



Psychological Correlates of Health anxiety in Response to the Coronavirus (COVID-19) Pandemic: a Cross-Sectional Online Study in Iran

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Abstract

Current models suggest health anxiety as a fundamental variable associated with fear and anxiety related to COVID-19. The investigation was carried out in separate two studies on the Iranian population. The first study aims to test the COVID-19 Anxiety Inventory ($N=202$). The findings indicate a two-factor structure of the scale. Participants ($N=1638$) completed the online survey anonymously in the second study, including the COVID-19 Anxiety Inventory, Short Health Anxiety Inventory, The Intolerance of Uncertainty Scale, Anxiety Sensitivity Index-3, Body Vigilance Scale, Depression Anxiety Stress Scales 21, and Contamination Cognitions Scale. Results showed that health anxiety, anxiety sensitivity, and body vigilance would significantly contribute to fears of contracting COVID-19. Moreover, the findings support a central role of intolerance of uncertainty in predicting COVID-19 anxiety. The study results provided both theoretical and practical implications for understanding psychosocial predictors during the COVID-19 pandemic.

Keywords COVID-19-related anxiety · Health anxiety · Intolerance of uncertainty · Contamination

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Introduction

The first outbreak of a novel coronavirus was reported in Wuhan, Hubei province, China, during the month of January 2020. By early March, this novel coronavirus, identified as Coronavirus disease 2019 (COVID-19), was declared a global pandemic by the World Health Organization (WHO, 2020). The first case in Iran was reported on Feb 19, 2020. After a short time, it rapidly spread throughout the country. As of mid-September, which was the end of data collection, about 407,353 people were infected, and more than 23,313 people died (Ministry of Health & Medical Education of Iran, 2021).

The international health crisis in Iran has generated a surge of panic and anxiety. Surgical masks and gloves are scarce, and people rush to the store to clean out the shelves. This crisis created a black market at multiple times the original price. Also, fake news and misinformation have grown chronophobia (Salimi et al., 2020). In addition to the considerable public health consequences of the pandemic, there have been significant mental health consequences, which had been anticipated based on previous pandemics this century (Bareket-Bojmel et al., 2021; Gruber et al., 2020).

Scientific efforts to understand the full scope of the psychological impact and consequences of the COVID-19 pandemic on mental health are being conducted. Early investigations demonstrate several negative psychological impacts of the ongoing pandemic on individuals, including anxiety, depression, stress, fear, post-traumatic stress, boredom, anger, helplessness, insomnia, and stigma (Gruber et al., 2020; Liu et al., 2020; Rodríguez-Rey et al., 2020; Taylor et al., 2020; Xiong et al., 2020). Early in the pandemic, a COVID-19 Stress Syndrome was identified, encompassing concerns over contamination and danger, socioeconomic consequences, traumatic stress, checking behaviors, and xenophobia (Taylor et al., 2020). These psychological consequences may also be intensified by factors such as long-term quarantine, separation from loved ones, loneliness, uncertainty over disease status, loss of financial resources, and unemployment (Brooks et al., 2020; Dubey et al., 2020; Serafini et al., 2020).

One psychological process that the current pandemic may particularly impact is health-related anxiety. Health anxiety relates to excessive preoccupation and concern about one's health status. It occurs when misinterpreted bodily sensations (e.g., fatigue, coughing, aching muscles) indicate the presence of severe disease (Asmundson & Taylor, 2020). Specifically, threatening appraisals of bodily sensations (e.g., "If I have a cough, I might have coronavirus") trigger anxiety and elicit the performance of health-related safety behaviors. These behaviors may include frequently visiting doctors, excessively researching diseases and their symptoms on the internet, or seeking reassurance (Benke et al., 2022; Taylor & Asmundson, 2017). Although these behaviors in the short term often reduce health anxiety, they can increase the severity of health anxiety in the long term (Blakey & Abramowitz, 2017). Excessive checking and reassurance-seeking are features of health anxiety that can be particularly troublesome (Tull et al., 2020). As a result, and as observations from previous infectious outbreaks or pandemics

have demonstrated, hospitals often face a massive flow of people with elevated health anxiety who report flu-like symptoms (e.g., aches, cough) that are not infected with the disease to seek reassurance from medical professionals. Such behaviors can rapidly overwhelm existing healthcare resources (Jungmann & Witthöft, 2020; Tyrer & Tyrer, 2018). For example, during the 2009 H1N1 influenza pandemic, the number of patients seeking treatment at 18 different emergency departments in the USA showed a 7% increase compared to rates prior to the emergence of H1N1 (McDonnell et al., 2012). Individuals may also engage in protective or safety behaviors above and beyond public health guidelines to lessen the possibility or severity of disease (e.g., excessive hand washing, avoidance of contaminants, and panic buying) (Taylor, 2021), but these efforts often increase anxiety and functional impairment. Media coverage of epidemics and pandemics can also worsen health-related anxiety, as was the case during the Ebola outbreak in late 2014 (Blakey et al., 2015).

A growing body of empirical evidence supports cognitive and behavioral theories of health-related anxiety. Anxiety sensitivity and body vigilance are two processes that are hypothesized to develop and sustain health anxiety (Abramowitz et al., 2007; McKay et al., 2020a, b). Anxiety sensitivity is a tendency to misinterpret the bodily sensations associated with anxious arousal (e.g., “When my heart beats very fast, I fear I have a heart attack”) (Taylor & Asmundson, 2004; Wheaton et al., 2010). Therefore, if someone misinterprets unexplained body sensations (e.g., aches or chills) as catastrophic and harmful, it may be associated with repeatedly scanning for bodily sensations and changes and misinterpreting them as a symptom of COVID-19 and lead to increased anxiety and more safety behaviors (Schmidt et al., 2021). Body vigilance is defined as conscious attention focused on bodily sensations (Schmidt et al., 1997), according to investigations related to anxiety-related concepts, health anxiety, and panic disorder (Olatunji et al., 2007; Schmidt et al., 2006). A person with a high level of body vigilance or anxiety sensitivity might believe that “If I become short of breath, it means I could suffocate” or “if I have a headache, I am infected.” Theoretically, anxiety sensitivity and body vigilance overlap with the concept of health anxiety, and both relate to the tendency of people to fear bodily sensations or changes as dangerous (Ojalehto et al., 2021). Therefore, they may also be vital concepts to predict COVID-19 anxiety, with early investigations demonstrating that these constructs are associated with fear or anxiety about becoming infected with COVID-19 (Wheaton et al., 2012).

In addition to the interoceptive focus on anxiety sensitivity and body vigilance, pandemics and the risk of infection increases intolerance of uncertainty (Carleton et al., 2007a, b). Further, intolerance of uncertainty has recently been shown to be an important predictor of well-being during the COVID-19 pandemic (Carnahan et al., 2022; Satici et al., 2020; Saulnier et al., 2022). Recent findings suggest a link between intolerance of uncertainty, health anxiety, and fear of COVID-19 contagion in a general community US sample (Paluszek et al., 2021; Wheaton et al., 2021). So pervasive are these concerns about infection and the diminished ability to tolerate the uncertainty that it has been shown to impact the delivery of exposure treatment by anxiety disorder experts (McKay et al., 2020a, b).

During pandemics, hand washing and sanitizer gels and sprays are commonly prescribed and recommended as sufficient hygiene measures to eradicate infections.

These recommendations can exacerbate symptoms in individuals with obsessive–compulsive disorder and might activate and create similar symptoms in healthy people (Abramowitz et al., 2010; Banerjee, 2020). Indeed, a COVID-19 Stress Syndrome (Taylor et al., 2020) would suggest that a wider proportion of the population would show significant stress from the risk of infection. OCD symptoms often include fear of disease, contamination, and excessive washing associated with overestimating the threat of becoming ill or bringing an infection home (McKay et al., 2020a, b; Storch et al., 2020). Therefore, fear of contamination may predict severe anxiety from COVID-19.

This cross-sectional online study is the first of its kind in Iran, designed to better account for the psychological impacts associated with COVID-19-related health anxiety in the Iranian population. This study represents a unique opportunity to increase our knowledge about the COVID-19 pandemic and concerns about the spread of such pandemics in the future. Therefore, Study 1 addressed the following research questions: (1) Is the hypothesis of the factor structure of the original questionnaire appropriate for the Persian version of CAI? (2) What is the most suitable structure for the Persian version of CAI? (3) Is the internal consistency of the most suitable structure of the Persian version of CAI acceptable?

Our hypotheses in Study 2 are as follows: (1) COVID-19 anxiety will be associated with depression, anxiety, stress, subclinical health anxiety, anxiety sensitivity, body vigilance, contamination cognitions, and intolerance of uncertainty, and (2) a higher level of depression, anxiety, stress, subclinical health anxiety, anxiety sensitivity, body vigilance, contamination cognitions, and intolerance of uncertainty can predict COVID-19 related fear and safety behaviors.

Study 1

This study aimed to investigate the factor structure and reliability of the COVID-19 anxiety inventory. It was expected that a COVID-19 anxiety inventory could demonstrate construct validity in light of recently developed measures in other languages and cultures that address this concern i.e. (Lee et al., 2020).

Participants and Procedure

Two hundred two participants (aged 18 to 78 years) volunteered to participate in the study via an online survey posted in Iranian online forums and social network communities (e.g., Telegram, Instagram, Twitter, WhatsApp). The online survey took around 5 min to complete. Data collection occurred from late 21 June 2020 to early July 2020. Participants' inclusion criteria were (i) at least 18 years old and (ii) Persian-speaking citizens. All the participants completed the survey anonymously and gave their informed consent online. After providing informed consent, participants completed the COVID-19 anxiety inventory. Participants' mean age (range 18 to 78 years) was 39.0 years; they were mostly females (123; 60.8%), married (125; 61.8%), and with a

graduate degree (140; 69.3%). The Ethics Committee approved the study of the Iran University of Medical Sciences (Approval ID: IR.IUMS.REC.1399.195).

Measures

COVID-19 Anxiety Inventory (CAI)

The CAI is a ten-item measure designed for the present study to assess anxiety associated with the COVID-19. Items were rated from 0 (not at all) to 4 (very much); scores can range from 0 to 40, with higher scores indicating higher COVID-related anxiety. The CAI was developed by modifying items used in Wheaton et al. (2012) to assess H1N1 (swine flu) fears (Wheaton et al., 2012).

Statistical Analysis

The analyses were completed using SPSS 25 statistical programs. An exploratory factor analysis (EFA) with Varimax rotation was performed to explore the differences in the instrument's structure in the Iranian population ($n=202$). Principal component analysis (PCA) was conducted to investigate the factor structure of the CAI in the sample. Bartlett's test of sphericity was significant, and the Kaiser–Meyer–Olkin index (KMO) was 0.86, indicating suitability for factor analysis. Psychometric and factor analytic properties are presented in the “[Preliminary Analyses](#)” section below, items listed in Table 1.

Preliminary Analyses

Factor loadings, eigenvalues, and proportions of total variance are presented in Table 1. The current study results showed that items 1, 2, 3, 4, 5, and 7 could be loaded on the first factor (eigenvalue=4.40). Items 6, 8, 9, and 10 were placed on the second factor (eigenvalue=1.30). Based on the content of the items and the definition of the anxiety concept, it can be said that the first factor measures the “COVID-19 Fear” and the second factor measures the “COVID-19 Safety Behaviors”.

In order to examine the relationships between the components of the questionnaire, a correlation matrix was used. The correlation matrix between the COVID-19 Fear and COVID-19 Safety Behaviors was 0.52, the correlation between the full scale and COVID-19 Fear was 0.92, and the correlation between the COVID-19 Safety Behaviors and total scales was 0.80 ($P>0.01$).

Discussion: Study 1

This study shows that the CAI is a reliable instrument in a large Persian general community sample. EFA in this population suggested a 10-item scale with a two-factor structure: COVID-19 Fear and Safety Behaviors. A principal component

Table 1 Item properties of the COVID-19 anxiety inventory (CAI; $n = 202$)

Item	Factor 1	Factor 2	Corrected item-total Correlation(total)	a if item deleted	M	SD
1. To what extent are you concerned about coronavirus?	.782*	.286	.716	.825	2.34	1.03
2. To what extent do you believe that coronavirus could become a “pandemic” in the Iran?	.681*	.270	.609	.836	3.04	.93
3. How likely is it that you could become infected with coronavirus?	.822*	.087	.621	.835	1.93	.94
4. How likely is it that someone you know could become infected with coronavirus?	.727*	.206	.610	.836	2.14	.98
5. How quickly do you believe contamination from coronavirus is spreading in the Iran?	.736*	.168	.591	.837	2.50	1.06
6. How much exposure have you had to information about coronavirus?	.241	.608*	.517	.844	3.35	.85
7. If you did become infected with coronavirus, to what extent are you concerned that you will be severely ill?	.624*	.200	.452	.849	2.20	1.04
8. To what extent has the threat of coronavirus influenced your decisions to be around people?	.322	.726*	.595	.837	3.00	1.02
9. To what extent has the threat of coronavirus influenced your travel plans?	.102	.716*	.402	.856	3.31	1.11
10. To what extent has the threat of coronavirus influenced your use of safety behaviors (e.g., hand sanitizer)?	.150	.787*	.487	.846	3.37	.82
Eigenvalue	4.40	1.30				
Explained variance (%)	44.04	13.03				
Cronbach α	.85	.71				
	Explained variance = 57.07%		Cronbach $\alpha = 0.854$ (10 item)			

*Extraction method: eigenvalues > 1 . Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy = .868 ($> .60$). Bartlett’s test of sphericity: Chi-square ($df = 45$) = 723.946, $p < .001$

analysis (PCA) suggested that 6 of 10 items loaded onto a factor 1, with component values higher than 0.62, and 4 items loaded onto a factor 2, with component values higher than 0.60. Item 3 (How likely is it that you could become infected with coronavirus?) with the highest loading was in factor 1 ($r=0.822$). Item 10 (To what extent has the threat of coronavirus affected your use of safety behaviors, e.g., hand sanitizer?) with the highest loading was in factor 2 ($r=0.787$).

One of the most common internal consistency indices is Cronbach's alpha coefficient. In this study, Cronbach's alpha obtained from the CAI was 0.85. The correlations of the factors and the whole scale showed that both factors had a positive and significant correlation with the total scale score. So, this instrument is a reliable questionnaire.

These two factors perpetuate COVID-19 anxiety. As for the widespread effect of COVID-19, high levels of anxiety and fear are predicted in the population. Moreover, high levels of anxiety and some behavioral modifications have been observed in the public reaction to the COVID-19 pandemic. While these behaviors may be suitable in a pandemic, they are often carried out to such an extent in health anxiety that they become maladaptive, lasting for hours per day, developing high levels of distress, and interrupting functioning in everyday life. However, what factors predispose a person to increased anxiety levels during a pandemic is unidentified (Knowles & Olatunji, 2021). The second study examined the effects of health anxiety, body vigilance, anxiety sensitivity, intolerance of uncertainty, and fear of contamination, on Covid-19-related anxiety.

Study 2

Study 2 was conducted with a large Persian general community sample to investigate the primary hypotheses of this project.

Methods

Study Design and Participants

To prevent the spread of COVID-19 through droplets or contact, we used a web-based cross-sectional survey based on the National Internet Survey on Emotional and Mental Health (NISEMH), an ongoing, online health-related behavior survey of the Iranian population, to collect data. This web-based survey of the COVID-19 was sent on the Internet through Telegram, WhatsApp, Twitter, and Instagram public platforms. The survey was available exclusively in Persian. To encourage the recruitment of potential participants, all participants in the survey were offered a report on their mental health after completing the evaluation. This web-based questionnaire was completely non-commercial and voluntary. Among the total participants (1638): females accounted for about 52%; the average age was about 37.63 years (± 12.80); over 42% of the participants held a Bachelor's Degree; 55%

of the total participants were married (see Table 2). The comparison between groups of demographic information in COVID-19 anxiety scores is shown in Table 2. Female respondents had statistically significantly higher COVID-19 anxiety scores than male respondents ($P < 0.01$). Respondents married had statistically significantly higher COVID-19 anxiety scores than respondents single ($P < 0.05$). Populations with the urban place of residence had statistically significantly higher COVID-19 anxiety scores ($P < 0.01$). Respondent employees had significantly higher COVID-19 anxiety scores ($P < 0.001$).

Table 2 Relationship between the COVID-19 anxiety with demographic and COVID-19 variables

Characteristic	Group	<i>n</i> (%)	<i>M</i> (SD) COVID-19 anxiety	Statistical test	<i>p</i>
Gender	Female	853 (52.1)	30.81 (5.15)	−4.552 ^a	< .001
	Male	785 (47.9)	29.81 (4.85)		
Age in years	18–30	537 (32.8)	30.69 (4.86)	6.673 ^b	< .001
	31–40	524 (32)	29.98 (5.39)		
	41–50	425 (25.9)	31.07 (4.60)		
	Upper 51	152 (9.3)	29.25 (5.21)		
	Education degree	Less than high school	56 (3.4)		
High school diploma	321 (19.6)	31.15 (4.26)			
Bachelor	696 (42.5)	30.72 (4.99)			
Master and higher	565 (34.5)	29.46 (5.41)			
Marital status	Single	729 (44.5)	29.93 (5.35)	−2.847 ^a	.004
	Married	909 (55.5)	30.72 (4.75)		
Place of residence	Urban	1430 (87.3)	30.60 (4.92)	4.269 ^a	< .001
	Rural	208 (12.7)	29.01 (5.59)		
Occupation	Employee	897 (54.8)	30.68 (4.94)	5.585 ^b	.003
	Unemployed	178 (10.9)	29.17 (6.35)		
	Student	512 (31.3)	30.40 (4.76)		
	Retired	51 (3.1)	29.35 (3.53)		
Chronic disease	yes	462 (28.2)	34.08 (1.88)	29.453 ^a	< .001
	no	1176 (71.8)	28.95 (5.15)		
Infected Acquaintances	yes	178 (10.9)	30.15 (5.05)	−6.207 ^a	< .001
	no	1460 (89.1)	32.39 (4.46)		

^aIndependent *t*-test, ^bANOVA

Data Collection

Participants answered the questionnaires anonymously on the Internet from late July 2020 to mid-September 2020. All subjects reported their demographic data and completed seven standardized questionnaires. The study's inclusion criteria were an age of at least 18 years and informed consent. In order to ensure the quality of the survey, we set the response range of some items (e.g., the age range was limited to 18–80 years old) and encouraged participants to answer carefully through questionnaire explanations. Finally, 1638 participants who completed the questionnaires were included in the analysis.

Ethical Statement

This study was approved by the Ethics Committee of the Iran University of Medical Sciences (Approval ID: IR.IUMS.REC.1399.195). Electronic informed consent was obtained from each participant prior to starting the investigation. Participants could withdraw from the survey at any moment without providing any justification.

Measures

COVID-19 Anxiety Inventory (CAI)

See Study 1 for a detailed description of the CAI. To verify the parameters of the two-factor model, confirmatory factor analysis (CFA) was conducted ($N=1638$). The model was tested using the following goodness-of-fit indices: $\chi^2/d.f.$ (chi-square relative to its degrees of freedom), CFI (comparative fit index), GFI (goodness-of-fit index), NFI (normed fit index), RMSEA (root mean square error of approximation), and SRMR (standardized root mean square residual). The results of CFA showed that the two-factor model had better indices and better fit in Iranian population ($\chi^2/d.f.=302.30/32$; CFI=0.94; GFI=0.96; NFI=0.93; RMSEA=0.07; SRMR=0.04).

Anxiety Sensitivity Index-3 (ASI-3)

The ASI-3 is an 18-item self-report measure of anxiety sensitivity that indicates the degree to which respondents are concerned about potential adverse consequences of anxiety-related sensations. ASI-3 contains three factors: fear of physical symptoms, fear of cognitive dyscontrol, and social concerns. Each item is assessed on a 5-point Likert scale ranging from "0=very little" to "4=very much." A higher score indicates higher anxiety sensitivity. This scale has excellent psychometric properties, showing high internal consistency, good test–retest reliability, and good validity (Taylor et al., 2007). Its psychometric characteristics in the Iranian sample showed an internal validity for the overall scale was 0.95 and reliability test–retest and split-half by 0.93 and 0.97, respectively. Concurrent validity was performed simultaneously with the SCL 90 questionnaire, which had a correlation coefficient of 0.56. The correlation coefficients with the overall score varied adequately between 0.74

and 0.88. The correlation between subscales ranged from 0.40 to 0.68 (Beirami et al., 2012). The ASI-3 demonstrated excellent internal consistency ($\alpha=0.93$) in the current sample.

Body Vigilance Scale (BVS; Schmidt et al., 1997)

BVS is a four-item scale that measures the propensity vigilance of anxiety-related body sensations. The first three items assess attentional focus, perceived sensitivity to changes in body sensations, and the average duration of time spent attending to body sensations, which are scored on an 11-point Likert-type scale (0 = none to 10 = extreme). The fourth item measures the responses to 15 body sensations (e.g., palpitations), defined as physical symptoms of panic attacks. The BVS has shown adequate internal consistency and test–retest reliability in clinical and non-clinical samples (Schmidt et al., 1997). The psychometric properties of this version have been validated in a study that is currently being prepared for publication. The current sample, the BVS, showed excellent internal consistency ($\alpha=0.94$).

Depression Anxiety Stress Scales 21 (DASS-21; Antony et al. 1998)

This 21-item self-report measure is a short form of the original 42-item DASS developed by Lovibond and Lovibond (1995). Items are rated on a four-point scale (ranging from 0 to 3) and reflect the frequency and severity of subjective distress over the last week. The DASS assesses the severity of three psychological conditions anxiety, depression, and stress. Studies reported good validity and reliability for DASS-21 in clinical and non-clinical populations (Henry & Crawford, 2005). In Iran, this instrument has shown excellent internal consistency (Cronbach's alpha reported a depression subscale of 0.81, the anxiety of 0.73, and stress of 0.81) (Asghari et al., 2008). Internal consistency in the current study for full scale was adequate (Cronbach's $\alpha=0.95$).

Contamination Cognitions Scale (CCS; Deacon & Olatunji, 2007)

The CCS measures the overestimation of threat from potentially contaminated objects, hypothesized to be associated with COVID-19 anxiety. The CCS lists 13 common objects often connected with germs (e.g., toilet seats, door handles) and then rates on a 0–100 scale (a) the likelihood that touching each would result in contamination and (b) how severe such contamination can be. Averaging responses to each question calculate CCS total scores. The CCS has demonstrated strong psychometric properties with excellent internal consistency and test–retest reliability (Deacon & Olatunji, 2007). Zanjani and colleagues examined the Persian version of CCS; according to their study, Cronbach's alpha was 0.93 for the likelihood ratings and 0.94 for the severity ratings. Also, test–retest reliability was confirmed after a 4-week interval (likelihood: $r=0.78$; severity: $r=0.81$, $p<0.00$) (Zanjani et al., 2018). The internal consistency was excellent for the CCS-L ($\alpha=0.97$) and CCS-S ($\alpha=0.98$) in the current sample.

The Intolerance of Uncertainty Scale-Short Form (IUS-12; Carleton et al., 2007a, b)

The IUS-12 is a short version of the original 27-item Intolerance of Uncertainty Scale (Freeston et al., 1994). The IUS-12 assesses prospective and inhibitory anxiety, and items are rated on a 5-point Likert scale ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me). Scores range from 12 to 60, and a higher score indicates higher Intolerance of Uncertainty. The total score and both subscale scores (8) have shown good convergent and discriminant validity and internal consistency (Carleton et al., 2007a, b). The internal consistency reliability of IUS-12 in Persian using Cronbach's was reported adequate (0.82), and the face and content validity were determined by experts (Bigdeli et al., 2014). Internal consistency for this measure in this sample was acceptable ($\alpha=0.89$).

Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002)

The SHAI is a self-report instrument developed by Salkowski et al. (2002) to assess health anxiety independent of physical health status. The SHAI is an 18-item with three subscales illness likelihood (items 1, 4–9, 11, 12, and 14), illness severity (items 15 to 18), and body vigilance (items 2, 3, and 10), that measured using a Likert scale from 0 (no symptoms) to 3 (severe). The SHAI has confirmed excellent reliability and validity as a measure of health anxiety in clinical and non-clinical populations (Abramowitz et al., 2007; Salkovskis et al., 2002). The Iranian sample's psychometric properties were reported as internal consistency overall scale was 0.88 by calculating Cronbach's alpha and test–retest reliability with 21-day interval ($r=0.7$) (Panahi et al., 2010). The SHAI showed good internal consistency ($\alpha=0.82$) in the current sample.

Statistical Analysis

All the analyses were implemented by IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY). First, we report the prevalence and demographic data of the subjects. Second, a *t*-test and one-way variance analysis (ANOVA) analyzed COVID-19 anxiety scores among different demographic and exposure groups. Third, to ascertain the relationship between anxiety about the COVID-19 anxiety and other variables, we next correlated the COVID-19 anxiety inventory with the other measures included in the study. Finally, to determine which variables would make significant contributions to predicting COVID-19-related anxiety, we computed a regression in which the COVID-19 anxiety inventory served as the dependent variable, and the other study measures were entered simultaneously as predictors.

Results

Descriptive Statistics and Correlations Between Variables

Data collected from the 1638 respondents who passed the distractor items were screened to assess concordance with statistical assumptions. Distributions of scores on all of the study measures were free of significant skew (all values < 3) and kurtosis (all values < 5). Means and standard deviations (SD) for scores of all the questionnaires are presented in Table 3.

Two-tailed zero-order correlations were conducted to examine the relationship between COVID-19 virus concerns, COVID-19 virus safety behaviors, and other study variables. As seen in Table 4, there were small to moderate positive correlations between the CAI and all study variables except for the age.

Regression Analyses Predicting COVID-19 Anxiety

A simultaneous linear regression was conducted to determine which psychological variables independently predicted COVID-19 anxiety (see Table 5). We found that ASI-3, SHAI-IL, SHAI-IS, SHAI-BV, DASS-21, CCS, IU, and gender were significant predictors of COVID-19 anxiety scores in the model, $F(9,1628) = 162.50$, $p < 0.001$, Adj R squared = 0.47. The BVS were not a significant predictor. We ran the same analyses for the prediction of COVID-19 fear. ASI-3, BVS, SHAI-IL, SHAI-IS, SHAI-BV, DASS-21, CCS, IU, and gender were all significant predictors of COVID-19 fear scores in the model, $F(9,1628) = 157.36$, $p < 0.001$, Adj R squared = 0.46. Also, ASI-3, BVS, SHAI-IL, SHAI-IS, SHAI-BV, CCS, IU, and gender were all significant predictors of COVID-19 Safety Behaviors scores in the model, $F(9,1628) = 56.933$, $p < 0.001$, Adj R squared = 0.23. The DASS-21 was not a significant predictor. The results of the regression analysis are presented in Table 5.

Table 3 Study measure descriptive statistics ($n = 1638$)

Measure	<i>M</i>	<i>SD</i>	Min	Max	Skew	Kurtosis
CAI-total	30.40	5.04	13	40	-.72	.68
COVID-19 fear subscale	16.66	3.64	5	24	-.53	.23
Safety behaviors subscale	13.73	2.12	4	16	-1.22	1.83
Anxiety sensitivity inventory-3	33.15	14.21	4	72	.36	-.23
Body vigilance scale	20.43	9.36	0	40	-.12	-.70
Short health anxiety inventory-illness Likelihood	11.95	4.22	1	30	.15	1.26
Short health anxiety inventory-illness Severity	4.28	2.25	0	12	.13	-.30
Short health anxiety inventory-Body Vigilance	4.08	1.65	0	9	-.05	-.39
DASS-depression	6.80	5.25	0	21	.71	.17
DASS-anxiety	5.93	4.87	0	21	1.02	.68
DASS-stress	8.67	5.29	0	21	.42	-.43
Contamination cognitions scale	72.94	27.24	0	100	-.82	-.51
Intolerance of uncertainty scale	39.43	8.97	16	60	.09	.19

Table 4 Zero-order correlations between study measures

	CAI-total	COVID-19 fear subscale	Safety behaviors subscale	ASI-3	BVS	SHAI-IL	SHAI-IS	SHAI-BV	DASS-21	CCS	IU	Gender
ASI-3	.48**	.50**	.27**	-								
BVS	.28**	.25**	.24**	.44**	-							
SHAI-IL	.51**	.49**	.37**	.34**	.26**	-						
SHAI-IS	.37**	.37**	.27**	.23**	.16**	.41**	-					
SHAI-BV	.28**	.26**	.25**	.18**	.16**	.30**	.14**	-				
DASS-21	.40**	.43**	.22**	.67**	.33**	.29**	.24**	.18**	-			
CCS	.27**	.24**	.24**	.05*	.01	.23**	.11**	.10**	.04	-		
IU	.47**	.47**	.31**	.33**	.27**	.44**	.23**	.21**	.31**	0.11**	-	
Gender	.11**	.08**	.12**	.07**	.01	.004	-.04	.07**	.08**	.08**	.04	-
age	-.01	-.02	-.02	-.05*	-.05*	.02	.04	-.04	-.05	.04	.01	-.01

CAI COVID-19 anxiety inventory, ASI-3 Anxiety Sensitivity Inventory-3, BVS Body Vigilance Scale, SHAI-IL short health anxiety inventory-illness Likelihood factor, SHAI-IS short health anxiety inventory-illness Severity factor, SHAI-BV short health anxiety inventory-Body Vigilance factor, DASS-21 Depression Anxiety Stress Scales-21, CCS Contamination Cognitions Scale, IU Intolerance of uncertainty scale; * $p < .05$, ** $p < .005$

Table 5 Simultaneous linear regression predicting COVID-19 anxiety

Variable	<i>B</i>	<i>SE_B</i>	β	<i>t</i>	<i>p</i>	<i>sr</i> ²
<i>COVID-19 anxiety-total</i>						
ASI-3	.082	.009	.231	8.791	.000	.025
BVS	.005	.011	.011	.448	.654	<.001
SHAI-IL	.244	.027	.200	8.963	.000	.026
SHAI-IS	.325	.045	.145	7.303	.000	.017
SHAI-BV	.24	.058	.078	4.134	.000	.005
DASS-21	.022	.009	.065	2.474	.013	.001
CCS	.029	.003	.162	8.511	.000	.023
IU	.120	.012	.211	10.156	.000	.033
Gender	.705	.184	.071	3.833	.000	.004
<i>COVID-19 fear</i>						
ASI-3	.067	.007	.263	9.933	.000	.032
BVS	-.018	.008	-.047	-2.271	.023	.001
SHAI-IL	.160	.020	.185	8.068	.000	.021
SHAI-IS	.235	.032	.145	7.245	.000	.017
SHAI-BV	.136	.042	.061	3.203	.001	.003
DASS-21	.025	.006	.099	3.971	.000	.005
CCS	.017	.003	.128	6.815	.000	.015
IU	.091	.009	.223	10.611	.000	.036
Gender	.275	.134	.038	2.049	.041	.001
<i>COVID-19 safety behaviors</i>						
ASI-3	.014	.005	.097	3.077	.002	.004
BVS	.023	.006	.103	4.163	.000	.008
SHAI-IL	.084	.014	.167	6.109	.000	.017
SHAI-IS	.090	.022	.096	4.008	.000	.007
SHAI-BV	.105	.029	.082	3.566	.000	.005
DASS-21	-.004	.004	-.025	-.829	.407	<.001
CCS	.012	.002	.157	7.020	.000	.023
IU	.029	.006	.120	4.803	.000	.01
Gender	.430	.093	.101	4.634	.000	.01

ASI-3 Anxiety Sensitivity Inventory-3, *BVS* Body Vigilance Scale, *SHAI-IL* short health anxiety inventory-Illness Likelihood factor, *SHAI-IS* short health anxiety inventory-Illness Severity factor, *SHAI-BV* short health anxiety inventory-Body Vigilance factor, *DASS-21* Depression Anxiety Stress Scales-21, *CCS* Contamination Cognitions Scale, *IU* Intolerance of uncertainty scale, *sr*² squared semi-partial correlation

Discussion

The mental health consequences of the COVID-19 pandemic have been extensive and cut across virtually all psychiatric conditions (Gruber et al., 2020). Considering the increased attention to physical health that comes with a mass public

health event such as a pandemic, it was predicted that health anxiety would contribute significantly to fears of contracting COVID-19.

Additionally, based on the literature, as we hypothesized, we found significant positive correlations between health anxiety, body vigilance (BV), contamination cognitions (CC), anxiety sensitivity (AS), and fear of the spread of COVID-19. These results are in line with previous studies on COVID-19 pandemic (Akbari et al., 2021; Dennis et al., 2021; Ojalehto et al., 2021; Taylor et al., 2020) and prior pandemic disease threats, which found that health anxiety symptoms are also related to the anxiety of contracting swine flu (Wheaton et al., 2012), SARS (Xie et al., 2011), Zika virus (Blakey & Abramowitz, 2017) and Ebola (Blakey et al., 2015).

Therefore, as expected, people with high health anxiety, body vigilance, anxiety sensitivity, intolerance of uncertainty, and fear of contamination can respond to COVID-19-related anxiety in various ways. On the one hand, some of these people may consider hospitals and doctors' offices as a source of transmission and, thus, avoid requesting a medical examination. On the other hand, other people who experience high levels of health anxiety, body vigilance, anxiety sensitivity, intolerance of uncertainty, and fear of contamination may seek health information and reassurance from physicians. Hence, they may go to multiple doctors or even hospital emergency care to ensure that their feelings and physical changes are not due to infection. It is not surprising that medical centers and hospitals frequently refer such people for medical and paraclinical examinations. These behaviors add an excessive burden on limited health resources (Asmundson & Taylor, 2020; Dennis et al., 2021). Accordingly, these results support the central hypothesis of this study that higher levels of health anxiety, body vigilance, anxiety sensitivity, intolerance of uncertainty, and fear of contamination would predict higher COVID-19-related anxiety.

Research conducted early in the pandemic showed a COVID-19 Stress Syndrome that encompassed several broad anxiety-related factors (contamination fear and danger, socioeconomic concerns, xenophobia), consequences of contact with the virus (traumatic stress), and behaviors (checking) (Taylor et al., 2020). Nevertheless, more specific associations with cognitions that may exacerbate health anxiety driven by pandemic fear, such as intolerance of uncertainty, warranted additional attention.

The present findings support a central role of intolerance of uncertainty in predicting COVID-19 anxiety. Possibility, people with a diminished ability to tolerate uncertainty tend to interpret vague information in the form of excessive concerns about infection and anxiety-related COVID-19. Hence, this hypothesis suggests that uncertainty intolerance plays a mediating role in the relationship between health anxiety and anxiety-related COVID-19. These results are consistent with additional recent research showing this relationship (Taylor et al., 2020; Wheaton et al., 2021).

These results expand this association by incorporating anxiety sensitivity and body vigilance, two specific health anxiety constructs whereby interoceptive awareness of changes in the physical state is appraised as potentially dangerous. Theoretically, anxiety sensitivity and body vigilance overlap with the concept of health anxiety, and both relate to the tendency of people to fear bodily sensations or changes as dangerous. Consequently, these results generally align with previous studies on the COVID-19 pandemic (Fedorenko et al., 2021; Ojalehto et al., 2021). Also, this is consistent with the findings of this study and early investigations demonstrating that

these constructs are associated with fear or anxiety about becoming contaminated with the infection (Wheaton et al., 2012).

In the present study, anxiety sensitivity and intolerance of uncertainty play an important role in predicting COVID-19-related anxiety. Higher levels of anxiety sensitivity may lead individuals to have cognitions that their symptoms are dangerous. The regard that the virus can be fatal increases anxiety sensitivity (Guo et al., 2021). The absence of definitive treatment for COVID-19 and a rising number of deaths due to the disease increased the level of intolerance of uncertainty (Satici et al., 2020), and when life will return to “typical” is still vague. In the COVID-19 pandemic, fear can become harmful and chronic since the threat is continued and uncertain. So the COVID-19 pandemic started feelings of illness and helplessness (Bakioğlu et al., 2021).

The findings from this study extend prior research by demonstrating that COVID-19 anxiety safety behaviors and outright fear of contracting the virus are predicted by psychological factors associated with health anxiety generally and contamination-based fear in particular. Given that it is anticipated there will be lingering anxiety consequences well after the risk of contracting COVID-19 subsides (Taylor & Asmundson, 2020), models of treatment will need to focus specifically on these psychological constructs. This will mean developing programs of therapy that are multifaceted in addressing post-pandemic fears, addressing cognitive dimensions of intolerance of uncertainty and health anxiety factors (i.e., anxiety sensitivity), as well as broad obsessive–compulsive concerns such as contamination fears.

The present study is limited by the self-report survey, and the cross-sectional nature of this study prevents the examination of causality or temporal sequencing. Also, most of our sample included educated people, who may limit the generalizability of our results to a broader population.

Additional research is warranted using direct contact methods (i.e., phone interviews) to further probe the nature of contamination and other safety behaviors, in conjunction with intolerance of uncertainty. Besides, a longitudinal study and multi-method assessment design are required to determine the psychological predictors of health anxiety in response to COVID-19 pandemics. Further, it is also possible that the robust nature of these associations may vary in clinical samples.

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Author Contribution Dr. Mohsenabadi and Shabani were involved in the implementation of the study and also in the preliminary analysis of data. Dr. Gharraee and Shabani designed the study and specified the details of implementation. Mr. Shayanfar helped the study by providing an online survey. Dr. Mckay and Corcoran helped write and revise the paper.

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Data Availability Data of participants who consented to the public sharing of data are accessible from the corresponding author upon reasonable demands.

Declarations

Conflict of Interest The authors declared no competing interests.

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