



The Moderating Role of Intolerance of Uncertainty in the Relationship Between Health Anxiety and Pandemic-Related Stress

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Abstract

Background and Objectives Global pandemics, including COVID-19, have a significant effect on mental health, and this may be especially true for individuals with health anxiety. Although health anxiety is related to both pandemic-related fears and perceptions of health risks, there is a paucity of research on individual difference variables that might exert an influence on these relationships. The present study examined intolerance of uncertainty (IU) as a potential moderator of the relationship between health anxiety and COVID-related stress, and the relationship between health anxiety and perceived risk of contracting COVID.

Design and Methods A nationally representative sample of North American adults ($N=204$) completed self-report measures of health anxiety, IU, COVID-related stress, and perceived risk of contracting COVID.

Results Prospective IU moderated the positive relationship between health anxiety and COVID-related stress, as the relationship was strengthened at average and higher levels of prospective IU. Neither IU subscale moderated the relationship between health anxiety and perceived risk.

Conclusion These results suggest that individuals with elevated health anxiety and high prospective IU may be at higher risk of experiencing COVID-related stress, illuminating the interplay of risk factors that place anxious populations at an increased risk of experiencing stress during acute health risks.

Keywords COVID-19 · Health anxiety · Intolerance of uncertainty · Stress · Perceived risk

Global pandemics can have serious physical and psychological effects on human beings. Such acute population-level health risks, including the H1N1 influenza epidemic (Wheaton et al., 2012), the Ebola virus (Mohammed et al., 2015), and the novel coronavirus (COVID-19; Qiu et al., 2020; Tull et al., 2020b, Zhu et al., 2021) have shown patterns of increased stress and mental health concerns. Although heightened stress and negative affect are normative responses to public health emergencies, the COVID

pandemic has had especially impactful physical and psychological effects on vulnerable populations (Asmundson et al., 2020; Diaz et al., 2021). Compared to individuals with no pre-existing mental health conditions, those with mental health disorders in general (Taylor et al., 2020a) and anxiety disorders in particular (Asmundson et al., 2022; McNeil & Purdon, 2022) report more COVID-related stress, are more adversely affected by COVID, and experience more COVID-related fears. These results suggest that psychopathology may confer risk of psychological distress during a pandemic. Importantly, however, there is less research examining the relationship between *health* anxiety and COVID-related stress, as well as individual difference variables that might amplify the experience of distress in health anxious individuals.

Health anxiety results from a perceived source of danger to one's health (Asmundson et al., 2010) and is an important construct in understanding the psychological correlates of viral pandemics, likely due to overlapping features such as concerns about contamination and fear of infection.

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Blakey and Abramowitz (2017) found that health anxiety was positively correlated ($r = .30$) with anxiety related to the 2016 Zika virus. Importantly, health anxiety may have been especially elevated during the early stages of the COVID pandemic due to the virus's many unknown properties at the time (e.g., method of transmission, incubation period, risk factors for hospitalization, long-term effects, mortality rates). Jungmann and Withhöft (2020) reported a positive relationship between health anxiety and a single-item measure of COVID-related anxiety ($r = .34$), and Taylor et al. (2020b) reported positive relationships between pre-COVID health anxiety and each factor of the COVID Stress Scales in a U.S. sample (r s ranging from 0.34 to 0.48). Similarly, Mertens et al. (2020) found that health anxiety uniquely predicted various COVID-related fear constructs (e.g., safety precautions, general worries) above and beyond general anxiety symptoms.

Health anxiety may also be related to perceived risk of contracting a virus during a pandemic. Individuals with high levels of health anxiety believe that they are at an inflated risk of becoming ill (Hadjistavropoulos et al., 1998; Haenen et al., 2000; Marcus & Church, 2003), and individuals who perceive a high risk of illness are more attuned to virus-related stimuli, which can in turn increase health anxiety (Cannito et al., 2020). Such attentional biases may help to explain the positive relationship between health anxiety and perceived risk of COVID. For example, health anxiety severity was positively related to perceived risk of COVID among Malaysian healthcare workers (Mohd et al., 2021). Additionally, Hadjistavropoulos et al. (1998) randomly assigned participants to receive positive, negative, or ambiguous diagnostic feedback. Health anxious participants perceived themselves as being at greater risk of medical complications, regardless of the type of feedback they received.

Although past research has indicated that health anxiety is related to both viral outbreak-related stress and perceived risk of contracting an illness, few studies have explored variables that may impact the strength of these relationships. One such variable is intolerance of uncertainty (IU). IU is an individual differences variable depicting an individual's appraisal of uncertain or ambiguous situations as threatening, and individuals high in IU accordingly have an adverse reaction to uncertain situations (Dugas et al., 1998). IU plays an important role in anxiety disorders (Carleton, 2012; Jensen et al., 2016), including health anxiety (Deacon & Abramowitz, 2008). In one experimental study by Rosen and Knäuper (2009), participants who were made to perceive themselves as having high IU (i.e., feel greater uncertainty about a serious health risk) engaged in more information seeking about that health risk compared with participants who were made to perceive themselves as

having low IU. Thus, both trait IU and situational uncertainty might be causally related to key variables in health anxiety, such as information seeking.

As with health anxiety, IU was highly relevant in the early stages of the COVID pandemic when crucial information about the virus was unknown and Centers for Disease Control and Prevention (CDC) guidelines were evolving. IU has been studied in relation to past pandemics, with one study finding that IU was related to state/trait anxiety during the 2009 H1N1 pandemic ($r = .48$; Taha et al., 2014). More recent studies on the COVID pandemic found that IU is positively associated with COVID-related fear ($r = .27$; Mertens et al., 2020) and that IU predicts body vigilance (a dimension of health anxiety) one month later ($r = .28$; Tull et al., 2020a). IU is also associated with increased probability estimates that a particular outcome is more likely than it is in reality (Einstein, 2014; Tull et al., 2020a). For example, Bavolar et al. (2021) found that IU was positively associated with perceived risk of COVID (both contracting the virus and threat posed by the virus), although the authors did not measure perceived threat of COVID using a validated scale. Tull et al. (2020a) similarly found that trait IU at baseline positively predicted perceived likelihood of contracting COVID one month later ($r = .41$). Prior research has identified IU as a moderator that may strengthen the negative impacts of stress and anxiety (e.g., Chen & Hong, 2010; Liao et al., 2016). Additionally, IU significantly moderated the relationship between social isolation and distress during the COVID pandemic (Smith et al., 2020). In summary, individuals with high levels of health anxiety likely experience more COVID-related stress and inflated perceptions of threat, and this relationship may be especially strong among those who are high in IU.

IU is commonly measured using the Intolerance of Uncertainty Scale (Freeston et al., 1994), which yields two subscales – prospective and inhibitory IU. *Prospective IU* measures anxiety about the anticipation of uncertainty (e.g., reacting poorly to unforeseen occurrences), and is uniquely implicated in generalized anxiety disorder and obsessive-compulsive disorder (McEvoy & Mahoney, 2011). Referred to as a “desire for predictability” (Berenbaum et al., 2008), prospective IU is positively related to health anxiety ($r = .44$, Fergus & Bardeen, 2013; $r = .39 - .52$, Fetzner et al., 2014; $r = .57$, Wright et al., 2016), leading some to propose that prospective IU is related to behaviors such as information seeking in health anxious individuals (Fetzner et al., 2014).

Inhibitory IU refers to the inhibition of action in response to uncertainty (e.g., feeling paralyzed when confronted with uncertainty) (Birrell et al., 2011). Research indicates that inhibitory IU is uniquely implicated in panic disorder, agoraphobia, social anxiety, and depression (Carleton et al., 2013; McEvoy & Mahoney, 2011; Saulnier et al., 2019). Studies

have reported positive associations between inhibitory IU and health anxiety ($r = .58$, Fergus & Bardeen, 2013; $r = .33 - .51$, Fetzner et al., 2014; $r = .52$, Wright et al., 2016), with inhibitory IU predicting health anxiety above and beyond the contributions of negative affect and anxiety sensitivity (Fergus & Bardeen, 2013). Inhibitory IU (but not prospective IU) is also associated with perceived likelihood of negative outcomes (Bredemeier & Berenbaum, 2008). However, there is some indication that prospective IU (compared to inhibitory IU) is more strongly related to health anxiety, and that individuals with health anxiety are unlikely to become inhibited and instead may escalate behavioral attempts to decrease distress (e.g., by making repeated appointments, seeking information) (Fetzner et al., 2014). Although both prospective and inhibitory IU are correlated with health anxiety, no studies to date have examined whether these two IU factors differentially moderate the relationship between health anxiety and either COVID-related stress or perceived risk of contracting COVID.

The present study aimed to examine the potential moderating effects of the two facets of IU (prospective and inhibitory) on the relationship between (a) health anxiety and COVID-related stress, as well as (b) health anxiety and perceived risk of contracting COVID. Based on prior literature, we hypothesized that both health anxiety and IU would be positively associated with both COVID-related stress and perceived risk of contracting COVID. Furthermore, we predicted that only prospective IU would significantly moderate the relationship between health anxiety and COVID-related stress, given that prospective IU is more strongly implicated in health anxiety (e.g., Fetzner et al., 2014). We also predicted that only inhibitory IU would moderate the relationship between health anxiety and perceived risk of contracting COVID, given evidence of a relationship between inhibitory IU and inflated perceived likelihood of negative outcomes (e.g., Bredemeier & Berenbaum, 2008).

Methods

Participants

Participants were recruited via advertisements on social media websites (Facebook and Twitter) and community message boards (Craigslist.com and Nextdoor.com) to participate in a larger online longitudinal study examining affective forecasting and affective recall as a function of various transdiagnostic constructs. To be included in the study, participants had to be between 18 and 65 years of age, currently living in the U.S. or Canada, and have access to a mobile device for collection of momentary data in the parent study. A total of 859 participants were recruited, of which

654 individuals were excluded due to poor data quality (see below for procedures to maximize data quality), resulting in a final sample size of 205 for the baseline assessment. One participant did not complete the measure of IU, and thus our final analytic sample was $N = 204$. Among this sample, the average age was 37.27 years ($SD = 12.94$), and most participants were female (74.50%). Participants were predominantly White (75.5%), while 10.3% were Black/African American, 0.5% were American Indian or Alaskan Native, 0.5% were Native Hawaiian or Pacific Islander, 7.4% were Asian, and 5.9% indicated “Other”. Independent of racial identity, 15.2% of the sample identified as Hispanic/Latino. Additionally, 2.9% of the sample had tested positive for COVID prior to participating in the study.

Procedure

Data for the current study were taken from the baseline assessment, which took place between August–September 2020. Online recruitment materials contained an invitation to participate in a study of people’s experiences during the COVID-19 pandemic. After providing informed consent, participants completed multiple self-report measures administered via Qualtrics in randomized order. Compensation for participation in the baseline assessment was \$15 in Amazon gift cards.

We instituted several procedures to safeguard against false and low-quality data. First, enrollees’ IP addresses were checked to ensure that they were associated with locations outside of the U.S. or Canada, and whether a virtual private network (VPN) was being used to shield the location of an IP address. Individuals located outside of the U.S. or Canada were screened out of the study, and those using a VPN were required to deactivate their VPN to participate in the study. Each IP address was permitted to enroll only once. Second, individuals who failed to complete $\geq 50\%$ of a questionnaire or failed to respond to key items related to the parent study were excluded. Third, we embedded nine multiple-choice questions throughout the study that were easily answered provided the respondent was paying proper attention; individuals who responded incorrectly to $> 25\%$ of these quality assurance questions were excluded from analyses. Fourth, we embedded honeypot (i.e., trap) items throughout the survey that were invisible to human participants but indistinguishable from other items to a programmed bot. Answered honeypot questions indicated that the study had been completed by a bot and resulted in the exclusion of that entity’s data. Fifth, we inspected the amount of time participants spent on each questionnaire; those whose average time was ≤ 1 s per item were excluded from analyses. Finally, a section in the parent study asked participants to describe personal events that may occur

during the coming week; those who provided nonsensical responses were excluded. Most excluded participants met more than one exclusion criterion.

Measures

Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002). Health anxiety was assessed using the 18-item SHAI. Participants were instructed to respond according to their experiences over the past six months. The SHAI is appropriate for both clinical and non-clinical levels of health anxiety (Salkovskis et al., 2002). The SHAI evidences good internal consistency ($\alpha=0.86$) and satisfactory convergent validity with the Illness Attitude Scale ($r=.63$; Abramowitz et al., 2007). We created a summed score for all 18 items, with higher scores indicating more severe health anxiety. The SHAI evidenced high internal consistency in the present study ($\alpha=0.90$).

Intolerance of Uncertainty Scale (IUS-12; Carleton et al., 2007). Intolerance of uncertainty was measured using the 12-item version of the IUS, which was adapted from the original 27-item IUS (Freeston et al., 1994). The IUS-12 has two subscales: prospective IU and inhibitory IU. Prospective IU is seen as the cognitively focused dimension of IU, whereas inhibitory IU is seen as the behaviorally focused dimension of IU (Carleton, 2012). This bifactor model of IU has garnered support in the literature (e.g., Jacoby et al., 2013; McEvoy & Mahoney, 2011). The prospective and inhibitory IU subscales have demonstrated excellent internal consistency ($\alpha s=0.85$; Carleton et al., 2007). The IUS-12 also evidences satisfactory convergent validity with the Beck Anxiety Inventory ($r=.57$; Carleton et al., 2007). The total score on the IUS-12 is strongly correlated with the 27-item version of the scale ($r=.96$), and the 27-item IUS has demonstrated satisfactory retest reliability ($\alpha=0.91$; Freeston et al., 1994). Higher scores indicate greater trait IU. The IUS-12 evidenced good internal consistency in the present study for both prospective ($\alpha=0.88$) and inhibitory ($\alpha=0.86$) subscales.

COVID Stress Scales (CSS; Taylor et al., 2020b). The CSS is a 36-item measure of COVID-related stress over the past week. Items from the CSS measure participants' concerns regarding the COVID pandemic, various stress-related symptoms, and checking and information-seeking behaviors. The CSS yields five scales (danger and contamination, socioeconomic consequences, xenophobia, traumatic stress symptoms, and compulsive checking and reassurance seeking). The CSS evidences good internal consistency ($\alpha s=0.86-0.95$; Taylor et al., 2020b). It also evidences good convergent validity with both health anxiety and obsessive-compulsive symptoms (i.e., contamination, checking), as well as good discriminant validity as most of

its subscales are more strongly correlated with anxiety than with depression (Taylor et al., 2020b). Items were summed to create a total score, with higher scores indicating greater COVID-related stress. The CSS evidenced excellent internal consistency in the current study ($\alpha=0.96$).

Perceived Risk of COVID Scale (PRCS; adapted from Napper et al., 2012). To measure perceived risk of contracting COVID, we adapted the 8-item Perceived Risk of HIV Scale (PRHS; Napper et al., 2012) by changing all mentions of "HIV" to "COVID-19" (e.g., "I worry about getting infected with COVID-19"). All items were summed to create a total score, with higher scores indicating greater perceived risk of contracting COVID. The PRHS has demonstrated high internal consistency ($\alpha=0.88$; Napper et al., 2012) and good criterion validity in its association with various risky sex behaviors (e.g., instances of unprotected sex) and a single-item risk behavior assessment ($r=.63$; Napper et al., 2012). We examined the validity of the PRCS by examining its relationship to two single-item measures collected in the parent study. At the baseline assessment, we asked participants to indicate their perceived likelihood of contracting COVID in the next 10 months using both a 0–6 likelihood rating (0 = *not at all likely*, 6 = *extremely likely*) and a 0–100% probability estimate. The PRCS was moderately correlated with both the 0–6 likelihood rating ($r=.48$) and the 0–100% probability estimate ($r=.46$). The PRCS evidenced satisfactory internal consistency ($\alpha=0.82$) in the current study.

Data Analysis Plan

Moderation analyses were conducted in *Mplus* 8.6 (Muthén & Muthén, 1998–2019) with specific syntax for estimating moderation models (Stride et al., 2015) based on the PROCESS 3.4 macro for SPSS (Hayes, 2017). To test study aims, we explored four separate interaction models, all controlling for age and sex. All analyses were conducted with health anxiety as the predictor and two separate outcome variables: (1) COVID-related stress and (2) perceived risk of contracting COVID. Furthermore, the IUS prospective and inhibitory subscales were estimated as moderators in the models. Within these models, statistical significance was determined with 95% bias-corrected standardized bootstrapped confidence intervals (based on 10,000 bootstrapped samples) that did not contain zero. Significant interactions were probed using conditional standardized coefficient effects at levels of IU (1 *SD* below mean, mean, and 1 *SD* above mean).

Table 1 Bivariate correlations among study variables in analytic sample

	M	SD	1	2	3	4	5	6	7
1. Health Anxiety	16.38	8.39	---						
2. IUS: Prospective	20.04	6.12	0.42***	---					
3. IUS: Inhibitory	10.74	4.95	0.42***	0.77***	---				
4. COVID Stress	40.13	25.28	0.45***	0.40***	0.42***	---			
5. Perceived Risk of COVID	27.44	4.54	0.26***	0.20**	0.22**	0.47***	---		
6. Age	37.27	12.91	-.06	-0.14*	-0.17*	-0.15*	-0.11	---	
7. Sex (1 = male, 2 = female)	1.75	0.44	0.11	0.05	0.08	0.18*	0.13	-0.13	---

IUS = Intolerance of Uncertainty Scale

* $p < .05$; ** $p < .01$; *** $p < .001$

Results

Table 1 displays bivariate correlations and descriptive statistics for all variables. Health anxiety, IU (prospective and inhibitory subscales), COVID-related stress, and perceived risk of contracting COVID were all significantly and positively correlated with each other (r s ranging from 0.20 to 0.77).

Table 2 depicts standardized effects from the moderation models. For the models with COVID-related stress as the outcome variable, results indicated a main effect of health anxiety such that health anxiety was positively associated with COVID-related stress at average levels of prospective IU ($\beta = 0.28$) and inhibitory IU ($\beta = 0.31$). Main effects were also found for prospective IU ($\beta = 0.22$) and inhibitory IU ($\beta = 0.24$) on COVID-related stress at average levels of health anxiety. Interaction effects indicated that only prospective IU significantly moderated the relationship between health anxiety and COVID-related stress (interaction $\beta = 0.14$, 95% CI [0.01, 0.27]). Specifically, the relationship between health anxiety and COVID-related stress was strengthened at higher levels of prospective IU: low level (1SD below mean), $\beta = 0.14$; average level, $\beta = 0.28$; high level (1 SD above mean) $\beta = 0.41$.

For the models with perceived risk of contracting COVID as the outcome variable, results indicated a main effect of health anxiety such that health anxiety was positively associated with perceived risk of COVID at average levels of prospective IU ($\beta = 0.23$) and inhibitory IU ($\beta = 0.21$). No statistically significant main effects were found for prospective IU ($\beta = 0.10$) and inhibitory IU ($\beta = 0.13$) on risk of contracting COVID at average levels of health anxiety. Further, neither prospective IU (interaction $\beta = -0.05$, 95% CI [-0.17, 0.08]) nor inhibitory IU (interaction $\beta = -0.05$, 95% CI [-0.21, 0.09]) significantly moderated the relationship between health anxiety and perceived risk of contracting COVID.¹

¹ We evaluated these models using IUS total score. Results were similar to the subscale-specific results: IU significantly moderated the relationship between health anxiety and COVID-related stress (interaction

Discussion

The purpose of the present study was to examine the moderating effects of IU on the relationship between health anxiety and (1) COVID-related stress and (2) perceived risk of contracting COVID. As hypothesized, we found that prospective IU (but not inhibitory IU) moderated the relationship between health anxiety and COVID-related stress. Specifically, the positive relationship between health anxiety and COVID-related stress was strongest among participants who reported high levels of prospective IU. This finding is consistent with prior research indicating that both health anxiety (Jungmann & Witthöft, 2020; Mertens et al., 2020; Taylor et al., 2020b) and IU (Mertens et al., 2020; Tull et al., 2020a) are associated with COVID-related fears, and adds to a growing literature implicating IU in anxiety regarding viral pandemics (e.g., H1N1; Taha et al., 2014). Moreover, our findings advance knowledge regarding the interactive relationship between health anxiety and IU in such pandemic-related fears.

It is important to understand why prospective, but not inhibitory, IU emerged as a significant moderator of the relationship between health anxiety and COVID-related stress. Prospective IU is closely related to *cognitive* indicators of anxiety such as anxious cognitions (McEvoy & Mahoney, 2011) and information seeking (Fetzner et al., 2014), whereas inhibitory IU is closely related to *behavioral* indicators of anxiety such as inhibited action (Carleton, 2012) and procrastination (Fourtounas & Thomas, 2016). Our results suggest that the relationship between health anxiety and pandemic-related stress is especially strong for individuals who are elevated on the cognitive element of IU. These individuals are more likely to experience anxious cognitions (McEvoy & Mahoney, 2011), seek information for reassurance (Fetzner et al., 2014), and engage in worrisome thinking (Yao et al., 2022). In contrast, the strength of this relationship was not impacted by

$\beta = 0.12$, 95% CI [0.00, 0.27]), but IU did not significantly moderate the relationship between health anxiety and perceived risk of contracting COVID (interaction $\beta = -0.05$, 95% CI [-0.19, 0.08]).

Table 2 Summary of effects of health anxiety, intolerance of uncertainty (IU) factors, and their interaction on COVID-related outcomes

	COVID-Related Stress (CSS)	
	β	95% CI
Model Information: $n=204$; $R^2=0.30$		
Health Anxiety (HA)	0.28	0.12, 0.44
Prospective IU	0.22	0.10, 0.36
HA × Prospective IU	0.14	0.01, 0.27
Effect of HA at low Prospective IU (1 <i>SD</i> below mean)	0.14	-0.08, 0.37
Effect of HA at average Prospective IU	0.28	0.12, 0.44
Effect of HA at high Prospective IU (1 <i>SD</i> above mean)	0.41	0.22, 0.59
	Perceived Risk of COVID (PRCS)	
	β	95% CI
Model Information: $n=204$; $R^2=0.10$		
Health Anxiety (HA)	0.23	0.09, 0.37
Prospective IU	0.10	-0.04, 0.24
HA × Prospective IU	-0.05	-0.17, 0.08
Effect of HA at low Prospective IU (1 <i>SD</i> below mean)	0.29	0.07, 0.50
Effect of HA at average Prospective IU	0.23	0.09, 0.37
Effect of HA at high Prospective IU (1 <i>SD</i> above mean)	0.18	0.03, 0.35
	COVID-Related Stress (CSS)	
	β	95% CI
Model Information: $n=204$; $R^2=0.30$		
Health Anxiety (HA)	0.31	0.13, 0.50
Inhibitory IU	0.24	0.10, 0.37
HA × Inhibitory IU	0.07	-0.04, 0.22
Effect of HA at low Inhibitory IU (1 <i>SD</i> below mean)	0.24	0.03, 0.48
Effect of HA at average Inhibitory IU	0.31	0.13, 0.49
Effect of HA at high Inhibitory IU (1 <i>SD</i> above mean)	0.38	0.16, 0.62
	Perceived Risk of COVID (PRCS)	
	β	95% CI
Model Information: $n=204$; $R^2=0.10$		
Health Anxiety (HA)	0.21	0.08, 0.35
Inhibitory IU (IU-I)	0.13	-0.04, 0.30
HA × Inhibitory IU	-0.05	-0.21, 0.09
Effect of HA at low Inhibitory IU (1 <i>SD</i> below mean)	0.26	0.05, 0.47
Effect of HA at average Inhibitory IU	0.21	0.08, 0.35
Effect of HA at high Inhibitory IU (1 <i>SD</i> above mean)	0.16	-0.03, 0.36

Note. CSS=COVID Stress Scales, PRCS=Perceived Risk of COVID Scale. Significant effects were determined by a 95% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero and are bolded for emphasis. All analyses were performed controlling for age and sex

behavioral manifestations of IU (e.g., freezing in the face of uncertainty; Carleton, 2012). In seeking to understand why we found moderation effects for prospective IU but not for inhibitory IU, we considered the possibility that our results emerged due to a methodological artifact. The CSS is comprised of items measuring worry about various aspects of the COVID pandemic, stress-related symptoms, and information seeking behavior – and most of these items are cognitive in nature. Likewise, prospective IU is strongly related to cognitive elements of anxiety. We considered the possibility that prospective IU emerged as a moderator *because* both the CSS and the prospective IU subscale tap into cognitive phenomena. This would challenge the idea that prospective IU is truly a moderator of the relationship between health anxiety and COVID-related stress, and would instead suggest that the relationship emerged simply because of the overlap in the types of processes measured by the two instruments. It would also suggest that if we had instead measured COVID-related stress using a measure that tapped into the affective elements of COVID-related fear, the moderating effect would not have emerged. However, we did *not* find that prospective IU moderated the relationship between health anxiety and perceived risk of contracting COVID, which is *also* highly cognitive in nature. Thus, we feel confident in our conclusion that prospective IU (but not inhibitory IU) moderates the relationship between health anxiety and COVID-related stress. This result is consistent with cognitive models positing the central (and potentially causal) role of anxious cognitions, reassurance seeking, and worry in stress and psychopathology (Beesdo-Baum et al., 2012; Kobori & Salkovskis, 2013).

Although we predicted that inhibitory IU would moderate the relationship between health anxiety and perceived risk of contracting COVID, neither prospective nor inhibitory IU moderated the relationship between health anxiety and perceived risk of contracting COVID. Thus, the behavioral element of IU did not affect the strength or direction of this relationship. Although our prediction was based on findings by Bredemeier and Berenbaum (2008) that inhibitory IU is uniquely associated with perceived probability of a negative event, these authors also found that for *low* base rate events (i.e., an average probability score across participants of <2 on a 1–7 scale - e.g., having one’s home robbed, being in a natural disaster, becoming seriously ill), prospective IU was negatively associated, and inhibitory IU was positively associated, with perceived likelihood of those negative events. We considered the possibility that our participants perceived the likelihood of contracting COVID as a low probability event, and that this might explain why we did not find effects of either IU subscale for this analysis. Our participants were asked (using two single-item measures unrelated to the current study) to indicate their perceived

likelihood of contracting COVID over the next 10 months. Participants did not indicate extremely low likelihoods on either a 0–6 Likert ($M=2.41$, $SD=1.28$) or a 0–100 probability estimate ($M=36.75$, $SD=22.73$) scale. Thus, it is unlikely that a very low perceived probability of contracting COVID accounted for lack of moderation effects. Rather, it may simply be that behavioral elements of IU (e.g., freezing in the face of uncertainty) do not moderate the relationship between health anxiety and perceived risk of contracting COVID.

Interestingly, health anxiety was positively associated with perceived risk of contracting COVID after controlling for both IU subscales. Prior research has suggested that individuals with health anxiety tend to inflate their risk of contracting illnesses (Haenen et al., 2000; Mohd et al., 2021). This relationship between health anxiety and perceived risk of contracting COVID seems to persist even when environmental conditions realistically increase the risk of COVID. For example, Mohd et al. (2021) reported a positive relationship between health anxiety and perceived risk of contracting COVID in a sample of healthcare workers who were likely at higher risk due to their role in treating COVID patients. In addition, Lindner et al. (2022) found a positive relationship between perceived risk of COVID and health anxiety even after accounting for varying levels of actual COVID risk (as measured by lockdown stringency). Just as the relationship between health anxiety and perceived risk of contracting COVID appears to be impervious to actual risk of contracting COVID, this relationship may also be impervious to other moderators, including IU.

Research regarding prospective and inhibitory IU and related outcomes is currently quite limited. The present study's findings suggest that prospective IU moderates the relationship between health anxiety and a measure of stress (i.e., COVID Stress Scales), but not the relationship between health anxiety and perceived risk of infection. Pandemic-related stress can manifest in various ways, including various cognitive (perceived risk of contracting the virus, anticipated severity of symptoms after contracting the virus, anticipated death from the virus) and behavioral (excessive reassurance seeking, excessive protective behaviors) indices. It may be that IU does not moderate the relationship between health anxiety and perceived risk of contracting COVID but would moderate the relationship between health anxiety and another cognitive or behavioral index of COVID-related stress. The CSS likely captured a broader set of phenomena that allowed for the detection of moderation.

Our findings suggest that interventions targeting prospective IU may be useful in treating pandemic-related stress among health anxious individuals. In particular, cognitive-behavioral (Barsky & Ahern, 2004; Cooper et al., 2017)

and acceptance-based (Eilenberg et al., 2016) interventions may be helpful for both health and pandemic-related anxiety due to their focus on helping individuals tolerate ambiguity. For example, Dugas et al.'s (1998) cognitive-behavioral intervention for generalized anxiety disorder contains exposure-based approaches to treating IU, and may be useful in treating patients with health anxiety during large-scale health threats. Because IU is also implicated in health anxiety (Deacon & Abramowitz, 2008), Dugas et al.'s (1998) treatment would likely also benefit health anxious individuals. Such exposure-based approaches can be helpful in resolving the discomfort that can arise from uncertainty (Goldman et al., 2007), particularly when there is no clear solution to the worry-inducing situation (Dugas & Ladouceur, 2000), as can be the case with health anxiety and novel viruses.

The present study has various limitations that should be considered alongside these findings. First, the majority of our participants were White and female. Future studies should examine these constructs in more diverse populations. Second, we assessed all constructs using self-report measures, which may have increased the risk of shared method variance, led to inaccurate reporting due to fallible memory, and/or increased social desirability. Furthermore, the results of the present study should be interpreted with specific regard to the period of data collection (i.e., August through September of 2020) since societal restrictions, public perceptions, and health outcomes fluctuated throughout different stages of the pandemic. As restrictions became more lenient and individuals adjusted to a pandemic full of uncertainties, it is possible that prospective IU would no longer significantly moderate the relationship between health anxiety and COVID-related stress in the later periods of the pandemic. Future pandemic-related studies may wish to examine whether the relationships between health anxiety, intolerance of uncertainty, pandemic-related stress, and perceived risks of contracting the virus differ at various stages of the pandemic when degrees of situational uncertainty evolve depending on knowledge acquired and disseminated by public health officials. Finally, because the PRCS was adapted from the Perceived Risk of HIV Scale, it is possible that a properly validated measure of risk perception would have produced significant results. However, it is also possible that existing measures of general risk perception may have failed to capture the nuances of COVID-specific risk perception, and thus our use of the PRCS may have been an advantage in the current study.

Given the effects of viral pandemics on the prevalence of anxiety (e.g., Gallagher et al., 2020) and the projected increase in the frequency of pandemics (Marani et al., 2021), it is critical for research to examine potential risk factors for health and pandemic-related anxiety. Few studies have

examined the potential moderating role of IU in the relationship between health anxiety and COVID-related outcomes. Our results suggest that the relationship between health anxiety and COVID-related stress is strengthened for individuals high in prospective IU, and more broadly indicate that examining the interactive effects of health anxiety and IU factors may be helpful in identifying individuals who are at highest risk for experiencing higher levels of COVID-related stress. These results contribute to a growing literature regarding psychological correlates of viral pandemics, and the individual difference variables that might increase risk for those psychological effects.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10608-023-10365-w>.

Availability of data and materials Data and analytic outputs are available upon request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

References

- Abramowitz, J. S., Deacon, B. J., & Valentiner, D. P. (2007). The short health anxiety inventory: Psychometric properties and construct validity in a non-clinical sample. *Cognitive Therapy and Research*, 31(6), 871–883. <https://doi.org/10.1007/s10608-006-9058-1>
- Asmundson, G. J., Abramowitz, J. S., Richter, A. A., & Whedon, M. (2010). Health anxiety: Current perspectives and future directions. *Current Psychiatry Reports*, 12(4), 306–312. <https://doi.org/10.1007/s11920-010-0123-9>
- Asmundson, G. J. G., Paluszczek, M. M., Landry, C. A., Rachor, G. S., McKay, D., & Taylor, S. (2020). Do pre-existing anxiety-related and mood disorders differentially impact COVID-19 stress responses and coping? *Journal of Anxiety Disorders*, 74, 102271. <https://doi.org/10.1016/j.janxdis.2020.102271>
- Asmundson, G. J. G., Rachor, G., Drakes, D. H., Boehme, B. A. E., Paluszczek, M. M., & Taylor, S. (2022). How does COVID stress vary across the anxiety-related disorders? Assessing factorial invariance and changes in COVID stress scale scores during the pandemic. *Journal of Anxiety Disorders*, 87, 102554. <https://doi.org/10.1016/j.janxdis.2022.102554>
- Barsky, A. J., & Ahern, D. K. (2004). Cognitive behavior therapy for hypochondriasis: A randomized controlled trial. *Journal Of The American Medical Association*, 291(12), 1464–1470. <https://doi.org/10.1001/jama.291.12.1464>
- Bavolar, J., Kacmar, P., Hricova, M., Schrötter, J., Kovacova-Holevova, B., Köverova, M., & Raczova, B. (2021). Intolerance of uncertainty and reactions to the COVID-19 pandemic. *The Journal of General Psychology*, 1–28. <https://doi.org/10.1080/00221309.2021.1922346>
- Beesdo-Baum, K., Jenjahn, E., Höfler, M., Lueken, U., Becker, E. S., & Hoyer, J. (2012). Avoidance, safety behavior, and reassurance seeking in generalized anxiety disorder. *Depression and Anxiety*, 29(11), 948–957. <https://doi.org/10.1002/da.21955>
- Berenbaum, H., Bredemeier, K., & Thompson, R. J. (2008). Intolerance of uncertainty: Exploring its dimensionality and associations with need for cognitive closure, psychopathology, and personality. *Journal of Anxiety Disorders*, 22(1), 117–125. <https://doi.org/10.1016/j.janxdis.2007.01.004>
- Birrell, J., Meares, K., Wilkinson, A., & Freeston, M. (2011). Toward a definition of intolerance of uncertainty: A review of factor analytical studies of the intolerance of uncertainty scale. *Clinical Psychology Review*, 31(7), 1198–1208. <https://doi.org/10.1016/j.cpr.2011.07.009>
- Blakey, S. M., & Abramowitz, J. S. (2017). Psychological predictors of health anxiety in response to the Zika Virus. *Journal of Clinical Psychology in Medical Settings*, 24(3–4), 270–278. <https://doi.org/10.1007/s10880-017-9514-y>
- Bredemeier, K., & Berenbaum, H. (2008). Intolerance of uncertainty and perceived threat. *Behaviour Research and Therapy*, 46(1), 28–38. <https://doi.org/10.1016/j.brat.2007.09.006>
- Cannito, L., Di Crosta, A., Palumbo, R., Ceccato, I., Anzani, S., La Malva, P., Palumbo, R., & Di Domenico, A. (2020). Health anxiety and attentional bias toward virus-related stimuli during the COVID-19 pandemic. *Scientific Reports*, 10(1), 16476. <https://doi.org/10.1038/s41598-020-73599-8>
- Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: Theoretical and practical perspectives. *Expert Review of Neurotherapeutics*, 12(8), 937–947. <https://doi.org/10.1586/ern.12.82>
- Carleton, R. N., Fetzner, M. G., Hackl, J. L., & McEvoy, P. (2013). Intolerance of uncertainty as a contributor to fear and avoidance symptoms of panic attacks. *Cognitive Behaviour Therapy*, 42(4), 328–341. <https://doi.org/10.1080/16506073.2013.792100>
- Carleton, R. N., Norton, M. A. P. J., & Asmundson, G. J. G. (2007). Fearing the unknown: A short version of the intolerance of uncertainty scale. *Journal of Anxiety Disorders*, 21(1), 105–117. <https://doi.org/10.1016/j.janxdis.2006.03.014>
- Chen, C. Y., & Hong, R. Y. (2010). Intolerance of uncertainty moderates the relation between negative life events and anxiety. *Personality and Individual Differences*, 49(1), 49–53. <https://doi.org/10.1016/j.paid.2010.03.006>
- Cooper, K., Gregory, J., Walker, I., Lambe, S., & Salkovskis, P. (2017). Cognitive behaviour therapy for health anxiety: A systematic review and meta-analysis. *Behavioural and Cognitive Psychotherapy*, 45(2), 110–123. <https://doi.org/10.1017/S1352465816000527>
- Deacon, B., & Abramowitz, J. S. (2008). Is hypochondriasis related to obsessive-compulsive disorder, panic disorder, or both? An empirical evaluation. *Journal of Cognitive Psychotherapy*, 22(2), 115–127. <https://doi.org/10.1891/0889-8391.22.2.115>
- Diaz, A., Baweja, R., Bonatakis, J. K., & Baweja, R. (2021). Global health disparities in vulnerable populations of psychiatric patients during the COVID-19 pandemic. *World Journal of Psychiatry*, 11(4), 94–108. <https://doi.org/10.5498/wjp.v11.i4.94>
- Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, M. H. (1998). Generalized anxiety disorder: A preliminary test of a conceptual model. *Behaviour Research and Therapy*, 36(2), 0–226. [https://doi.org/10.1016/s0005-7967\(97\)00070-3](https://doi.org/10.1016/s0005-7967(97)00070-3)
- Dugas, M. J., & Ladouceur, R. (2000). Treatment of GAD: Targeting intolerance of uncertainty in two types of worry. *Behavior Modification*, 24(5), 635–657. <https://doi.org/10.1177/0145445500245002>
- Eilenberg, T., Fink, P., Jensen, J., Rief, W., & Frostholm, L. (2016). Acceptance and commitment group therapy (ACT-G) for health anxiety: A randomized controlled trial. *Psychological Medicine*, 46(1), 103–115. <https://doi.org/10.1017/S0033291715001579>
- Einstein, D. A. (2014). Extension of the transdiagnostic model to focus on intolerance of uncertainty: A review of the literature and implications for treatment. *Clinical Psychology: Science and Practice*, 21(3), 280–300. <https://doi.org/10.1111/cpsp.12077>

- Fergus, T. A., & Bardeen, J. R. (2013). Anxiety sensitivity and intolerance of uncertainty: Evidence of incremental specificity in relation to health anxiety. *Personality and Individual Differences*, 55(6), 640–644. <https://doi.org/10.1016/j.paid.2013.05.016>
- Fetzner, M. G., Asmundson, G. J. G., Carey, C., Thibodeau, M. A., Brandt, C., Zvolensky, M. J., & Carleton, R. N. (2014). How do elements of a reduced capacity to withstand uncertainty relate to the severity of health anxiety? *Cognitive Behaviour Therapy*, 43(3), 262–274. <https://doi.org/10.1080/16506073.2014.929170>
- Fourtounas, A., & Thomas, S. J. (2016). Cognitive factors predicting checking, procrastination and other maladaptive behaviours: Prospective versus inhibitory intolerance of uncertainty. *Journal of Obsessive-Compulsive and Related Disorders*, 9, 30–35. <https://doi.org/10.1016/j.jocrd.2016.02.003>
- Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and Individual Differences*, 17(6), 791–802. [https://doi.org/10.1016/0191-8869\(94\)90048-5](https://doi.org/10.1016/0191-8869(94)90048-5)
- Gallagher, M. W., Zvolensky, M. J., Long, L. J., Rogers, A. H., & Garey, L. (2020). The impact of COVID-19 experiences and associated stress on anxiety, depression, and functional impairment in american adults. *Cognitive Therapy and Research*, 44(6), 1043–1051. <https://doi.org/10.1007/s10608-020-10143-y>
- Goldman, N., Dugas, M. J., Sexton, K. A., & Gervais, N. J. (2007). The impact of written exposure on worry: A preliminary investigation. *Behavior Modification*, 31(4), 512–538. <https://doi.org/10.1177/0145445506298651>
- Hadjistavropoulos, H. D., Craig, K. D., & Hadjistavropoulos, T. (1998). Cognitive and behavioral responses to illness information: The role of health anxiety. *Behaviour Research and Therapy*, 36(2), 149–164. [https://doi.org/10.1016/s0005-7967\(98\)00014-x](https://doi.org/10.1016/s0005-7967(98)00014-x)
- Haenen, M. A., de Jong, P. J., Schmidt, A. J. M., Stevens, S., & Visser, L. (2000). Hypochondriacs' estimation of negative outcomes: Domain-specificity and responsiveness to reassuring and alarming information. *Behaviour Research and Therapy*, 38, 819–833. [https://doi.org/10.1016/s0005-7967\(99\)00128-x](https://doi.org/10.1016/s0005-7967(99)00128-x)
- Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). Guilford Press.
- Jacoby, R. J., Fabricant, L. E., Leonard, R. C., Riemann, B. C., & Abramowitz, J. S. (2013). Just to be certain: Confirming the factor structure of the intolerance of uncertainty scale in patients with obsessive-compulsive disorder. *Journal of Anxiety Disorders*, 27(5), 535–542. <https://doi.org/10.1016/j.janxdis.2013.07.008>
- Jensen, D., Cohen, J. N., Mennin, D. S., Fresco, D. M., & Heimberg, R. G. (2016). Clarifying the unique associations among intolerance of uncertainty, anxiety, and depression. *Cognitive Behaviour Therapy*, 45(6), 431–444. <https://doi.org/10.1080/16506073.2016.1197308>
- Jungmann, S. M., & Witthöft, M. (2020). Health anxiety, cyberchondria, and coping in the current COVID-19 pandemic: Which factors are related to coronavirus anxiety? *Journal of Anxiety Disorders*, 73. <https://doi.org/10.1016/j.janxdis.2020.102239>
- Kobori, O., & Salkovskis, P. (2013). Patterns of reassurance seeking and reassurance-related behaviours in OCD and anxiety disorders. *Behavioural and Cognitive Psychotherapy*, 41(1), 1–23. <https://doi.org/10.1017/S1352465812000665>
- Liao, K. Y. H., Weng, C. Y., & West, L. M. (2016). Social connectedness and intolerance of uncertainty as moderators between racial microaggressions and anxiety among black individuals. *Journal of Counseling Psychology*, 63(2), 240–246. <https://doi.org/10.1037/cou0000123>
- Lindner, C., Kotta, I., Marschalko, E. E., Szabo, K., Kalcza-Janosi, K., & Retelsdorf, J. (2022). Increased risk perception, distress intolerance and health anxiety in stricter lockdowns: Self-control as a key protective factor in early response to the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 19(9), 5098.
- Marani, M., Katul, G. G., Pan, W. K., & Parolari, A. J. (2021). Intensity and frequency of extreme novel epidemics. *Proceedings of the National Academy of Sciences of the United States of America*, 118(35), e2105482118. <https://doi.org/10.1073/pnas.2105482118>
- Marcus, D. K., & Church, S. E. (2003). Are dysfunctional beliefs about illness unique to hypochondriasis? *Journal of Psychosomatic Research*, 54(6), 543–547. [https://doi.org/10.1016/s0022-3999\(02\)00526-3](https://doi.org/10.1016/s0022-3999(02)00526-3)
- McEvoy, P. M., & Mahoney, A. E. J. (2011). Achieving certainty about the structure of intolerance of uncertainty in a treatment-seeking sample with anxiety and depression. *Journal of Anxiety Disorders*, 25(1), 0–122. <https://doi.org/10.1016/j.janxdis.2010.08.010>
- McNeil, A., & Purdon, C. (2022). Anxiety disorders, COVID-19 fear, and vaccine hesitancy. *Journal of Anxiety Disorders*, 90, 102598. <https://doi.org/10.1016/j.janxdis.2022.102598>
- Mertens, G., Gerritsen, L., Duijndam, S., Saleminck, E., & Engelhard, I. M. (2020). Fear of the coronavirus (COVID-19): Predictors in an online study conducted in March 2020. *Journal of Anxiety Disorders*, 74, 102258. <https://doi.org/10.1016/j.janxdis.2020.102258>
- Mohammed, A., Sheikh, T. L., Gidado, S., Poggensee, G., Nguku, P., Olayinka, A., Ohuabunwo, C., Waziri, N., Shuaib, F., Adeyemi, J., Uzoma, O., Ahmed, A., Doherty, F., Nyanti, S. B., Nzuki, C. K., Nasidi, A., Oyemakinde, A., Oguntimehin, O., Abdus-Salam, I. A., & Obiako, R. O. (2015). An evaluation of psychological distress and social support of survivors and contacts of Ebola virus disease infection and their relatives in Lagos, Nigeria: A cross sectional study–2014. *Bmc Public Health*, 15, 824. <https://doi.org/10.1186/s12889-015-2167-6>
- Mohd, H. S. S., Azman, N., Jaafar, N., Daud, N. R. M., Baharudin, T. I., Ismail, A., Malek, A. K. A., Hassan, A. Z., M. R., & Mohammed Nawi, A. (2021). Health anxiety and its correlations with self-perceived risk and attitude on COVID-19 among Malaysian healthcare workers during the pandemic. *International Journal of Environmental Research and Public Health*, 18(9), <https://doi.org/10.3390/ijerph18094879>
- Muthén, L. K., & Muthén, B. O. (1998–2019). *Mplus user's guide* (8th ed.). Muthén & Muthén.
- Napper, L. E., Fisher, D. G., & Reynolds, G. L. (2012). Development of the Perceived risk of HIV Scale. *AIDS and Behavior*, 16, 1075–1083. <https://doi.org/10.1007/s10461-011-0003-2>
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., & Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: Implications and policy recommendations. *General Psychiatry*, 33(2), <https://doi.org/10.1136/gpsych-2020-100213>
- Rosen, N. O., & Knäuper, B. (2009). A little uncertainty goes a long way: State and trait differences in uncertainty interact to increase information seeking but also increase worry. *Health Communication*, 24(3), 228–238. <https://doi.org/10.1080/10410230902804125>
- Salkovskis, P. M., Rimes, K. A., Warwick, H. M., & Clark, D. M. (2002). The Health Anxiety Inventory: Development and validation of scales for the measurement of health anxiety and hypochondriasis. *Psychological Medicine*, 32(5), 843–853. <https://doi.org/10.1017/s0033291702005822>
- Saulnier, K. G., Allan, N. P., Raines, A. M., & Schmidt, N. B. (2019). Depression and intolerance of uncertainty: Relations between uncertainty subfactors and depression dimensions. *Psychiatry*, 82(1), 72–79. <https://doi.org/10.1080/00332747.2018.1560583>
- Smith, B. M., Twohy, A. J., & Smith, G. S. (2020). Psychological inflexibility and intolerance of uncertainty moderate the relationship between social isolation and mental health outcomes during COVID-19. *Journal of Contextual Behavioral Science*, 18, 162–174. <https://doi.org/10.1016/j.jcbs.2020.09.005>

- Stride, C. B., Gardner, S., Catley, N., & Thomas, F. (2015). *Mplus code for mediation, moderation, and moderated mediation models*<http://www.offbeat.group.shef.ac.uk/FIO/mplusmedmod.htm>
- Taha, S., Matheson, K., Cronin, T., & Anisman, H. (2014). Intolerance of uncertainty, appraisals, coping, and anxiety: The case of the 2009 H1N1 pandemic. *British Journal of Health Psychology*, *19*(3), 592–605. <https://doi.org/10.1111/bjhp.12058>
- Taylor, S., Landry, C. A., Paluszek, M. M., Fergus, T. A., McKay, D., & Asmundson, G. J. G. (2020a). COVID stress syndrome: Concept, structure, and correlates. *Depression and Anxiety*, *37*(8), 706–714. <https://doi.org/10.1002/da.23071>
- Taylor, S., Landry, C. A., Paluszek, M. M., Fergus, T. A., McKay, D., & Asmundson, G. J. G. (2020b). Development and initial validation of the COVID stress scales. *Journal of Anxiety Disorders*, *72*, 102232. <https://doi.org/10.1016/j.janxdis.2020.102232>
- Tull, M. T., Barbano, A. C., Scamaldo, K. M., Richmond, J. R., Edmonds, K. A., Rose, J. P., & Gratz, K. L. (2020a). The prospective influence of COVID-19 affective risk assessments and intolerance of uncertainty on later dimensions of health anxiety. *Journal of Anxiety Disorders*, *75*, 102290. <https://doi.org/10.1016/j.janxdis.2020.102290>
- Tull, M. T., Edmonds, K. A., Scamaldo, K. M., Richmond, J. R., Rose, J. P., & Gratz, K. L. (2020b). Psychological outcomes associated with stay-at-home orders and the perceived impact of COVID-19 on daily life. *Psychiatry Research*, *289*, 113098. <https://doi.org/10.1016/j.psychres.2020.113098>
- Wheaton, M. G., Abramowitz, J. S., Berman, N. C., Fabricant, L. E., & Olatunji, B. O. (2012). Psychological predictors of anxiety in response to the H1N1 (swine flu) pandemic. *Cognitive Therapy and Research*, *36*(3), 210–218. <https://doi.org/10.1007/s10608-011-9353-3>
- Wright, K. D., Lebell, M. A. N. A., & Carleton, R. N. (2016). Intolerance of uncertainty, anxiety sensitivity, health anxiety, and anxiety disorder symptoms in youth. *Journal of Anxiety Disorders*, *41*, 35–42. <https://doi.org/10.1016/j.janxdis.2016.04.011>
- Yao, N., Yang, Y., Jiang, Y., & Rodriguez, M. (2022). Intolerance of uncertainty relates to anxiety and depression through negative coping and worry: Evidence from a repeated-measures study. *International Journal of Cognitive Therapy*, *15*, 42–56. <https://doi.org/10.1007/s41811-021-00130-w>
- Zhu, K., Niu, Z., Freudenheim, J. L., Zhang, Z. F., Lei, L., Homish, G. G., Cao, Y., Zorich, S. C., Yue, Y., Liu, R., & Mu, L. (2021). COVID-19 related symptoms of anxiety, depression, and PTSD among US adults. *Psychiatry Research*, *301*, 113959. <https://doi.org/10.1016/j.psychres.2021.113959>

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