



Predicting COVID-19-related anxiety: The role of obsessive-compulsive symptom dimensions, anxiety sensitivity, and body vigilance

Heidi J. Ojalehto, Jonathan S. Abramowitz ^{*}, Samantha N. Hellberg, Megan W. Butcher, Jennifer L. Buchholz

University of North Carolina at Chapel Hill, United States

ARTICLE INFO

Keywords:

COVID-19-related anxiety
Obsessive-compulsive symptoms
Anxiety sensitivity
Body vigilance

ABSTRACT

The novel coronavirus disease (COVID-19), first detected in December of 2019 and declared a global pandemic in March of 2020, continues to pose a serious threat to public health and safety worldwide. Many individuals report anxiety in response to this threat, and at high levels, such anxiety can result in adverse mental health outcomes and maladaptive behavioral responses that have consequences for the health of communities more broadly. Predictors of excessive anxiety in response to COVID-19 are understudied. Accordingly, the present study examined psychological factors that predict more intense COVID-19-related anxiety. 438 community members completed measures assessing COVID-19-related anxiety as well as psychological variables hypothesized to predict anxious responding to the threat of COVID-19. As expected, obsessive-compulsive symptoms related to contamination, the fear of arousal-related body sensations (i.e., anxiety sensitivity), and body vigilance each predicted more severe anxiety related to the pandemic. Obsessive-compulsive symptoms related to responsibility for causing harm also emerged as a predictor. Study limitations and implications are discussed.

1. Introduction

Anxiety and fear are common experiences during disease outbreaks, such as the COVID-19 pandemic (e.g., Cheng, Wong, Tsang, & Wong, 2004; Rubin, Amlôt, Page, & Wessely, 2009; Wheaton, Abramowitz, Berman, Fabricant, & Olatunji, 2012). Approximately 30 % of the general population has reported significant anxiety symptoms since the COVID-19 outbreak in early 2020 (Salari et al., 2020). Moreover, the intensity of one's anxiety appears to be a significant predictor of dysfunctional behavior amidst the threat of illness, such as frequent hospital visits for minor symptoms and panic buying (e.g., stockpiling toilet paper; Taylor, 2019). Research has also found that greater levels of anxiety about COVID-19 are associated with increased depression and suicidal ideation (Lee, Jobe, & Mathis, 2020). Given the importance of anxiety in predicting psychological and behavioral responses to pandemics more generally, it is critical to understand factors that may predict the severity of anxiety in this context.

Whereas the majority of research to date has focused on the mental health impact of the COVID-19 pandemic (e.g., Serafini et al., 2020; Xiong et al., 2020), less attention has been paid to identifying predictors

of COVID-19-related anxiety. Prior work has demonstrated that individuals with anxiety-related disorders experience greater COVID-related distress, indexing higher scores on measures of COVID stress than those with mood disorders and non-clinical individuals (e.g., Asmundson et al., 2020). Further, individuals with generalized anxiety disorder, panic disorder, and obsessive-compulsive disorder (OCD) report greater stress and phobic reactions to COVID-19 compared to individuals with social anxiety and specific phobia (e.g., Khosravani, Asmundson, Taylor, Bastan, & Ardestani, 2021). Studies have also demonstrated links between health anxiety, defined as the preoccupation with the fear that one has or may contract a serious medical illness (Hedman & Axelsson, 2017), and COVID-19-related anxiety (e.g., Jungmann & Witthöft, 2020; Khosravani, Asmundson et al., 2021; Mertens, Gerritsen, Duijndam, Saleminck, & Engelhard, 2020). However, excessive COVID-19-related anxiety may also be a unique variant of health anxiety in which the fear is specific to contracting COVID-19 rather than illness more generally. Notably, previous research has demonstrated that there is some, but not complete, overlap in psychological predictors implicated in anxiety specific to disease outbreaks and more generalized health anxiety (e.g., Blakey, Reuman, Jacoby, &

^{*} Corresponding author at: Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill, Campus Box 3270 (Davie Hall), Chapel Hill, NC 27599, United States.

E-mail address: jabramowitz@unc.edu (J.S. Abramowitz).

<https://doi.org/10.1016/j.janxdis.2021.102460>

Received 3 February 2021; Received in revised form 2 June 2021; Accepted 27 July 2021

Available online 29 July 2021

0887-6185/© 2021 Elsevier Ltd. All rights reserved.

Abramowitz, 2015; Blakey & Abramowitz, 2017; Wheaton et al., 2012). Research has also implicated disgust, intolerance of uncertainty, and anxiety sensitivity (AS)—the fear of arousal-related body sensations—as predictors of excessive COVID-19-related anxiety (McKay, Yang, Elhai, & Asmundson, 2020; Wheaton, Messner, & Marks, 2021). Although these data provide valuable information for constructing predictive models of COVID-19-related anxiety, additional psychological constructs also likely play a role.

Obsessive-compulsive (OC) symptoms, for example, remain an understudied factor in anxiety about COVID-19. Indeed, previous research has demonstrated associations between OC symptoms and anxiety in response to prior disease outbreaks such as the swine flu (H1N1) outbreak in 2009–2010 (Brand, McKay, Wheaton, & Abramowitz, 2013) and emerging evidence suggests that these symptoms in general are also related to anxious responding to the COVID-19 pandemic (e.g., Khosravani, Asmundson et al., 2021). Yet OC symptoms are highly heterogeneous, distilling into four theme-related dimensions: (a) contamination, (b) responsibility for causing and preventing harm, (c) unacceptable thoughts related to violence, morality, sex, and religion, and (d) the need for symmetry and exactness (e.g., Abramowitz et al., 2010; McKay et al., 2004). Few studies to date have examined the four empirically supported OC symptom dimensions as they relate to COVID-19-related anxiety. Khosravani, Aardema, Ardestani, and Bastan (2021) found that all four OC symptom dimensions were associated with COVID-stress responses, including anxiety about COVID-19. Similarly, Wheaton et al. (2021) found that all four OC symptom dimensions were associated with concerns about the spread of COVID-19, observing the strongest correlation between contamination OC symptoms and fear of COVID-19. It is therefore important to further examine how these symptom dimensions, especially contamination (e.g., Wheaton et al., 2021), uniquely relate to COVID-19-anxiety given the highly publicized ease of transmission of COVID-19 and recommendations for frequent hand washing and use of disinfectants to prevent its spread.

Certain cognitive biases are also likely to predict anxiety in the context of COVID-19. The tendency to overestimate the likelihood and severity of threat, particularly dangers related to contamination, for example, has been associated with anxiety related to the swine flu (H1N1) outbreak in 2009–2010 (Wheaton et al., 2012), the Ebola outbreak in 2014 (Blakey et al., 2015), and the Zika virus outbreak in 2015–2016 (Blakey & Abramowitz, 2017). To our knowledge, however, no research has yet examined whether contamination-related overestimates of threat predict COVID-19-related anxiety.

Anxiety sensitivity (AS) is another set of cognitive biases that deserves further consideration as a predictor of COVID-19-related anxiety. AS is multidimensional, involving beliefs that (a) physical sensations associated with anxious arousal are dangerous (e.g., a racing heart is a sign of a heart attack), (b) the social consequences of experiencing anxiety are severe (e.g., appearing nervous would be noticeable and lead to embarrassment), and (c) anxiety would lead to significant cognitive dysregulation (e.g., the inability to concentrate on a task equates to a serious mental problem). Of these three domains, the belief that arousal-related physical sensations are harmful may be most strongly linked to COVID-19-related anxiety since individuals with this view might misinterpret benign bodily sensations (e.g., feeling short of breath after climbing a flight of stairs) as indicating a COVID-19 infection (e.g., since it is known to affect the lungs). Indeed, emerging evidence suggests a link between AS-related physical concerns and fear of contracting COVID-19 among Chinese individuals (McKay et al., 2020).

Relatedly, individuals high in AS may be more likely to self-monitor body sensations—e.g., body vigilance—in an attempt to detect and respond to threat. Body vigilance refers to a tendency to carefully monitor body sensations (Olatunji, Deacon, Abramowitz, & Valentiner, 2007) and may contribute to COVID-19-related anxiety as frequent body scanning creates more opportunities to notice benign changes in one's body, which individuals high in AS then might interpret as dangerous (i.

e., as signs of infection). It is important to note that while body vigilance is a more general tendency to scan one's body and not specific to monitor for signs of illness or threat, the pandemic has likely activated higher levels of vigilance tilting in the threat-related direction (e.g., McKay et al., 2020), contributing to the misinterpretation of body sensations (Duman, Herdi, İlhan, & Çolak, 2020) and possibly increasing somatic symptoms (Barello, Palamenghi, & Graffigna, 2020). Previous research has demonstrated that AS is associated with body vigilance (Zvolensky & Forsyth, 2002), and that both are associated with anxiety in response to previous infectious disease outbreaks (e.g., Blakey et al., 2015; Wheaton et al., 2012). Thus, AS-related physical concerns and body vigilance may be two additional risk factors for anxious responding to COVID-19.

With the current threat of COVID-19, and with future disease outbreaks certain to occur, it is critical that we understand predictors of excessive anxiety in response to the COVID-19 pandemic. Such research is particularly vital given that dysfunctional anxiety about viral outbreaks may lead to ineffective behaviors that interfere with personal and community functioning, such as repeated hospital visits that overburden the health care system (Taylor, 2019). Accordingly, the aim of the present study was to examine the aforementioned psychological factors as predictors of COVID-19-related anxiety in an unscreened (non-clinical) sample in the United States. We hypothesized that contamination-related OC symptoms, overestimates of contamination-related threats, the physical concerns domain of AS, and body vigilance would each emerge as predictors of COVID-19-related anxiety.

2. Method

2.1. Participants and procedure

The study included affiliates (students, faculty, staff) of a large public university in the southeastern United States. Participants were recruited through (a) a psychology department research participation pool, (b) university-wide listserv recruitment emails, and (c) a university-sponsored website that publicizes opportunities to participate in research. Responses were collected via a survey administered through Qualtrics, a secure online survey platform, between August 27, 2020 and November 5, 2020. Participants completed a demographics questionnaire and the measures described below. Four distractor items (e.g., “please answer *Never True* for this item”) were included among the measures to increase the probability that only valid responses from attentive participants would be included in the analyses. A total of 518 participants completed the study. Participants who endorsed testing positive for COVID-19 ($n = 80$) were excluded from analyses resulting in a final sample of 438 participants. The study was approved by the university's Institutional Review Board, and informed consent was obtained from all participants included in the study.

2.2. Measures

2.2.1. Coronavirus Anxiety Scale (CAS; Lee, 2020a, 2020b)

The CAS is a widely used five-item measure of anxiety specifically associated with COVID-19. Items assess the frequency of anxious responding related to the novel coronavirus (e.g., “I felt paralyzed or frozen when I thought about or was exposed to information about the coronavirus”) over the previous two-week period. Items are rated on a 0 (not at all) to 4 (nearly every day over the last two weeks) scale and possible scores range from 0 to 20. The CAS has shown good internal consistency and test-retest reliability (Lee, 2020a, 2020b). In their replication analysis, Lee (2020a, 2020b) identified a score of 5 or greater as indicating “clinically severe” COVID-19-related anxiety. In the present study, Cronbach's alpha for the CAS was .77.

2.2.2. Depression, Anxiety, and Stress Scale-21 item (DASS21; Antony, Bieling, Cox, Enns, & Swinson, 1998)

The DASS-21 assesses general subjective distress over the past week along three subscales: depression, anxiety, and stress. Participants rate how each of the 21 statements (e.g., “I felt downhearted and blue”) apply to them on a 0 (rarely) to 4 (very much or most of the time) scale. Possible scores range from 0 to 84, with lower scores indicating lower subjective distress. The DASS-21 has demonstrated good reliability and construct validity in clinical and nonclinical samples (Henry & Crawford, 2005). In the present study, Cronbach’s alpha for the DASS-21 was .93.

2.2.3. Anxiety Sensitivity Index-3 (ASI3; Taylor et al., 2007)

The ASI-3 is an 18-item measure of beliefs regarding the dangerousness of anxiety along physical (e.g., “it scares me when my heart beats rapidly”), cognitive (e.g., “it scares me when I am unable to keep my mind on a task”), and social (e.g., “it scares me when I blush in front of other people”) domains. Participants rate their agreement with these items on a 0 (very little) to 4 (very much) scale. Possible subscale scores range from 0 to 24, and total scores range from 0 to 72. The ASI-3 has a three-factor structure with good reliability and criterion-related validity in previous research (Taylor et al., 2007). In the present study, Cronbach’s alpha for the ASI-3 was .91.

2.2.4. Dimensional Obsessive-Compulsive Scale (DOCS; Abramowitz et al., 2010)

The 20-item self-report DOCS assesses the severity of the four empirically supported OCD symptom dimensions: contamination, responsibility for harm, symmetry/ordering, and unacceptable thoughts. Each dimension has its own subscale containing 5 items (rated 0–4) which assess the following severity parameters: time occupied by obsessions and rituals, avoidance behavior, associated distress, functional interference, and difficulty disregarding the obsessions and refraining from the compulsions. DOCS subscale scores range from 0 to 20, have shown excellent reliability and sensitivity to the effects of treatment in clinical samples, and demonstrate good convergent validity with other measures of OCD symptoms (Abramowitz et al., 2010). In the present study, Cronbach’s alpha for the DOCS was .89.

2.2.5. Contamination Cognitions Scale (CCS; Deacon & Maack, 2008)

The CCS assesses one’s tendency to overestimate the likelihood and severity of contamination from a variety of commonplace objects (e.g., money). Participants separately rate the likelihood and severity of contamination for each item on a 0 (not at all) to 100 (extremely) scale. Separate likelihood (CCS-L) and severity (CCS-S) subscales are formed by computing the average response for items falling on the CCS-L and CCS-S subscales, respectively. The CCS total score is then created by summing the two subscales. In the present study, Cronbach’s alpha for the CCS was .97.

2.2.6. Body Vigilance Scale (BVS; Schmidt, Lerew, & Trakowski, 1997)

The BVS is a four-item measure of one’s tendency to closely attend to arousal-related body sensations. The first three items assess attentional focus to, sensitivity to changes in, and amount of time devoted to monitoring body sensations on a 0 (not at all) to 10 (extremely) scale. One of these items is “I am very sensitive to changes in my internal body sensations.” In the fourth item, respondents separately rate the degree of attention paid to 15 body sensations (e.g., heart rate) on a 0 (none) to 10 (extreme) scale, which are averaged to yield a single score. Possible scores range from 0 to 40, with lower scores indicating less body vigilance. The BVS has shown good internal consistency and test–retest reliability in previous research (Schmidt et al., 1997). In the present study, Cronbach’s alpha for the BVS was .97.

2.3. Data analytic strategy

Our approach to data analysis proceeded as follows: first, we computed mean scores on all study measures and compared across gender. Next, correlation coefficients were computed to examine relationships among all study variables. To test our hypotheses, a hierarchical linear regression analysis was performed to predict scores on the CAS. To control for potential differences based on age and gender, these variables were entered in Step 1. Next, in Step 2, the DASS depression subscale was entered to control for general distress. Then, in Step 3, the ASI subscales, DOCS subscales, CCS, and BVS were entered simultaneously. Tolerance and variance inflation factor statistics were calculated to examine the presence of multicollinearity between predictors in the regression model.

3. Results

3.1. Sample characteristics

The sample ($N = 438$) had a mean age of 30.29 years ($SD = 17.92$, range was 17–88). The majority of the sample identified as female ($n = 330$; 75.3 %), with 24.4 % identifying as male ($n = 107$), and 0.2 % identifying as gender queer or gender non-conforming ($n = 1$). The majority of the sample identified as White ($n = 315$; 71.9 %), with 11.4 % identifying as Asian ($n = 50$), 8.2 % identifying as African American or Black ($n = 36$), 5 % identifying as Hispanic or Latino ($n = 22$), 0.2 % identifying as American Indian or Alaska Native ($n = 1$), 0.7 % identifying as Middle Eastern ($n = 3$), 1.8 % identifying as multiracial ($n = 8$), and 0.2 % identifying with another racial/ethnic group ($n = 1$), and 0.5 % of the sample missing responses to this item ($n = 2$).

3.2. Descriptive statistics

Table 1 presents the group mean scores on the CAS, DASS, ASI subscales, DOCS subscales, CCS, and BVS by gender. As expected, the mean CAS scores fell below the clinical cutoff of 5.0 (Lee, 2020a, 2020b). Females had slightly higher CAS scores than did males (however this difference was no longer significant at the Bonferroni corrected alpha level). Of note, scores on the CAS ranged from 0 to 11 among males and 0–14 among females, indicating that some study participants had severe anxiety related to COVID-19. Indeed, 8.7 % of the sample ($n = 38$), 10.3 % of females ($n = 34$) and 3.7 % of males ($n = 4$), reported CAS scores above the cutoff point for identifying clinically severe COVID-19-related anxiety (Lee, 2020a, 2020b).

As can also be seen in Table 1, the mean DOCS scores indicated mild

Table 1
Descriptive Statistics for Study Measures by Gender.

| Variable | Female ($n = 330$) | Male ($n = 107$) | p |
|-----------------|----------------------|--------------------|--------|
| | M (SD) | M (SD) | |
| CAS | 1.37 (2.22) | 0.79 (1.70) | .01 |
| DASS Depression | 5.68 (4.57) | 4.98 (4.67) | .17 |
| ASI Physical | 5.06 (4.85) | 3.11 (3.74) | <.001* |
| ASI Cognitive | 4.59 (5.10) | 3.02 (4.87) | .01 |
| ASI Social | 9.42 (4.95) | 7.90 (4.87) | .01 |
| DOCS-C | 6.56 (3.44) | 6.12 (3.24) | .25 |
| DOCS-R | 4.08 (3.31) | 3.07 (2.65) | .001* |
| DOCS-UT | 3.67 (3.59) | 3.52 (3.42) | .72 |
| DOCS-S | 2.89 (3.39) | 2.68 (3.28) | .58 |
| CCS | 172.56 (58.60) | 147.05 (55.07) | <.001* |
| BVS | 18.20 (7.59) | 15.36 (6.27) | <.001* |

Notes: CAS – Coronavirus Anxiety Scale, BVS – Body Vigilance Scale, CCS – Contamination Cognitions Scale, DOCS – Dimensional Obsessive-Compulsive Scale (C – Contamination, R – Responsibility for Harm, UT – Unacceptance Thoughts, S – Symmetry), ASI-3 – Anxiety Sensitivity Index – 3, DASS-21 – Depression, Anxiety, and Stress Scale 21 item.

* $p < .004$ (Bonferroni corrected).

OC symptoms overall. However, scores on the DOCS subscales ranged from 0 to 20, indicating that some study participants had clinically severe OC symptoms as assessed by this instrument (Abramowitz et al., 2010). Females generally reported greater DOCS-Responsibility for Harm symptoms than males, as well as greater scores on the ASI physical subscale, the CCS, and the BVS.

3.3. Correlations among study measures

Table 2 presents the zero-order correlations among all study variables. As can be seen, scores on the CAS were weakly to moderately positively associated with scores on the other study measures. The CAS was most strongly associated with DOCS-Responsibility for Harm, ASI-Physical, DOCS-Contamination, and BVS.

3.4. Predicting COVID-19-related anxiety

Table 3 shows the summary statistics for the final step of the linear regression model predicting scores on the CAS. Tolerance coefficients were all above 0.2 (range = .44-.92) and variance inflation factor coefficients all fell below 10 (range = 1.08-2.27), indicating no reason to be concerned about multicollinearity among predictors in the regression model. In Step 1, gender and age accounted for 1.6 % of the variance ($F(2, 425) = 3.44, p = .03$). When the DASS depression subscale was added in Step 2, an additional 6.2 % of the variance was accounted for, which was statistically significant ($F(3, 424) = 28.46, p < .001$). Finally, addition of the clinical measures in Step 3 explained an additional 15.6 % of the variance, which was also statistically significant ($F(9, 415) = 9.41, p < .001$). The overall model accounted for approximately 23.4 % of the variance in CAS scores ($F(12, 427) = 10.57, p < .001$), with the ASI-Physical subscale, DOCS-Contamination and Responsibility subscales, and the BVS emerging as significant individual (positive) predictors.

4. Discussion

Despite vaccination efforts across the United States, the COVID-19 outbreak is expected to remain a significant threat to public health and safety given vaccine hesitancy and the emergence of new strains. Due to the extensive uncertainty surrounding the COVID-19 outbreak, it is not surprising that many Americans report experiencing anxiety about this disease (Salari et al., 2020). When this anxiety becomes excessive, it is associated with various adverse mental health outcomes (Lee et al., 2020) as well as maladaptive behavioral responses that have consequences for the health of communities more broadly (Asmundson & Taylor, 2020; Taylor, 2019). Accordingly, the present study was designed to better understand the psychological factors that predict

Table 2
Zero-order Correlations Among Study Measures.

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--------------------|------|-------|------|------|-------|------|------|-------|-------|------|------|----|
| 1. CAS | - | | | | | | | | | | | |
| 2. DASS Depression | .24* | - | | | | | | | | | | |
| 3. ASI Physical | .31* | .32* | - | | | | | | | | | |
| 4. ASI Cognitive | .24* | .54* | .55* | - | | | | | | | | |
| 5. ASI Social | .21* | .44* | .46* | .54* | - | | | | | | | |
| 6. DOCS-C | .32* | .19* | .23* | .20* | .27* | - | | | | | | |
| 7. DOCS-R | .40* | .38* | .38* | .44* | .44* | .47* | - | | | | | |
| 8. DOCS-UT | .25* | .50* | .27* | .42* | .41* | .22* | .45* | - | | | | |
| 9. DOCS-S | .21* | .32* | .25* | .36* | .28* | .19* | .41* | .39* | - | | | |
| 10. CCS | .18* | .13 | .24* | .18* | .27* | .48* | .32* | .13 | .16 | - | | |
| 11. BVS | .29* | .27* | .50* | .35* | .43* | .29* | .33* | .22* | .23* | .32* | - | |
| 12. Age | .04 | -.18* | -.04 | -.14 | -.24* | -.02 | -.10 | -.27* | -.22* | -.08 | -.01 | - |

Notes: CAS – Coronavirus Anxiety Scale, BVS – Body Vigilance Scale, CCS – Contamination Cognitions Scale, DOCS – Dimensional Obsessive-Compulsive Scale (C – Contamination, R – Responsibility for Harm, UT – Unacceptance Thoughts, S – Symmetry), ASI-3 - Anxiety Sensitivity Index – 3, DASS-21 – Depression, Anxiety, and Stress Scale 21 item.

* $p < .001$ (Bonferroni corrected).

Table 3
Final Step of the Linear Regression Predicting CAS Scores.

| Variable | R ² | B | SE _B | β | t | p | sr ² |
|-----------------|----------------|------|-----------------|------|-------|--------|-----------------|
| Predicting CAS | .234 | | | | | < .001 | |
| Gender | | -.25 | .22 | -.05 | -1.13 | .26 | -.05 |
| Age | | .01 | .01 | .09 | 2.01 | .05 | .09 |
| DASS Depression | | .03 | .03 | .07 | 1.26 | .21 | .05 |
| ASI Physical* | | .06 | .03 | .13 | 2.20 | .03 | .10 |
| ASI Cognitive | | -.01 | .03 | -.02 | -.28 | .78 | -.01 |
| ASI Social | | -.03 | .03 | -.07 | -1.17 | .24 | -.05 |
| DOCS-C* | | .10 | .03 | .15 | 2.85 | .01 | .12 |
| DOCS-R* | | .14 | .04 | .22 | 3.74 | <.001 | .16 |
| DOCS-UT | | .04 | .03 | .07 | 1.32 | .19 | .06 |
| DOCS-S | | .03 | .03 | .04 | .79 | .43 | .03 |
| CCS | | -.00 | .00 | -.04 | -.68 | .50 | -.03 |
| BVS* | | .03 | .02 | .11 | 2.07 | .04 | .09 |

Notes: CAS – Coronavirus Anxiety Scale, BVS – Body Vigilance Scale, CCS – Contamination Cognitions Scale, DOCS – Dimensional Obsessive-Compulsive Scale (C – Contamination, R – Responsibility for Harm, UT – Unacceptance Thoughts, S – Symmetry), ASI-3 - Anxiety Sensitivity Index – 3, DASS-21 – Depression, Anxiety, and Stress Scale 21 item.

* $p < .05$.

more intense COVID-19-related anxiety. The results partially supported our hypothesis in that contamination OC symptoms, AS-related physical concerns, and body vigilance each predicted more severe anxiety related to the pandemic. Yet contrary to our predictions, contamination cognitions were not predictive. Further, OC symptoms related to responsibility for causing harm emerged as a predictor, which we did not predict.

Our finding that contamination OC symptoms significantly predicted COVID-19-related anxiety was not surprising given that symptoms often involve the fear of being exposed to, contracting, or spreading infectious diseases like COVID-19. Further, given the widespread messages concerning the highly communicable nature of COVID-19 (e.g., Sun, Lu, Xu, Sun, & Pan, 2020), individuals with OC concerns about contamination might be especially worried about this virus. Our findings, however, are correlational; thus, it is also plausible that OC contamination symptoms developed or worsened after COVID-19-related anxiety had emerged (e.g., Asmundson et al., 2020; Khosravani, Aardema et al., 2021; Khosravani, Asmundson et al., 2021). We were surprised by our finding that the tendency to overestimate the likelihood and severity of contamination did not predict COVID-19-related anxiety. Not only did this conflict with our hypothesis and findings for contamination OC symptoms, it also conflicts with previous research suggesting a robust link between overestimates of contamination risk and excessive anxiety in response to other disease outbreaks such as the Ebola virus (e.g., Blakey et al., 2015), swine flu (e.g., Wheaton et al., 2012), and the Zika virus (e.g., Blakey & Abramowitz, 2017). Of note, however, the scale used to assess

contamination-related cognitions (the CCS) includes many items that measure contamination overestimates resulting from *surface transmission*, which is not the principal way that COVID-19 is thought to spread. This might explain our findings and represent a phenomenological difference between contamination fears in general and those specifically associated with COVID-19.

As expected, we found that AS-related physical concerns were associated with greater COVID-19-related anxiety. This is in line with previous research showing that the tendency to misinterpret benign bodily sensations as danger signs is associated with excessive concerns about health—including within the context of disease outbreaks (e.g., Blakey et al., 2015; Wheaton et al., 2012). Thus, individuals with elevated physical AS, may be prone to misinterpreting harmless bodily sensations as evidence that they are infected with COVID-19. This, in turn, may increase COVID-19-related anxiety and lead to safety-seeking behaviors (e.g., visiting multiple doctors to seek reassurance that bodily sensations or changes are not due to infection). Body vigilance, which is closely related to AS (Zvolensky & Forsyth, 2002), also emerged as a significant predictor of COVID-19-related anxiety, as predicted. Thus, it is possible that individuals with greater AS, who are prone to monitoring their body, are more likely to detect and misinterpret body sensations that trigger anxiety about COVID-19. In this way, AS and body vigilance may work in tandem to confer risk for excessive COVID-19-related-anxiety.

OC symptoms related to responsibility for harm were also a significant individual predictor of anxiety about the COVID-19 outbreak. These OC symptoms involve distressing, repetitive thoughts of causing unwanted accidents, illnesses, injuries, or other awful events to befall oneself or others, along with checking and re-assurance-seeking rituals. Given that COVID-19 is a highly transmissible disease, it is understandable that individuals with excessive fears of this virus would endorse elevated concerns about causing harm to others as well as checking behavior. This finding is in line with recent studies that have demonstrated that all OC dimensions, including responsibility for harm, are associated with increased stress responses to COVID-19 in OCD patients (e.g., Khosravani, Aardema et al., 2021). This finding is also notable given findings that OCD patients with responsibility for harm symptoms may be at particular risk for general distress as well as worsening OCD symptoms during the pandemic (e.g., Fontenelle et al., 2021; Nissen, Højgaard, & Thomsen, 2020). Fears related to causing harm to oneself or others are often associated with elevated feelings of personal responsibility. As such, it also follows that individuals with greater concerns about being responsible for harm would be more vulnerable to excessive COVID-19-anxiety. Unfortunately, as this finding was not hypothesized to be a unique predictor of COVID-19-anxiety, we did not include a measure of cognitive biases associated with inflated responsibility (such as the Obsessive Beliefs Questionnaire; *Obsessive Compulsive Cognitions Working Group*, 2003) in the present study. However, we recommend that future research aimed at better understanding COVID-related anxiety include such a measure given this result.

This study's findings are subject to a number of limitations. First, the cross-sectional nature of our data precludes drawing conclusions regarding causality or temporal precedence. For instance, as discussed earlier, individuals with excessive anxiety about COVID-19 may have only later developed contamination OC symptoms. Further, the lack of specificity of the DOCS limits the ability to differentiate OC symptoms from fears or behaviors specific to the COVID-19 outbreak such as (a) excessive concern with spreading the virus vs. increased handwashing in line with public health recommendations and (b) excessive checking behaviors vs. recommended COVID-19 testing. The use of a nonclinical sample, while advantageous for examining our hypotheses in the general population, limits the generalizability of the present findings to clinically severe individuals, given that a relatively small proportion had clinically elevated levels of anxiety about COVID-19. We also did not assess for current or previous mental health conditions which is a

limitation given that pre-existing mental health and physical disorders may exacerbate COVID-19-related anxiety.

Data collection was also restricted to one state in the southeastern United States, which may limit the generalizability of our findings to the broader U.S. population given regional differences in COVID-19 infection rates as well as ideologies that likely influence the level of concern about COVID-19. That said, our sample was drawn primarily from a university campus in an otherwise ideologically diverse state, and as such can be expected to represent a relatively heterogeneous group of ideologies (e.g., political). Importantly, however, while our sample demographics were relatively consistent with state census data, it remained majority White and female. There was particular underrepresentation (8 %) of individuals identifying as African American or Black, compared to state (22 %) and national (13.4 %) data. Given the known racial health disparities in the risks and vulnerabilities related to COVID-19 in the U.S. (e.g., DiMaggio, Klein, Berry, & Frangos, 2020; Poteat, Millett, Nelson, & Beyrer, 2020; van Dorn, Cooney, & Sabin, 2020), it is critical to consider how findings may differ for individuals within African American/Black communities. Further study in this area is imperative to help bolster individual and community resilience amidst the current and future pandemics. It is also worth noting that there have been multiple facets of COVID-stress identified (Taylor et al., 2020). The present study focused solely on anxiety related to the COVID danger and contamination fears dimension, however, there are other dimensions of COVID-stress that may be influential and deserve further evaluation (i.e., checking, traumatic stress, xenophobia, and socioeconomic concerns).

Lastly, we solely relied on self-report measures to assess study constructs, which may have inflated associations among variables. Further research utilizing multimodal assessment and employing a longitudinal design will be critical for elucidating risk factors for dysfunctional anxiety in response to future disease outbreaks. Such research is imperative given that behaviors that result from excessive anxiety in response to disease outbreaks are not only socially disruptive but may also add undue burden to strained health care systems and interfere with the success of strategies used to manage disease outbreaks (e.g., Taylor, 2019).

Acknowledgements

Samantha N. Hellberg is funded by the National Science Foundation Graduate Research Fellowship Program (NSF GRFP, # DGE-1650116).

References

- Abramowitz, J. S., Deacon, B. J., Olatunji, B. O., Wheaton, M. G., Berman, N. C., Losardo, D., ... Hale, L. R. (2010). Assessment of obsessive-compulsive symptom dimensions: Development and evaluation of the Dimensional Obsessive-Compulsive Scale. *Psychological Assessment*, 22(1), 180.
- Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment*, 10(2), 176.
- Asmundson, G. J., & Taylor, S. (2020). How health anxiety influences responses to viral outbreaks like COVID-19: What all decision-makers, health authorities, and health care professionals need to know. *Journal of Anxiety Disorders*, 71, Article 102211.
- Asmundson, G. J., Paluszek, 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, Article 102271.
- Barello, S., Palamenghi, L., & Graffigna, G. (2020). Burnout and somatic symptoms among frontline healthcare professionals at the peak of the Italian COVID-19 pandemic. *Psychiatry Research*, 290, Article 113129.
- 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.
- Blakey, S. M., Reuman, L., Jacoby, R. J., & Abramowitz, J. S. (2015). Tracing "Fearbola": Psychological predictors of anxious responding to the threat of ebola. *Cognitive Therapy and Research*, 39(6), 816-825.
- Brand, J., McKay, D., Wheaton, M. G., & Abramowitz, J. S. (2013). The relationship between obsessive compulsive beliefs and symptoms, anxiety and disgust sensitivity,

- and Swine Flu fears. *Journal of Obsessive-compulsive and Related Disorders*, 2(2), 200–206.
- Cheng, S. K., Wong, C. W., Tsang, J., & Wong, K. C. (2004). Psychological distress and negative appraisals in survivors of severe acute respiratory syndrome (SARS). *Psychological Medicine*, 34(7), 1187.
- Deacon, B., & Maack, D. J. (2008). The effects of safety behaviors on the fear of contamination: An experimental investigation. *Behaviour Research and Therapy*, 46(4), 537–547.
- DiMaggio, C., Klein, M., Berry, C., & Frangos, S. (2020). Black/African American Communities are at highest risk of COVID-19: Spatial modeling of New York City ZIP Code-Level testing results. *Annals of Epidemiology*, 51, 7–13.
- Duman, B., Herdi, O., Ilhan, R. S., & Çolak, B. (2020). COVID-19 pandemic associated misinterpretation of somatic sensations: A model for mind-body interaction. *Archives of Neuropsychiatry*, 57(3), 169.
- Fontenelle, L. F., Albertella, L., Brierley, M. E., Thompson, E. M., Destrée, L., Chamberlain, S. R., & Yücel, M. (2021). Correlates of obsessive-compulsive and related disorders symptom severity during the COVID-19 pandemic. *Journal of Psychiatric Research*.
- Hedman, E., & Axelsson, E. (2017). Severe health anxiety in the somatic symptom and related disorders. *Treatments for psychological problems and syndromes*, 345–359.
- Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *The British Journal of Clinical Psychology*, 44(2), 227–239.
- 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, 102239.
- Khosravani, V., Aardema, F., Ardestani, S. M. S., & Bastan, F. S. (2021). The impact of the coronavirus pandemic on specific symptom dimensions and severity in OCD: A comparison before and during COVID-19 in the context of stress responses. *Journal of Obsessive-compulsive and Related Disorders*, 29, Article 100626.
- Khosravani, V., Asmundson, G. J., Taylor, S., Bastan, F. S., & Ardestani, S. M. S. (2021). The Persian COVID stress scales (Persian-CSS) and COVID-19-related stress reactions in patients with obsessive-compulsive and anxiety disorders. *Journal of Obsessive-compulsive and Related Disorders*, 28, Article 100615.
- Lee, S. A. (2020a). Coronavirus Anxiety Scale: A brief mental health screener for COVID-19 related anxiety. *Death Studies*, 44(7), 393–401.
- Lee, S. A. (2020b). Replication analysis of the coronavirus anxiety scale. *Dusunen Adam : Bakirkoy Ruh Ve Sinir Hastaliklari Hastanesi Yayin Organi*, 33(2), 203–205.
- Lee, S. A., Jobe, M. C., & Mathis, A. A. (2020). Mental health characteristics associated with dysfunctional coronavirus anxiety. *Psychological Medicine*, 1–2.
- McKay, D., Abramowitz, J. S., Calamari, J. E., Kyrios, M., Radomsky, A., Sookman, D., ... Wilhelm, S. (2004). A critical evaluation of obsessive-compulsive disorder subtypes: Symptoms versus mechanisms. *Clinical Psychology Review*, 24(3), 283–313.
- McKay, D., Yang, H., Elhai, J., & Asmundson, G. (2020). Anxiety regarding contracting COVID-19 related to interoceptive anxiety sensations: The moderating role of disgust propensity and sensitivity. *Journal of Anxiety Disorders*, Article 102233.
- Mertens, G., Gerritsen, L., Duijndam, S., Salemink, E., & Engelhard, I. M. (2020). Fear of the coronavirus (COVID-19): Predictors in an online study conducted in March 2020. *Journal of Anxiety Disorders*, Article 102258.
- Nissen, J. B., Højgaard, D. R. M. A., & Thomsen, P. H. (2020). The immediate effect of COVID-19 pandemic on children and adolescents with obsessive compulsive disorder. *BMC Psychiatry*, 20(1), 1–10.
- Obsessive Compulsive Cognitions Working Group. (2003). Psychometric validation of the obsessive beliefs questionnaire and the interpretation of intrusions inventory: Part I. *Behaviour Research and Therapy*, 41, 863–878.
- Olatunji, B. O., Deacon, B. J., Abramowitz, J. S., & Valentiner, D. P. (2007). Body vigilance in nonclinical and anxiety disorder samples: Structure, correlates, and prediction of health concerns. *Behavior Therapy*, 38(4), 392–401.
- Poteat, T., Millett, G., Nelson, L. E., & Beyrer, C. (2020). Understanding COVID-19 risks and vulnerabilities among black communities in America: The lethal force of syndemics. *Annals of Epidemiology*.
- Rubin, G. J., Amlöt, R., Page, L., & Wessely, S. (2009). Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: Cross sectional telephone survey. *BMJ*, 339, b2651.
- Salari, N., Hosseini-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., ... Khaledi-Paveh, B., et al. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: A systematic review and meta-analysis. *Globalization and Health*, 16(1), 1–11.
- Schmidt, N. B., Lerew, D. R., & Trakowski, J. H. (1997). Body vigilance in panic disorder: Evaluating attention to bodily perturbations. *Journal of Consulting and Clinical Psychology*, 65(2), 214.
- Serafini, G., Parmigiani, B., Amerio, A., Aguglia, A., Sher, L., & Amore, M. (2020). The psychological impact of COVID-19 on the mental health in the general population. *QJM: An International Journal of Medicine*, 113(8), 531–537.
- Sun, P., Lu, X., Xu, C., Sun, W., & Pan, B. (2020). Understanding of COVID-19 based on current evidence. *Journal of Medical Virology*, 92(6), 548–551.
- Taylor, S. (2019). *The psychology of pandemics*. Cambridge: Cambridge Scholars Publishing.
- Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., ... Cardenas, S. J. (2007). Robust dimensions of anxiety sensitivity: Development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment*, 19(2), 176.
- Taylor, S., Landry, C. A., Paluszczek, M. M., Fergus, T. A., McKay, D., & Asmundson, G. J. (2020). Development and initial validation of the COVID stress scales. *Journal of Anxiety Disorders*, 72, Article 102232.
- van Dorn, A., Cooney, R. E., & Sabin, M. L. (2020). COVID-19 exacerbating inequalities in the US. *Lancet (London, England)*, 395(10232), 1243.
- 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.
- Wheaton, M. G., Messner, G. R., & Marks, J. B. (2021). Intolerance of uncertainty as a factor linking obsessive-compulsive symptoms, health anxiety and concerns about the spread of the novel coronavirus (COVID-19) in the United States. *Journal of Obsessive-Compulsive and Related Disorders*, 28, 100605.
- Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M., Gill, H., Phan, L., ... McIntyre, R. S. (2020). Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *Journal of Affective Disorders*.
- Zvolensky, M. J., & Forsyth, J. P. (2002). Anxiety sensitivity dimensions in the prediction of body vigilance and emotional avoidance. *Cognitive Therapy and Research*, 26(4), 449–460.