldviews in this domain. Participants rate their agreement with a series of statements on a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Items include statements such as 'the government interferes far too much in our everyday lives' and 'it's a mistake to ask society to help every person in need.' Chronbach's α in our sample was.92 ($M = 43.14$, $SD = 13.17$).

2.3.4. Conspiratorial beliefs scale – generic

The Conspiratorial Beliefs Scale – Generic (Brotherton et al., 2013) is a 15-item self-report measure where participants read conspiratorial statements and respond with how likely the statement is to be true on a scale from 1 (definitely not true) to 5 (definitely true). This scale is psychometrically sound and has strong internal and test-retest reliability. The scale has also shown strong content, criterion, convergent, and discriminant validity. Examples of items include 'The spread of certain viruses and/or diseases is the result of the deliberate, concealed efforts of some organizations' and 'evidence of alien contact is being concealed from the public.' Chronbach's α in our sample was.94 ($M = 32.89$, $SD = 12.80$).

2.3.5. Hong's psychological reactance scale

Hong's Psychological Reactance Scale (HPRS; Hong & Page, 1989) assesses psychological reactance to restrictions on freedom of choice (Steindl et al., 2015). Hong's scale is a psychometrically sound self-report measure with demonstrated reliability. Participants rate their agreement with 14 statements such as "I become angry when my freedom of choice is restricted" and "I consider advice from others to be an intrusion" on a scale from 1 (disagree completely) to 5 (agree completely). Chronbach's α in our sample was.90 ($M = 37.55$, $SD = 9.57$).

2.3.6. Intolerance of uncertainty

The Intolerance of Uncertainty Scale Short Form (IUS-SF; Carleton et al., 2007) is a self-report measure adapted from the 27-item Intolerance of Uncertainty Scale. The short version correlates highly with the full-length version $\alpha = .94$ and consists of 12 items such as "unforeseen events upset me greatly" and "when I am uncertain, I can't function very

well." Participants rate how characteristic each statement is of themselves on a scale from 1 (not at all characteristic of me) to 5 (exactly characteristic of me). Chronbach's α was.95 in our sample ($M = 35.00$, $SD = 12.84$).

2.3.7. Trust scale

The trust scale (Naef & Schupp, 2009) assesses trust in authorities and institutions, as well as trust in strangers and known others. Participants respond to three questions on a Likert scale from 1 (disagree strongly) to 4 (agree strongly). An example of an item asked is "in general, you can trust people." Participants then rated their level of trust in various people and institutions (i.e., churches, police) from 1 (no trust at all) to 4 (a lot of trust). Chronbach's α in our sample was.82 ($M = 35.86$, $SD = 6.04$).

2.3.8. Disgust propensity and sensitivity scale

The revised disgust propensity and sensitivity scale (DPSS-R; Van Overveld et al., 2006) is a revised version of the DPSS, which was initially developed by Cavanagh and Davey (2000). The revised scale has demonstrated reliability and validity. Participants respond to twelve items such as 'I avoid disgusting things' and 'I feel repulsed.' The scale measures the extent to which participants avoid feeling disgust and appraise the emotion of disgust as negative. Participants rate how often each item is true for them, on a Likert scale ranging from 1 (never) to 5 (always). Chronbach's α in our sample was.92 ($M = 38.13$, $SD = 10.97$).

2.4. Data analytic approach

Data collection took place from January 8, 2021, until April 4, 2021. Analyses were conducted using SPSS version 27 (IBM Corp., Armonk, NY, USA). Given that there is no known difference in vaccine hesitancy across age groups (e.g., Shapiro et al., 2018) we did not control for age in our analyses. Preliminary analyses were performed to examine whether there are significant differences between clinical and control groups on vaccine hesitancy and variables known to be associated with anxiety (e. g., intolerance of uncertainty, disgust sensitivity and propensity), and vaccine hesitancy (conspiratorial beliefs, individualistic worldviews). Next, we examined differences in intention to be vaccinated between clinical and control groups, and participants who regularly receive the influenza vaccine and those who do not. Finally, a hierarchical regression was performed to better understand the predictors of vaccine hesitancy in anxious and non-anxious participants.

Qualitative data on reasons to take the vaccine and reasons for hesitancy were subject to content analysis by the authors. First, the responses were randomized so the coders were blind to anxiety group status. The authors identified orthogonal categories that emerged from the responses for vaccine hesitancy (concern about the speed of vaccine development, risk of adverse effects, etc.) and vaccine motivation (to protect myself, to protect friends and family, etc.) and then coded each response as reflecting or not reflecting each theme. The reviewers achieved sufficient reliability with the average kappa value for vaccine hesitancy reasons being .79 and the average kappa value for vaccine motivation reasons being .84. The independent coders discussed the coding discrepancies to determine the final codes.

3. Results

3.1. Data integrity

Prior to conducting the analyses, data were examined for outliers within groups. Outliers were defined as data points three standard deviations or further from the group mean and discontinuous from the distribution. Outliers were replaced with the second most extreme data point in that group (Kwak & Kim, 2017). There were three outliers in the clinical group and one outlier in the control group for the daily time spent seeking COVID-19 related information; two outliers in the clinical

group for COVID-19 stress; one outlier in the control group for psychological reactance, and one outlier in the control group for cultural cognition worldviews. Missing values were handled using the available case analysis technique (Kwak & Kim, 2017), which preserved the largest sample size possible, but resulted in varying sample sizes between the different variables included in the analysis. When Levene's tests for equality of variance was significant we reported the t-value and degrees of freedom for equal variances not assumed, the latter rounded up to the nearest whole number.

3.2. Preliminary analyses

Means and standard deviations of all measures are presented in Table 1. As expected, the Anxious group had significantly higher scores on DASS Total Scores (Levene's test for equality of variance was significant, $p < .001$, $t(143) = -14.26$, $p < .001$, $d = -2.09$), COVID-19 Stress (Levene's test was significant, $p < .001$, $t(133) = -8.16$, $p < .001$, $d = -1.29$), Intolerance of Uncertainty (Levene's test was significant $p < .001$, $t(135) = -11.69$, $p < .001$, $d = -1.83$), Disgust Sensitivity and Propensity ($t(141) = -4.97$, $p < .001$, $d = -0.88$), and Psychological Reactance ($t(143) = -2.21$, $p = .029$, $d = -0.39$). The two groups did not differ in worldview ($t(136) = 1.21$, $p = .229$, $d = 0.21$) or Conspiratorial Beliefs ($t(140) = -1.76$, $p = .078$, $d = -0.31$), but the Anxious group reported greater trust ($t(144) = 2.01$, $p = .046$, $d = 0.35$). Participants in the Anxious group also spent significantly more time daily engaging with COVID-19 related information than did the Control group (Levene's test for equality of variance was significant, $p = .002$, $t(124) = -3.40$, $p < .001$, $d = -0.55$. This verifies that the Anxiety and Control groups differed as expected on anxiety-related factors. The independent sample t-tests were adequately powered to detect medium effect sizes ($d > 0.50$), based on a-priori computations of required sample size.

3.2.1. COVID-19 vaccine hesitancy and intentions across groups

Vaccine hesitancy scale scores did not differ significantly across groups $t(145) = 0.81$ $p = .419$, $d = 0.14$. We then examined intention to get the COVID-19 vaccination across groups. These data are presented in Table 2. There was no significant difference, $X^2 (2, N = 148) = 4.08$, $p = .130$. We were next interested in whether intention to get the COVID-19 vaccination was associated with whether participants regularly received vaccination against the flu. We first examined whether flu vaccination history differed across the groups, and found they did not ($X^2 (2, N = 147) = 2.48$, $p = .12$). Given that the anxious and control groups did not differ in their intention to get the COVID-19 vaccination, nor in their history of receiving a regular flu vaccine, we collapsed across groups and examined whether those who received a flu vaccination regularly differed in their intention to get the COVID-19 vaccination. These data are presented in Table 2. We did find significant group differences in intention to get the COVID-19 vaccination, $X^2 (2, N = 147) = 22.87$, $p < .001$. Post-hoc testing of pairwise comparisons using z-scores revealed that people who regularly received the influenza vaccine had greater intention to get the vaccine but also were more likely to be undecided.

3.2.2. Predictors of vaccine hesitancy

To determine whether factors associated with anxiety (COVID-19 Stress, IUS, and Disgust), time spent researching COVID-19, and factors known to predict vaccine hesitancy (Conspiratorial Beliefs, Psychological Reactance, Trust, and World View) predicted vaccine hesitancy, and whether they did so to the same degree across groups, we conducted a series of hierarchical multiple regression analyses of vaccine hesitancy scores. All predictors were centered prior to analyses to reduce nonessential multi-collinearity. Green (1991) suggests that at least 114 participants are required to detect a moderate omnibus effect in a regression model with eight predictors (i.e., N $\geq$ 50 + 8 m) while 112 participants are required to detect the unique effect of individual

Table 1
Means and standard deviations of measures by group.

Measure	Anxious			Control					
	n	*M*	*SD*	*n*	*M*	*SD*	*t*	*p*	*d*
DASS-Total	94	57.66	25.64	51	11.45	13.38	-14.26	< 0.001	-2.09
COVID Stress Total	91	36.95	18.80	50	15.24	12.62	-8.16	< 0.001	-1.29
Disgust Propensity and Sensitivity	94	41.18	10.84	49	32.29	8.69	-4.97	< 0.001	-0.88
Intolerance of Uncertainty	94	41.22	10.70	51	23.53	7.40	-11.69	< 0.001	-1.83
Daily time spent seeking COVID-19 related information (minutes)	93	38.65	35.80	49	20.55	26.69	-3.40	< 0.001	-0.55
Psychological Reactance	94	38.83	8.82	51	35.20	10.52	-2.21	.029	-0.39
Trust in Others	94	37.19	6.22	52	35.12	5.84	2.01	.046	-0.35
Conspiratorial Beliefs	92	34.28	12.38	50	30.32	13.29	-1.78	.078	-0.31
Individualistic Worldviews	88	42.13	12.57	50	44.94	14.13	1.21	.229	0.21
Vaccine Hesitancy Scale	95	19.99	8.53	52	21.27	10.21	0.81	.419	0.14

Table 2
COVID-19 vaccine intention by group and flu vaccination history.

	Intend to Get COVID-19 Vaccination		
Group (*n*)	Yes (%)	No (%)	Undecided (%)
Anxious (96)	71 (74.0)	8 (8.3)	17 (17.7)
Control (52)	32 (61.5)	10 (19.2)	10 (19.2)
Total (148)	103 (69.6)	18 (12.2)	27 (18.2)
Regularly Get Flu Vaccine (*n*)			
Yes (62)	56 (90.3)	1 (1.6)	17 (27.4)
No (85)	46 (54.1)	17 (20.0)	10 (11.8)
Total (147)	102 (69.4)	18 (12.2)	27 (18.4)

predictors (i.e., N ≥ 104 + m). Based on this guideline, our results were adequately powered. A moderate effect size was selected for this calculation because, to our knowledge, no previous research has examined the relationship between anxiety disorders and vaccine hesitancy. A concern with moderation analyses that include categorical predictors is that statistical artifacts can prevent researchers from detecting significant effects in their sample, when a significant effect does exist in the population (Aguinis et al., 2005). The high multicollinearity between the interaction term and its individual predictor terms also inflates the SE and makes interactions difficult to detect. As

such, the non-significant interaction effects should be considered preliminary, and replication is required to determine whether there could in fact be a significant effect at the population level. With this said, none of our non-significant results were approaching significance.

Results are presented in Table 3.

In the first analysis, Group, COVID-19 Stress, IUS, and Disgust scores were entered on Step 1, followed by the interaction of Group with each of the predictors on Step 2. Step 1 was not significant but entry of the interaction terms on Step 2 resulted in a significant change in R^2. The only significant unique predictor was the interaction of Group with IUS $(t(126) = -2.87, p = .005)$. To determine the nature of this interaction we ran separate regressions on vaccine hesitancy for each Group, entering IUS, COVID-19 Stress, and Disgust together. In the Control group, R^2 was not significant ($R^2 = .128$), $F(3, 42) = 2.049, p = .122$. However, IUS was a significant unique predictor of VH, with higher IUS associated with greater hesitancy $(t (42) = 2.18, p = .035)$. In the Anxious group, R^2 was also not significant ($R^2 = .04$, $F(3, 84) = 1.13$, $p = .341$), but IUS was not a significant unique predictor of VH scores, and the directionality of the relationship was opposite $(t(84) = -1.838, p = .070)$, accounting for the interaction.

We then examined whether time spent researching COVID-19 and its interaction with group would predict VH scores. Step 1 was not significant, nor was the entry of the interaction on Step 2. Finally, we

Table 3
Multiple regression analyses of vaccine hesitancy.

	R^2	R^2 change	*F* change	B	SE	Beta	*t*	*p*
Anxiety-Related Factors (*N* = 134)								
Step 1	.006		.191					.943
Group				-.61	2.15	-0.03	-0.28	.778
COVID-19 Stress				.01	.05	.01	.09	.929
Intolerance of Uncertainty				-0.04	.09	-0.06	-0.49	.624
Disgust				.05	.08	.07	.60	.551
Step 2	.076	.070	3.169					.027
Group * COVID-19 Stress				.04	.13	.08	.35	.73
Group * IUS				-0.59	.21	-1.45	-2.87	.005
Group * Disgust				-0.02	.19	-0.03	-0.13	.90
Time Spent Researching COVID-19 (*N* = 141)								
Step 1	.005		.326					.722
Group				-1.31	1.67	-0.07	-0.78	.434
Time				.01	.02	.03	.39	.699
Step 2	.010	.005	.689					.408
Group * Time	.			.05	.06	.15	.83	.408
Attitudes (*N* = 133)								
Step 1	.551		31.207					< 0.001
Group				-1.74	1.21	-0.09	-1.44	.152
Psychological Reactance				-0.07	.07	-0.07	-0.99	.326
Conspiracy Beliefs				.27	.05	.38	5.31	< 0.001
World View				.30	.05	.44	5.94	< 0.001
Trust				-0.30	.10	-0.19	-2.95	.004
Step 2	.559	.008	.542					.705
Group * Psychological Reactance				.17	.15	.13	1.12	.267
Group * Conspiracy Beliefs				-0.09	.10	-0.10	-0.87	.388
Group * World View				-0.08	.10	-0.09	-0.81	.421
Group * Trust				.00	.22	.00	.01	.992

examined whether factors known to predict vaccine hesitancy would predict VH, and, for exploratory purposes, whether group status would moderate these relationships. Entry of Group, Conspiratorial Beliefs, Psychological Reactance, Trust, and World View on Step 1 was significant. Lower trust was uniquely associated with higher VH, as was higher endorsement of conspiracy beliefs and a more individualistic world view. Entry of the interaction terms resulted in virtually no change in R^2.

3.3. Qualitative results

We examined the top reason that Participants listed for being hesitant to get the vaccine and their top reason for being motivated to get the COVID-19 vaccine. The frequencies and proportions of themes across groups are presented in Table 4. There were no significant differences across groups in the frequency which vaccine hesitancy themes were endorsed X^2 (4, $N = 126$) $= 1.98$, $p = .739$ nor in reasons that participants were motivated to get the vaccine X^2 (4, $N = 136$) $= 0.416$, $p = .927$. This was inconsistent with our hypothesis that the Anxious group would offer unique reasons for vaccine hesitancy in addition to common reasons.

4. Discussion

The purpose of this study was to investigate whether people with anxiety disorders differ from people without an anxiety disorder in COVID-19 vaccine hesitancy or their intentions to get vaccinated. We were also interested in the psychological factors that predict hesitancy across both groups, and whether anxiety group status would moderate these relationships.

The results of this study provide preliminary evidence that people with anxiety and related disorders do not show greater COVID-19 vaccine hesitancy or differ in their intentions to get vaccinated. We hypothesized that the relationship of vaccine hesitancy to intolerance of uncertainty, COVID-19 Stress, disgust, and time spent researching COVID-19 would be stronger in people high in anxiety, but our results did not support this hypothesis. There was no interaction between these variables and group, except for intolerance of uncertainty. However, the nature of this interaction was not as expected. In the non-anxious group, intolerance of uncertainty was positively related with vaccine hesitancy, whereas in the anxious group, intolerance of uncertainty was slightly negatively associated with vaccine hesitancy. This could suggest that people without anxiety disorders are less reactive to the uncertainties about the COVID-19 virus, but more concerned about the vaccine. In contrast, people with anxiety disorders might view the vaccine as an opportunity to reduce uncertainty related to the COVID-19 virus. This is supported by our finding that clinically anxious participants reported significantly higher levels of COVID-19 fear.

It was notable that the three biggest predictors of vaccine hesitancy, which were greater individualistic worldview, greater belief in

Table 4
Top reason for vaccine hesitancy and top reason to get vaccinated across groups.

Theme	Total		Anxious		Control	
Hesitancy	n	%	n	%	n	%
Vaccine concerns (efficacy, adverse effects, novelty)	99	78.6	62	78.5	37	78.7
Concerns related to existing medical conditions	15	11.9	10	12.7	5	10.6
Limited access or availability	5	4.0	2	2.5	3	6.4
Wanting others to get the vaccine first	5	4.0	4	5.1	1	2.1
Conspiratorial Beliefs	2	1.6	1	1.3	1	2.1
Motivation						
To protect others	47	34.6	31	36.0	16	32.0
To protect self	62	45.6	39	45.3	23	46.0
To return to normal life	25	18.4	15	17.4	10	20.0
Because it's the right thing to do	2	1.5	1	1.2	1	2.0

conspiracy theories, and trust, had little to do with vaccines specifically. It would seem that people who are high in individualism may refuse vaccination on principle rather than concerns about the vaccine alone. We know that people often have conflicting values. For example, the compulsions people with obsessive compulsive disorder perform are typically highly consistent with core values (e.g., protect family from harm) but they seek treatment when their compulsions compromise other important values (e.g., being a conscientious employee by getting to work on time and focusing) (Purdon, 2021). Vaccine hesitancy may be consistent with the value of independence, but it may be worthwhile to establish what values vaccine hesitancy contradicts, and work to establish ways of fitting vaccination into existing value systems. It may also be of use to consider if there are ways of advertising vaccine importance that activate individualism less and other values more. Campaigns that help enhance trust in the vaccine such as by focusing on the individual people responsible for the breakthroughs, rather than on the companies or the "scientists" more broadly may develop trust. Finally campaigns that help people question why they accept low probability conspiracy beliefs could be helpful; that is, it may be helpful to have people identify and revisit the assumptions on which they base their conspiracy beliefs.

We also found that history of receiving the influenza vaccine was a significant predictor of positive COVID-19 vaccine intentions, which is consistent with current research (Gerussi et al., 2021; Kose et al., 2021). Fogarty and Crues (2017) suggested that focusing education on people who are hesitant but potentially open to getting the vaccine, rather than those who express an unequivocal refusal, may be more worthwhile. One recommended approach for educating people is through the 'elicit-provide-elicit' model, which is an application of motivational interviewing that supports people in making an educated decision (Fogarty & Crues, 2017). By asking people open-ended questions, responding with factual information, and then following up, people can get a better understanding of the benefits and risks of the vaccine, and make an educated and autonomous choice (Fogarty & Crues, 2017).

In our sample, anxious participants reported greater time researching COVID-19 related information, but this was not a predictor of vaccine hesitancy. This is in contrast to past research which has shown that time spent engaging with unregulated internet content is associated with COVID-19 vaccine hesitancy (Murphy et al., 2021). It may be the case that those in the anxious group focused on science-based information from credible authorities, which could reflect the fact that 77% had completed a post-secondary education program. This is important to consider because university and college programs often educate students, in at least some capacity, on ways to assess the validity of sources and identify fake news (Musgrove et al., 2018).

We found no group differences in the reasons people stated for being hesitant to get the COVID-19 vaccine and for being motivated to get it. Interestingly, the reasons were at odds with each other; on the one hand people were concerned about adverse effects and efficacy, on the other hand were motivated to get the vaccine because they wanted to protect others and themselves. This suggests that there is awareness that the vaccine is important despite concerns. Campaigns that normalize feelings of uncertainty and ambivalence and facilitate decision making guided by what is well established rather than guarding against vague, uncertain probabilities may be helpful.

Meanwhile, these findings fit with emerging studies which suggest that vaccine acceptance depends on the domain in which people experience anxiety, rather than overall levels of anxiety (Bendau et al., 2021). Bendau et al. (2021) found that high levels of health anxiety positively correlated with vaccine acceptance, whereas social and economic fears were negatively correlated with COVID-19 vaccine acceptance. Our clinical group was composed of participants with a range of principal diagnoses, including obsessive-compulsive disorder, social anxiety disorder, and generalized anxiety disorder. Our limited sample size meant that we could not analyze each diagnostic group separately. Given that the domain of COVID-19 anxiety (i.e., economic, social, or

health-related concerns) appears to influence vaccine intentions (Bendau et al., 2021), it may be that people with anxiety disorders experience varying levels of COVID-19 vaccine hesitancy, depending on the focus of their anxiety. The clinical diagnostic groups were combined because of the important transdiagnostic features of anxiety disorders such as intolerance of uncertainty and overestimating the probability of harm (Ferreri et al., 2011), which we hypothesized could influence vaccine hesitancy. However, it is possible that the focus of people's anxiety is more important than these overarching features.

4.1. Limitations and future research directions

These findings are preliminary because our sample size was relatively small, particularly the control group. Despite this limitation, this study provides some basis for understanding the extent to which anxiety influences vaccine decision making. Future research could explore whether stress, intolerance of uncertainty, and disgust sensitivity motivate a subset of people to get vaccinated, while being associated with hesitancy in another subset of the population. Understanding what predicts whether these factors motivate or prevent vaccine hesitancy will be an important next step. It will also be important for future research to determine what part of the COVID-19 vaccine distribution process activated concerns that values of individualism were being violated. Understanding why individualism is related to COVID-19 vaccine hesitancy might help public health professionals develop vaccine promotion materials that are more appealing to this portion of the population. Another important consideration for future research is the relationship between political orientation and vaccine hesitancy. This will be especially important for generalizing our results to the United States, where Democratic party membership significantly predicted vaccine acceptance (Milligan et al., 2021), and political views are more polarized compared to Canada (Pennycook et al., 2021). Future research could also explore interventions to promote vaccine uptake among vaccine hesitant individuals. For example, examining whether interventions that encourage participants to consider their values and then reflect on behaviors that align with their values could be helpful. Specifically, because individualism is associated with vaccine hesitancy, identifying other values such as health and security could be important in promoting vaccine uptake. Additionally, having participants consider what is objectively known about the vaccine and comparing these facts with vague uncertainties that may be driven by anxiety or intolerance of uncertainty, may facilitate vaccine uptake.

4.2. Conclusion

These findings provide preliminary evidence that anxiety does not appear to influence vaccine hesitancy or intentions. However, intolerance of uncertainty may be an important predictor of vaccine hesitancy in non-anxious, but not clinically anxious people; however, this finding requires replication. Finally, we found that the same factors that predict vaccine hesitancy for well-known vaccines also predict COVID-19 vaccine hesitancy for both anxious and non-anxious people. Considering the variables driving vaccine hesitancy for people with and without anxiety disorders will be important when developing public health messaging to promote vaccine uptake among vaccine hesitant individuals.

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