

## Abstract

**Background:** Associations among illness perceptions of viruses, anxiety and depression symptoms, and self-management decisions, such as mask-wearing, are critical to informing public health practices to mitigate the short- and long-term consequences of the SARS-CoV-2 viral pandemic.

**Purpose:** Guided by the common-sense model of self-regulation, this observational study examined associations among illness perceptions of COVID-19, anxiety, and depression symptoms among community-dwelling adults.

**Method:** Data were collected from 1380 adults living in the United States early in the pandemic (03-23-2020 to 06-02-2020). Participants completed online surveys. Analyses were conducted using descriptive statistics and correlations.

**Findings:** While increased anxiety symptoms were associated with less perceived personal control, greater concern, and higher emotional responsiveness, increased depression symptoms were related to lower concern as well as greater emotional responsiveness and perceived consequences of the pandemic.

**Discussion:** Associations among illness perceptions, anxiety, and depression symptoms may impact viral spread mitigation behavior adoption.

**Keywords:** Coronavirus, COVID-19, Illness Perceptions, Depression, Anxiety

## **Associations between COVID-19 Perceptions, Anxiety, and Depressive Symptoms among Adults Living in the United States**

As of November 18, 2020, 55.3 million people worldwide have contracted the SARS-CoV-2 virus, and 1.3 million people have died, with 11.1 million people in the United States contracting and 245 thousand dying from this virus (World Health Organization, 2020). The resulting public health interventions to 'flatten the curve' (e.g., social or physical distancing) have had a major impact internationally, with each country responding in its own way (Kandel et al., 2020). With the last global pandemic occurring in 1918-1919 (Mills et al., 2004), the limited relevant personal experiences with similar contagions and nascent, observational, descriptive, scientific evidence left public and health care professionals feeling inadequately prepared to manage the spread of the SARS-CoV-2 virus responsible for COVID-19 (Mason & Friese, 2020). With little experience and evidence, health care professionals have struggled to predict and manage the long-term physical and mental health consequences (Estes & Thompson, 2020). The inability to predict the consequences of COVID-19 has made long-term planning for health systems extremely difficult.

Americans responded quite vocally to the impact of both formal and informal interventions and policies on their daily lives and economic well-being (Malecki et al., 2020). These responses were, in part, influenced by illness perceptions. Illness perceptions are the mental constructs a person creates cognitively and emotionally around an illness (Diefenbach & Leventhal, 1996; Leventhal et al., 1992). Typically, illness perceptions are isolated to having an illness or concern with contracting an illness. In the early months of the pandemic, individual concern for infection, widespread and individually implemented mitigation efforts, and larger societal changes impacted individual lives whether they did or did not contract COVID-19. This therefore extends the typical characterization of illness perceptions from duration of an individual illness to the longevity of potential infection, individual mitigation behaviors, and societal impact. Individuals form illness perceptions with specific representations about the

consequences, anticipated timeline of the illness, the extent of personal control over the illness, the extent to which treatment can control the illness, their experiences with symptoms of the illness (i.e., identity), their concern about the illness, their understanding of the illness, and their emotional response to the illness (e.g., symptoms of anxiety and depression) (Diefenbach & Leventhal, 1996; Leventhal et al., 1992). The development of illness perceptions is highly individualized and subject to personal, social, and cultural contextual factors (e.g., age, race, education; (Diefenbach & Leventhal, 1996; Leventhal et al., 1992).

Illness perceptions are integral to understanding how people react to an illness (Diefenbach & Leventhal, 1996; Leventhal et al., 1992). According to the common-sense model of self-regulation, cognitive and emotional illness perceptions are important precursors to health behaviors (Diefenbach & Leventhal, 1996; Leventhal, 1970) and, in turn, subsequent health outcomes, including symptoms of anxiety and depression (Diefenbach & Leventhal, 1996; Leventhal et al., 1992). The model suggests personal, social, and cultural context influence the parallel processing between cognitive and emotional illness perceptions, which jointly lead to behaviors and illness outcomes (Diefenbach & Leventhal, 1996; Leventhal et al., 1992). Consistent with this model, research has shown that perceptions of viruses and self-management decisions, such as hand washing, mask-wearing, and vaccinations, were interdependent during other respiratory viral epidemics (Karademas et al., 2013; Leventhal et al., 1992; Mo & Lau, 2015). More recently, survey research from early March 2020 identified a link between the perception that SARS-CoV-2 infection is likely to cause death and lower adherence to recommendations regarding personal mitigation behaviors (Jimenez et al., 2020).

Accordingly, one's illness perceptions and health behaviors can impact psychosocial outcomes, including symptoms of anxiety and depression (Broadbent et al., 2015; Kim et al., 2012; Kucukarslan, 2012; Le Grande et al., 2012; Wierenga et al., 2017a). For instance, in studies of chronic illnesses, patients who felt they had little control were more likely to experience symptoms of anxiety and depression (Arat et al., 2018). Anxiety and depression

adversely affect well-being (Gostoli et al., 2017). Unfortunately, in addition to the independent negative effect of anxiety and depression symptoms on well-being, these symptoms may put people at additional risk of contracting viral illnesses through cell-mediated immunity and inflammatory processes (Adam et al., 2013; Cohen et al., 2003; Coughlin, 2012; Kim et al., 2011; Okusaga et al., 2011). Distinct from chronic illnesses, even people not in direct contact with COVID-19 may experience associated symptoms of anxiety and depression, impacting their well-being.

Just as with other illnesses, perceptions of a pandemic virus are varied and critical to understanding the resulting attitudes and behaviors that help mitigate spread (Karademas et al., 2013). The rapidly changing circumstances, guidelines, mandates, and shutdown periods varied across the country during the COVID-19 pandemic and likely represent unique influences on individuals' illness perceptions especially as personal experiences during the pandemic may have been disproportionately impacted compared to others'. Understanding the relationship between illness perceptions, anxiety and depression symptoms, and personal, social, and cultural contextual factors is important for two reasons. First, examining these associations provides insight into the potential impacts of physical distancing and other mitigation interventions. Second, understanding these relationships between illness perceptions and psychological symptoms may inform adaptation, development, and targeting of future informational, behavioral, and community interventions to reduce the viral spread. As such, the purpose of this study was to examine associations between symptoms of anxiety and depression and illness perceptions related to COVID-19 among community-dwelling adults living in the United States during the first three months of the COVID-19 pandemic. The aims of this project were to 1) describe anxiety symptoms, depression symptoms, and illness perceptions, and 2) evaluate associations between COVID-19 illness perceptions, anxiety, and depression symptoms while controlling for the influence of personal, social, and cultural contextual factors.

## Method

### Study Design and Procedures

This observational study included all (n=1380) individuals who completed the Behavioral Outcomes During Social Distancing Study from March 23 through June 20, 2020. At the time of data collection, SARS-Cov-2 tests were not widely available, and individual states were beginning to implement viral mitigation mandates. Adults were recruited using advertisements posted on social media sites (paid [Facebook] and unpaid [Facebook, Reddit, Twitter, Instagram]) and professional networks. Interested individuals were provided with information about the study. For informed consent, participants were asked a single question about understanding the risks and benefits of the study. After consenting, participants completed questionnaires on personal, social, and cultural contexts, anxiety symptoms, depression symptoms, and illness perceptions. Due to the personal nature of demographic items they were included as the final questionnaire in the survey (Cameron & Stinson, 2019). The survey was delivered to participants in a secure REDCap survey platform (Harris et al., 2019). Several reading-check items were incorporated into the survey to limit the likelihood of fraudulent or automated bot respondents, prevent speeding or patterning, and allow easy identification of records that pose potential threats to data quality. As an incentive for participating in the study, participants were eligible to win one of 25 electronic gift cards valued at \$25. The Institutional Review Board (STUDY2003910440) of Indiana University designated the study as exempt.

### Sample

Inclusion criteria were 1) 18 years of age or older, 2) living in the United States, and 3) able to read and understand English. A total of 2145 adults clicked on the survey link and viewed the consent acknowledgement page, while 2138 consented and indicated their meeting the inclusion criteria, 1965 answered at least one item on the survey, and 1380 (64%) completed the entire survey on personal, social, and cultural contexts. For the purposes of this study, individuals who did not complete this survey were removed from the analysis. The

selection of completers ensured adequate demographic information to control for personal, social, and cultural contexts, consistent with the common-sense model of self-regulation.

## **Measures**

### ***Personal, Social, and Cultural Contexts***

Personal, social, and cultural context variables were self-reported. These variables consisted of 1) sex assigned at birth, 2) age in years, 3) race, 4) level of educational attainment, 5) employment status, 6) if employed, type of employment (non-essential vs. essential industry as defined by the United States Department of Homeland Security Cybersecurity & Infrastructure Security Agency (2020), 7) health insurance status, 8) living alone or with others, 9) the number of days in the past 30 days during which the respondent drank alcohol, 10) any illicit drug use in the past 30 days, 11) current smoking status, 12) urban vs. rural, 13) having been diagnosed with COVID-19 or knowing someone who has, 14) job loss or financial difficulty related to COVID-19, 15) underlying medical conditions reported on a modified Charlson Comorbidity Index to include those conditions associated with increased risk for severe COVID-19 (Centers for Disease Control and Prevention[CDC], 2020a; Charlson et al., 1987), and 16) COVID-19-associated symptoms based on the CDC's curated list of COVID-19 symptoms (Centers for Disease Control and Prevention, 2020b). In addition, the number of days post-mitigation announcement was calculated as the total number of days between the CDC's initial announcement of recommended mitigation measures (The White House, 2020) and a participant's survey completion date.

### ***Anxiety Symptoms***

To measure anxiety symptoms, we used the Generalized Anxiety Disorder-7 (GAD-7), a seven-item measure of anxiety symptom frequency (Spitzer et al., 2006). Each item of the GAD-7 has four options to describe the frequency of experiencing anxiety symptoms (0 = "not at all," 1 = "several days," 2 = "over half the days," and 3 = "nearly every day"). Scores for the seven items are summed with higher scores indicating greater or more severe symptoms. Possible

scores range from 0 to 21 points. Cronbach's  $\alpha$  for the GAD-7 was 0.92 in this sample. Construct validity has been supported in previous studies among adults in healthy and ill populations (Plummer et al., 2016).

### ***Depression Symptoms***

Symptoms of depression were measured using the Patient Health Questionnaire-8 (PHQ-8; (Kroenke et al., 2009). Each of the eight items has four options to describe the frequency of experiencing depression symptoms (0 = "not at all," 1 = "several days," 2 = "more than half the days," and 3 = "nearly every day"). Scores for the eight items are summed with higher scores indicating more symptoms or more severe symptoms. Possible scores range from 0 to 24 points, with a score of 10 or greater indicating possible depressive issues (Kroenke et al., 2009). Cronbach's  $\alpha$  for the PHQ-8 was 0.89 in this sample. Construct validity was supported in previous studies among adults in healthy and ill populations (Kroenke et al., 2009; Pressler et al., 2011).

### ***Illness Perceptions***

Illness perceptions were measured with the 8-item Brief Illness Perception Questionnaire (BIPQ; (Broadbent et al., 2006). To assess participants' perceptions of COVID-19, specifically, items from the BIPQ were adapted to specify COVID-19. See Table 1 for the adapted wording used for the items representing the 8 domains. While each item is measured on a scale from 0 to 10, the anchors for each scale differ depending upon the domain measured. This brief measure demonstrates good concurrent and predictive validity in each domain in a variety of illness populations (Broadbent et al., 2006). As this questionnaire consists of one item for each of the 8 domains there are no reliability assessments of these items.

Table 1. Adapted Brief Illness Perception Questionnaire Items

Domain	Item
Consequences	“How much does COVID-19 affect your life?”
Timeline	“How long do you think the current pandemic (COVID-19) will continue?”
Personal Control	“How much control do you feel you have over catching COVID-19?”
Treatment Control	“How much do you think treatment can help COVID-19?”
Identity	“How much do you experience symptoms from COVID-19?”
Concern	“How concerned are you about COVID-19?”
Understanding	“How well do you feel you understand COVID-19?”
Emotional Response	“How much does COVID-19 affect you emotionally? (e.g., Does it make you angry, scared, upset or depressed?)”

### Statistical Analyses

After the survey closed, the de-identified dataset was downloaded from REDCap and directly uploaded into IBM SPSS Statistics version 27. When data were transferred between platforms, descriptive statistics, including measures of central tendency, were used to check for consistency and integrity in data. Additionally, a random selection of individual cases was checked for item-level consistency prior to performing any other analyses. The confirmed dataset was then further assessed for patterns and problems with missingness and extreme values by examining frequencies, distributions, and normality using measures of central tendency, skewness, and kurtosis for each item. For this analysis, no survey items had greater than 5% missingness, and thus, imputation was not conducted.

For analysis of responses from the questionnaire on personal, social, and cultural contexts, several items were collapsed due to lower variability in distribution. Those items



included race (white or non-white), educational attainment (with or without any graduate education), employment (unemployed or employed), health insurance status (uninsured or insured), and smoking status (current smoker or not currently a smoker). For COVID-19 associated symptoms, symptoms were counted and summed to generate a total number. Additionally, rurality was assessed by converting 5-digit ZIP codes to the RUCA designations (Bryer, 2009) using the R Statistical Computing Platform, version 4.0.2 (R Core Team, 2020) in RStudio, version 1.3.959. This *ruca* package uses a methodology developed by the Washington, Wyoming, Alaska, Montana, Idaho Rural Health Research Center. For this analysis, the dichotomous “urban” and “rural” approximations were examined as these designations have been reported to have 99.02% agreement with the census block level RUCA codes (Rural Health Research Center).

For Aim 1, descriptive statistics (frequencies, percentages, means, standard deviations, medians, and interquartile ranges) were calculated for all measures. For Aim 2, we calculated bivariate zero-order correlations using Pearson’s correlation coefficient. Given that personal, social, and cultural contextual variables are known to influence illness perceptions, we also conducted partial correlation analyses, examining the relationships between anxiety symptoms, depression symptoms, and the eight BIPQ domains while controlling for personal, social, and cultural contextual variables. We used pairwise removal of cases to calculate bivariate and partial correlations among anxiety symptoms, depression symptoms, the illness perception domains, and personal, social, and cultural contextual variables, and to reduce the potential for Type I error, we used 99% confidence intervals (CIs) and the Holm-Bonferroni procedure for multiple tests (Holm, 1979) with two-sided  $\alpha = .01$ ; calculations were conducted using the *psych* package (Revelle, 2020). Figures for reporting simple and partial Pearson correlations were created using the *corrplot* package (Wei & Simko, 2017).

## **Results**

### **Sample Characteristics**

Table 2 shows descriptive data for the 1,380 respondents in the sample. The majority of respondents identified as female (n = 1,119, 81.3%), White (n = 1,256, 91%), and living in an urban setting (n = 1,172, 89.8%). The age range of respondents was 18 to 89 years old. Nearly a quarter of respondents (n = 338, 24.5%) indicated they had experienced a job loss or financial difficulty related to COVID-19. A quarter of respondents (n = 342, 24.8%) reported that they knew someone diagnosed with COVID-19. Although most participants did not report a diagnosis themselves (n= 8, 2.4%), the majority of participants (n= 1,211, 87.8%) reported experiencing at least one of the CDC-identified symptoms associated with COVID-19, which have substantial overlap with other conditions. The three most commonly endorsed symptoms were headache (n = 889, 64.6%), backache (n = 600, 43.6%), runny nose (n = 597, 41.3%). Individuals with symptoms associated with COVID-19 reported having 3 symptoms on average.

**Table 2. Descriptive statistics, measures of central tendency (n=1380)**

Variable	n (%)	Mean	SD	Median	IQR	Missing
Sex Assigned at Birth						3
Female	1,119 (81.3)					
Male	252 (18.3)					
Intersex	2 (0.1)					
Decline to Answer	4 (0.3)					
Age (years)		43.62	15.67	41	25	
Race <sup>a</sup>						
American Indian or Alaska Native	9 (0.7)					
Asian	62 (4.5)					
Black or African American	31 (2.2)					
Hispanic or Latinx	50 (3.6)					
Native Hawaiian or other Pacific Islander	6 (0.4)					
White	1,256 (91)					
Other	10 (0.7)					
Education						3
Less Than High School Diploma	9 (0.7)					
High School (GED or Equivalent)	65 (4.7)					
Trade School	29 (2.1)					
Two or fewer years of college	157 (11.4)					
Associates Degree	88 (6.4)					
Bachelors Degree	352 (25.5)					
Some Graduate School	131 (9.5)					
Graduate Degree	379 (27.5)					
Doctoral Degree	167 (12.1)					
Unemployed	52 (3.8)					
Works in an 'Essential Industry'	734 (53.2)					
Uninsured	66 (4.8)					
Living with other people	1,145 (83.5)					8
Reporting Not drinking Alcohol in Past 30 days	401 (29.4)					19
Percentage of Days drinking Alcohol in Past 30 days		22.04	29.00	10	33.3	19

Any Illicit Drug Use in past 30 days	202 (14.6)					
Currently Smokes	125 (14.9)					1
Rurality (Rural-Urban Commuting Area Code)						75
Urban	1,172 (89.8)					
Rural	133 (10.2)					
Report Self/Knowing Someone Diagnosed with COVID-19	342 (24.8)					2
Self	8 (2.4)					
Immediate Family Member	14 (4.1)					
Extended Family Member	42 (12.4)					
Work Colleague	54 (15.9)					
Friend	151 (44.4)					
Other	71 (20.9)					
Report Job Loss or Financial Difficulty related to COVID-19	338 (24.5)					2
Number of Days between Survey date and initial CDC Recommendations (3/16/2020)		24.28	19.37	15	32	0
Number of Chronic Conditions		0.45	0.80	0	1	0
Report Having 1 or more Conditions associated with elevated COVID-19 mortality risk	345 (25)	0.33	0.67	0	1	0
Report Any COVID-19-associated Symptom in past month	1,211 (87.8)	3.48	2.64	3	4	1

Note. total N = 1380; n-number of respondents; SD – standard deviation; IQR – Interquartile Range; Missing – indicates number of individuals who did not provide an answer for the item.

<sup>a</sup> 1 or more categories could be simultaneously selected by respondents.

**Table 3. Study variable statistics, measures of central tendency (n=1380)**

Variable	Score Range	Mean	SD	Median	IQR	Missing
Anxiety Symptoms (General Anxiety Disorder-7; GAD7) <sup>b</sup>	0-21	6.56	5.56	5	8	0
Depressive Symptoms (Personal Health Questionnaire; PHQ8) <sup>c</sup>	0-24	7.16	5.67	6	8	0
Brief Illness Perception Questionnaire (BIPQ) <sup>d</sup>						
Consequences	0-10	7.14	2.10	7	2	1
Timeline	0-10	6.01	1.63	6	2	3
Personal Control	0-10	5.15	2.40	5	4	5
Treatment Control	0-10	5.02	2.59	5	4	5
Identity (Experience Symptoms)	0-10	0.86	1.79	0	1	20
Concern	0-10	7.22	2.50	8	4	4
Understanding	0-10	7.28	2.03	7	3	10
Emotional Response	0-10	6.16	2.53	7	3	4

Note. total N = 1380; SD – standard deviation; IQR – Interquartile Range; Missing – indicates number of individuals who did not provide an answer for the item.

<sup>b</sup> Scores range from 0 to 21 with higher scores indicating more severe experiences in symptoms, scores over 10 indicate concern for clinical significance. <sup>c</sup> Scores range from 0 to 24 with higher scores indicating more severe experiences in symptoms, scores over 10 indicate concern for clinical significance. <sup>d</sup> Scores range from 0 to 10 with ten indicating a higher perception of the illness perception domain (e.g. a higher score for Consequences indicates that the respondent reports perceiving that COVID-19 will have greater negative impacts on them; a higher Personal Control domain score indicates more perceived personal control over contracting COVID-19)

## Aim 1

Table 3 shows respondents' anxiety symptoms, depression symptoms, and illness perceptions. The mean scores for the measures of anxiety symptoms (GAD-7) and depression symptoms (PHQ-8) were above 5, which is the cut point for mild to moderate symptom burden (Kroenke et al., 2009; Spitzer et al., 2006). Participants rated the perceived impact (i.e., consequences) of the pandemic on their daily lives as moderately high ( $M=7.14$ ,  $SD=2.10$ ). When considering the timeline of the COVID-19 pandemic, participants believed that the pandemic would last a long time ( $M=6.01$ ,  $SD=1.63$ ). On average, survey respondents rated personal control over becoming ill from COVID-19 ( $M=5.15$ ,  $SD=2.40$ ) and treatment control over COVID-19 as moderate ( $M=5.02$ ,  $SD=2.59$ ). Additionally, survey respondents reported rarely experiencing any COVID-19 symptoms, if any at all (i.e., identity) within the revised BIPQ. When examined dichotomously based on selecting 0 (not experiencing any symptoms of COVID-19 at all) or any value other than 0, more than a quarter of respondents ( $n = 378$ , 27.8%) believed that they had experienced some symptom related to COVID-19. On average, the survey respondents rated their level of concern related to COVID-19 ( $M=7.22$ ,  $SD=2.50$ ) and their understanding of COVID-19 as moderately high ( $M=7.28$ ,  $SD=2.03$ ). Overall, participants reported that the COVID-19 pandemic had been somewhat emotionally distressing for them ( $M=6.16$ ,  $SD=2.53$ ).

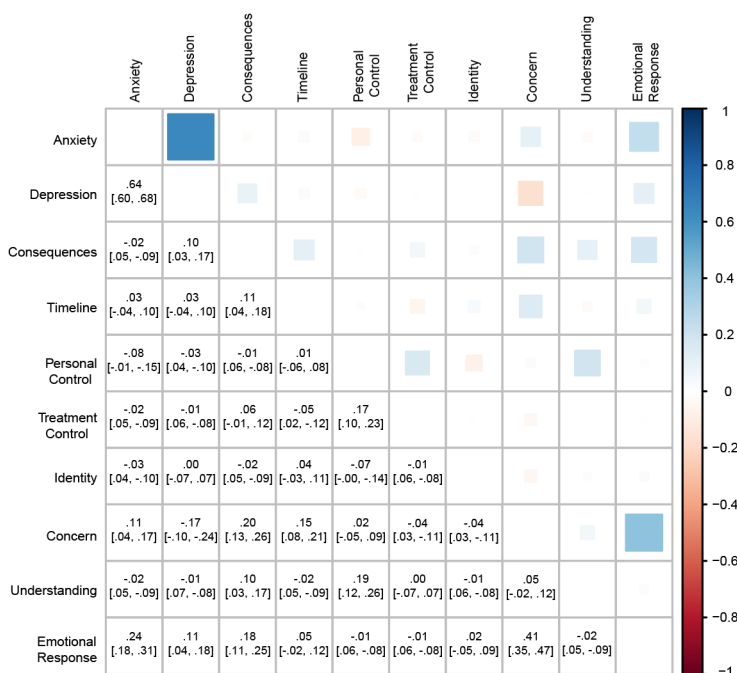
## **Aim 2**

Figure 1a shows the zero-order Pearson correlation coefficients, Holm-Bonferroni corrected 99% CIs, and the correlogram, and Figure 1b shows the partial Pearson correlation coefficients, Holm-Bonferroni corrected 99% CIs, and the correlogram for anxiety, depression symptoms, and illness perceptions, while controlling for personal, social, and cultural contextual variables. Zero-order Pearson correlation coefficients demonstrate correlations between many of the illness perception variables and symptoms of both anxiety and depression. After controlling for intercorrelation among anxiety symptoms, depression symptoms, the illness perception domains, and personal, social, and cultural contextual variables, significant partial

correlations remained between anxiety and depression ( $pr = .64$  [.60, .68]), anxiety and level of concern ( $pr = .11$  [.04, .17]), anxiety and emotional distress related to COVID-19 ( $pr = .24$  [.18, .31]), depression and perceived impact (i.e., consequences) ( $pr = .10$  [.03, .17]), depression and level of concern, ( $pr = -.17$  [-.10, -.24]), and depression and the emotional distress related to COVID-19 ( $pr = .11$  [.04, .18]).

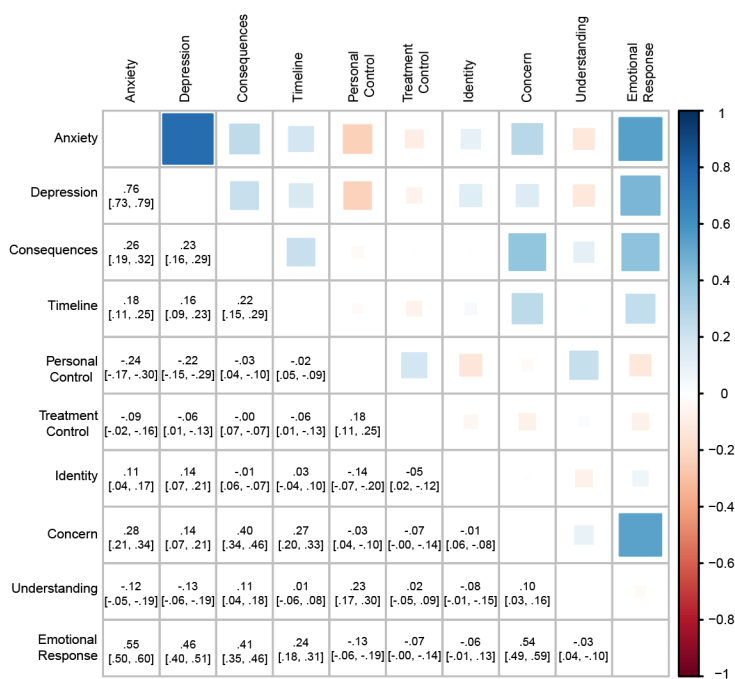
**Figure 1a**

*Correlogram Depicting Uncorrected Intercorrelation Between Illness Perceptions and Symptoms of Anxiety and Depression*



**Figure 1b**

*Correlogram Depicting Residual Intercorrelation Between Illness Perceptions and Symptoms of Anxiety and Depression*



*Note.* These figures include the results of both the zero-order Pearson's correlations (Figure 1a) and the partial Pearson's correlations (Figure 1b) with their respective Holm-Bonferroni corrected 99% confidence intervals below the diagonals, and correlograms representing relationships among variables above the diagonals. In both figures, the size and color saturation of squares represent the correlation coefficients. Larger squares indicate stronger associations, and smaller squares indicate weaker associations. The color associations are presented to the right of the correlation matrix, with 'blue' representing positive correlations and 'red' representing negative correlations.

## Discussion

Our study yielded several interesting findings. Although analyses preclude the ability to determine causality, our study suggests that illness perceptions, anxiety, and depression symptoms are related. Within the first three months of the pandemic, symptoms of anxiety and depression were moderately associated with the emotional response and concern domains of

illness perceptions. When controlling for personal, social, and cultural contextual factors, depression symptoms, but not anxiety symptoms, were positively associated with the consequences domain (small effect size), meaning that those with increased depression symptoms also reported an increased impact of COVID-19 on their lives. Additionally, perceptions of personal control were negatively associated with anxiety symptoms (small effect size) but not with depression symptoms, indicating that those who felt that they had more control over being infected with COVID-19 experienced fewer anxiety symptoms. Though when controlling for personal, social, and cultural contexts the magnitude of the correlation was small, these findings suggest the need to consider the existence of a more complex, underlying interconnectedness shared among pandemic illness perceptions, emotional symptoms, and other factors yet to be determined. Those interconnections may mimic the relationships initially proffered by our use of the common-sense model of self-regulation (Diefenbach & Leventhal, 1996; Leventhal et al., 1992); however, the complex nature of this pandemic may require extension of such models and more likely inform the development of new frameworks to address future global health events and their potential longer-term sequelae.

Based on our initial suppositions, the common-sense model of self-regulation was generally supported by the associations between COVID-19 illness perceptions, anxiety, and depression symptoms. Although COVID-19 illness perceptions are unique, some similarities remain among illness perceptions and psychological symptoms relationships in chronic illness populations. Other studies have shown that depression and anxiety symptoms impact perceptions and responses to illness, including fear and worry (Wierenga et al., 2017b). For instance, depression and anxiety symptoms have been associated with changes in health behaviors, social behaviors, and even emotional reactivity (Rao et al., 2020; Riegel et al., 2017; Wierenga et al., 2019). Unfortunately, even after controlling for sex and age, heightened anxiety has not correlated with improved use of personal protective behaviors of mask-wearing or hand washing during the COVID-19 pandemic, as evidenced by a study of 203 adults in Thailand

(Goodwin et al., 2020). Instead of a positive effect, heightened perceptions of concern and susceptibility have been linked to potential self-harm (Bao et al., 2020; Goyal, 2020; Li et al., 2020; Montemurro, 2020). Given the presence of depression and anxiety symptoms, an online survey of 44,447 college students in Guangzhou, China in 2020 identified an increased demand for knowledge and interventions related to psychological well-being (Wang et al., 2020). This relationship between COVID-19 illness perceptions, anxiety, and depression symptoms might serve as an important target for interventions seeking to improve the uptake of and compliance with self-care and risk mitigation behaviors throughout the pandemic. Further research is needed to determine the influence of illness perceptions on health behaviors to identify the impact on outcomes.

Time is an important factor to consider when interpreting the findings of illness perceptions during a pandemic. For instance, one H1N1 study showed illness perceptions impact viral mitigation over time (Karademas et al., 2013). Given the rapidly changing state of public health information and recommendations at the beginning of the COVID-19 pandemic, we examined illness perceptions, anxiety, and depression symptoms during the first three months of the pandemic. While controlling for the number of days post-mitigation announcement allowed us to control for the influence of time, at least cross-sectionally, we did not examine it longitudinally. Future studies should consider researching changes in relationships between anxiety, depression symptoms, and illness perceptions over time.

While assessing the relationships between anxiety, depression symptoms, and illness perceptions, it was necessary to also account for relationships among BIPQ domains of illness perceptions. Similar to associations between illness perception domains in this study, Broadbent et al. (2006) identified domain categories of cognitive (consequences, timeline, personal control, treatment control, and identity), comprehensibility (understanding), and emotional (concern and emotional response) illness perceptions. This progression of the theory supports an improved understanding of the interrelationships between domains and among the categories rather than



parallel cognitive and emotional processes featured in Leventhal's initial theory. Recent network analyses of the BIPQ domains among patients with chronic conditions identified a central clustering of concern, understanding, emotion, and consequences (Shim et al., 2020), which indicates strong bivariate interrelationships among these domains, similar to the bivariate relationships in our data. Additionally, while few study participants reported experiences of symptoms that they identified as being associated with COVID-19 when responding to the Identity domain item of the BIPQ ( $n = 378, 27.8\%$ ), when responses to the items collecting individual symptom experience reports are evaluated based on the CDC-identified COVID-19 symptom profile a majority of participants reported experiencing one or more CDC-identified COVID-19 symptoms ( $n = 1,211, 87.8\%$ ). The discrepancy in these two findings indicates potentially important differences in how healthcare providers and researchers measure and interpret symptom experiences and how individual reports may differ when symptoms are asked about without any disease-specific context compared with those measures that more specifically link symptom experiences with an illness (e.g. the COVID-19 adapted BIPQ Identity domain item; Riegel et. al, 2019).

There are some limitations that we must acknowledge when considering these findings. First, we recruited participants online and do not have data on where individuals saw the advertisement. It is well documented that using online recruitment non-purposive or representative samples may increase the risk of self-selection bias (Choi et al., 2017). In this study, 36% of individuals accessing the surveys did not complete them; these individuals may have unique perceptions that differ from those reported by this sample. Despite this limitation, the use of online recruitment through social media platforms allowed us to reach a large sample of individuals. Although our sample was mostly assigned female at birth, White, and educated, there was variation in sample make-up based on the proportions of essential vs. non-essential workers, those who had used alcohol and illicit drugs, and those affected by job loss. Finally, it

must be noted that self-referral studies may be more appealing to those individuals seeking a receptive audience or who may have had stronger feelings about the pandemic.

### **Implications for Future Research and Policy**

SARS-CoV-2 infections and the COVID-19 pandemic have undeniably altered trajectories of health and well-being for people worldwide. In less than 12 months, this global threat has developed into a problem that spans healthcare, science, politics, social justice, and inequity. Nursing research, nursing practice, nursing education, and health policy have an important role in addressing these complex issues. Beyond the work of nurses on the 'front line,' nurses will have to act to limit and treat both the acute and chronic negative effects of this pandemic in the coming months and years. This observational analysis of data collected during the early months of the pandemic brings attention to the interactions among illness perceptions and symptoms of depression and anxiety. However, ongoing longitudinal assessments are imperative for assessing how personal illness perceptions related to COVID-19 change over time. Further, we must accept that models initially developed to understand contagious and chronic illnesses may not ever adequately represent the complexities of this or any future pandemic and thus may warrant exploration of new or altered approaches to explaining phenomena of interest surrounding health and well-being during the pandemic. Research is also needed that clarifies targeting and development of interventions to better describe the influences of time and symptom, behavioral, and perceptual changes over time especially in the midst of rapidly fluctuating COVID-19-related information.

Health policy design and implementation during public health crises are often different from those applied when there is no crisis. Beyond the masking, testing, distancing, and contact tracing, the disruption of day-to-day life is still present across the country as individuals are asked to switch back and forth from quarantining to resuming 'normal' daily life. Nursing expertise is needed to inform public health interventions and policies that address the psychosocial impacts of the COVID-19 pandemic. Increased financial support for the

adaptation, ramp-up, and rollout of culturally appropriate and easily accessible interventions at individual and community levels is important for improving health promotion, stress management, and self-care. Depression and anxiety symptom burden may be key markers for identifying individuals with a greater need for evidence-based knowledge, self-management, and behavior change interventional resources. Given the relationships between depression and anxiety symptoms and illness perceptions, these individuals may require more frequent exposure to relevant risk mitigation and health promotion information.

### **Conclusions**

The COVID-19 pandemic has substantially altered almost all aspects of our daily lives. Examining anxiety, depression, and illness perceptions is critical for understanding the public's emotional and cognitive response to the COVID-19 pandemic. This study focused on understanding the relationships between symptoms of anxiety and depression and the various domains associated with COVID-19 illness perceptions. Depression and anxiety symptoms' associations with illness perceptions during a pandemic is, on its own, not unexpected. However, the use of broad sweeping public health interventions such as physical distancing and 'stay-at-home' orders has psychosocial implications that were not broadly present in the US during recent viral outbreaks, which made studying these relationships in the current context important.

The rates of infection and death due to COVID-19 have been dynamic during the current pandemic, and the world has seen the processes of science, research, and public health policy change in real-time as knowledge of individual and group mortality and morbidity risks evolved. Understanding personal and public health practices efficacious in slowing or limiting the spread of infection has improved, as have treatments for those experiencing more aggressive symptoms. While there has been progress in the fight to limit poor health outcomes from viral infections, the variation in information and recommendations has created a challenging landscape for the average person to traverse during the pandemic. Illness perceptions are key

indicators of the cognitive and emotional manifestations of the COVID-19 pandemic. These observational data collected in the first 3 months following the initial issuance of national COVID-19 guidance (The White House, 2020) provide a valuable glimpse of illness perceptions among US adults in this critical period. While Leventhal and colleagues initially described perceptions as parallel paths (Leventhal et al., 1992), the emotional and cognitive manifestations are not mutually exclusive or agnostic processes. These findings suggest that they may be more appropriately described as interactive during the early days of the pandemic.

In such a time when politics and science must work in tandem but are often posed as being in conflict, the need for clear, reasoned, and actionable research is undeniable. Thus, it is important to identify how the pandemic response is affecting the psychosocial well-being and health-related outcomes of individuals across the US. We must consider the extent to which depression and anxiety symptoms (such as worry and fear) may allow for emotional charging of cognitive processes and potentially bias an individual's intake, assessment, and application of information based on those 'hot,' affect-laden cognitions rather than 'cool,' rational, and considerate cognitions (Goyal, 2020; Li et al., 2020; Montemurro, 2020).

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