


## Empirical Article

**Relationships between fear of COVID-19, cyberchondria, intolerance of uncertainty, and obsessional probabilistic inferences: A structural equation model**MURAT BOYSAN,<sup>1</sup> MUSTAFA EŞKISU<sup>2</sup>  and ZEKERİYA ÇAM<sup>3</sup><sup>1</sup>Faculty of Social Sciences and Humanities, Social Sciences University of Ankara, Ankara, Turkey<sup>2</sup>Faculty of Education, Erzincan Binali Yıldırım University, Erzincan, Turkey<sup>3</sup>Faculty of Education, Muş Alparslan University, Muş, Turkey

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The study was set out to explore the structural relationships between fear of COVID-19, cyberchondria, intolerance of uncertainty, and obsessional probabilistic inferences. The data were recruited online from a community population ( $n = 1,049$ ) subjected to a confirmatory factor analytic procedure. The structural model specified according to the previous findings in the literature showed that a general tendency to negative expectations in terms of probabilistic thinking was significantly associated with both COVID-19-related-fear and intolerance of uncertainty. Fear of COVID-19 was significantly associated with cyberchondria. Probabilistic thinking style and intolerance of uncertainty contributed to cyberchondria through fear of COVID-19 as well. We concluded that a tendency to engage in a probabilistic thinking style and intolerance of uncertainty seems to play role in the etiology of fear of infection and cyberchondria.

**Key words:** fear of infection, health behaviors, online addiction, probabilistic thinking, health psychology.

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## INTRODUCTION

The burden of the globally challenging infectious disease novel coronavirus 2019 (2019-nCoV) has become the most crucial worldwide public health concern. Extremely high transmission and high morbidity and mortality rates are likely to make individuals more prone to pondering about the probability of contamination and the consequences of probable cases. Fear of contamination is common in place (Lin, 2020) which may lead to other psychosocial strains such as stigmatization and discrimination (Pappas, Kiriaze, Giannakis & Falagas, 2009). Although the attempts to take control over the infection have largely focused on decreasing the infection rates, the psychological aspects of the COVID-19 pandemic are still yet elusive. Addressing the individual's anxious concerns about the pandemic, a readily used brief and valid instrument of the Fear of COVID-19 Scale (FCV-19S) was developed by Ahorsu, Lin, Imani, Saffari, Griffiths & Pakpour (2020). In the initial validation study of the FCV-19S, the overall scores had dose-response relationships with depression and anxiety, as well as perceived vulnerability to diseases. In a national survey of 2019-nCoV-related-fear in a sample of 1,304 community Turkish adults, Satici, Gocet-Tekin, Deniz and Satici (2021) showed that fear of contamination significantly contributed to life dissatisfaction via increased anxiety and depression. In another survey of 1,772 Turkish adults aged from 18 to 73 demonstrated that significant association between intolerance of uncertainty and mental well-being was mediated by 2019-nCoV-related-fear and rumination (Satici, Saricali, Satici & Griffiths, 2020).

An increasing number of users for health-related applications and websites is indicative that the Internet may have become the

most prominent source of health-related information (Kamel Boulos, Brewer, Karimkhani, Buller & Dellavalle, 2014; Starcevic & Berle, 2015). That is, using the Internet as an instrument to search health-related information for novel coronavirus pandemics might admittedly be commonplace (Dadaczynski *et al.*, 2021; Neely, Eldredge & Sanders, 2021). On the other hand, fear of infection, excessive levels of uncertainty, and financial insecurities may raise the levels of distress which, in turn, reinforce maladaptive engagement in unduly use of information and communication technologies, particularly a sizable minority are at higher risk of developing problematic use patterns (Király, Potenza, Stein *et al.*, 2020). Although the health-related information on the Internet is abundant and conflicting, individual differences in users of online health-related information seem to significantly vary owing to their emotional and behavioral responses to their online searches. People more prone to experience over-arousal during health-related online searches for even mild complaints are likely to manifest increased worry and anxiety which, in turn, leads to treatment-seeking and further online searches (Starcevic & Berle, 2015). Deterioration of health-related anxiety as a result of medical research on the Internet is termed as "cyberchondria" (Taylor & Asmundson, 2004).

The phenomenon has been conceptualized on a continuum ranging from daily health-related information seeking on websites to more pathological forms representing an online version of hypochondriasis. The prevailing notion on the phenomenon posited that primarily excessive anxiety and worry underlie cyberchondria, or at least it is an integral aspect of health-related apprehensions that triggers incentives for seeking self-soothing

information but merely results in anxious arousal (Starcevic & Berle, 2013). More recent advances in the relevant research showed that cyberchondria as indexed by the Cyberchondria Severity Scale (CSS; McElroy & Shevlin, 2014) is a multifaceted construct the dimensions of which include compulsions, distress, excessiveness, reassurance and mistrust. Fergus (2014) reexamined the psychometric properties of the CSS in a relatively large sample of English-speaking normative population and replicated the original five-factor structure. Health anxiety is a psychological condition featured by excessive and uncontrollable concerns about physical health in the absence of illness (Salkovskis & Warwick, 2001). The CSS components were found to be tied significantly to health anxiety, with the stronger relationships for distress, excessiveness, and mistrust of medical professionals than obsessive-compulsive symptoms. Data recruited from two samples of Italian community adults supported the original five-factor structure of the CSS and Study 2 showed that metacognitive beliefs about thoughts being uncontrollable was the significant domain linked to the dimensions of the CSS with the exception of mistrust of medical professionals, which was largely accounted for by the biased thinking. Intolerance of uncertainty exerted quite weak direct effects on only compulsions and mistrust of medical professionals (Marino, Fergus, Vieno, Bottesi, Ghisi, & Spada, 2020). Validating the Polish version of the CSS, Bajcar, Babiak, and Olchowska-Kotala (2019) found a four-factor latent structure through eliminating mistrust of medical professionals with a robust correlation between composite scores on the CSS and health anxiety construct. In a German speaking normative adult population recruited online, the shortened 15-item CSS based on the long version was developed. The CSS-15 had five dimensions representing the latent factor structure of the original version, which revealed stronger associations with health anxiety relative to depression (Barke, Bleichhardt, Rief & Doering, 2016). Given the low correlations of “mistrust” scale of the CSS with other four facets of cyberchondria (Fergus, 2014), another psychometric study to develop a short form of the CSS removed this subscale and validated the CSS-12 that retained four factors of the original version, each scale consisting of three items. The general cyberchondria was moderately correlated with health anxiety and quite mildly correlated with generalized anxiety (McElroy, Kearney, Touhey, Evans, Cooke & Shevlin, 2019).

To date, the emerged evidence is that significant relationship between fear of COVID-19 and cyberchondria has been established in several studies (Durmuş, Deniz, Akbolat & Çimen, 2022; Jungmann & Witthöft, 2020; Wu, Nazari & Griffiths, 2021). Laato, Islam, Islam, and Whelan (2020) identified that perceived severity and perceived susceptibility of COVID-19 infection significantly contributed to cyberchondria after controlling for age and gender. In a 499 Polish community sample, Oniszczenko (2021) found that fear of COVID-19 was associated with cyberchondria and it also mediated the relationship between anxious temperament and cyberchondria. Durmuş *et al.* (2022) also revealed a substantial relationship between fear of COVID-19 and perceived distress which was mediated by cyberchondria. Given the more recent literature, the significant interaction between fear of COVID-19 and cyberchondria seem to be causally involved within the psychological problems during the pandemic.

## THE ROLE OF INTOLERANCE OF UNCERTAINTY AND PROBABILISTIC THINKING

The COVID-19 pandemic has brought out ambiguities in daily life experiences, which increased psychological distress as a function of individual differences in tolerance to uncertainty and probabilistic thinking style. Intolerance of uncertainty simply refers to a tendency of fear of the unknown. Individuals less likely to tolerate uncertainty might experience excessive feeling of distress and engage in safety behaviors (Carleton, 2016). These psychological mechanisms might presumably take place during COVID-19 pandemic. More recent studies presented significant contribution of intolerance of uncertainty on mental health that fear of COVID-19 mediated the relationship between intolerance of uncertainty and psychological well-being (Deniz, 2021; Satici, Saricali, *et al.*, 2020) and depression (Pak, Süsen, Denizci Nazlıgül & Griffiths, 2021; Voitsidis, Nikopoulou, Holeva *et al.*, 2021).

Internet searches for health-related information may sometimes result in erroneous perceptions that even innocuous signs of corporeal symptoms might be attributed to serious medical conditions, thereby leading to serious distress and sequential over-catastrophizing inferences (White & Horvitz, 2009). Scholars articulated that the search of medical information on the Internet can be best conceptualized from the view of safety behaviors or harm avoidance to gain reassurance (Baumgartner & Hartmann, 2011; Muse, McManus, Leung, Meghreblian & Williams, 2012). In a semi-structured interview survey of patients in a medical setting, the basic incentives for online review of information were uttered as a need for acknowledgement, gaining perspective and reduction of uncertainty as a function of a sense of self-responsibility and having opportunity to use the Internet (Caiata-Zufferey, Abraham, Sommerhalder & Schulz, 2010). However, online review of medical information may pose more ambiguity by means of the abundance of knowledge and presentation of the content instead of reassurance. The interaction between trustworthiness of health-related information and health anxiety was associated with negative consequences of health-rated information seeking. Individuals with health anxiety were more likely to get worried in response to information from a trustworthy website (Baumgartner & Hartmann, 2011).

Even though there is no consensus on the definition of intolerance of uncertainty (Carleton, 2012; Grenier, Barrette & Ladouceur, 2005), it may be defined as an inclination for an individual to consider in a way that the possibility of a negative event occurring as threatening, irrespective of the probability of its occurrence (Dugas & Robichaud, 2007). The construct was suggested to be best represented by cognitive appraisals about uncertainty that infers “prospective anxiety” and behavioral avoidance from uncertain situations that infers “inhibitory anxiety” (Carleton, 2012). Only a few studies have addressed the potential role of intolerance of uncertainty in relation to cyber safe seeking and reassurance seeking. In a community sample of healthy adults, scholars identified that the frequency of online medical searches was significantly associated with an increase in health anxiety insofar as these reviews lead to a decrease in one’s tolerance to a sense of uncertainty (Fergus, 2013). More specifically, after controlling for shared variances among anxiety

sensitivity dimensions, intolerance of uncertainty dimensions, and health anxiety, inhibitory intolerance of uncertainty and physical anxiety sensitivity were found to be significant associates of various dimensions of cyberchondria in a normative adult sample (Fergus, 2015). In a similar vein, anxiety sensitivity, health anxiety and inhibitory intolerance of uncertainty contributed to anxious arousal emerged from health-related online searches, particularly inhibitory intolerance of uncertainty was significantly associated with mistrust of medical professionals (Norr, Albanese, Oglesby, Allan & Schmidt, 2015). A more recent community survey of cyberchondria pointed out significant relationships with emotional stability; whereas, in the second study, the potential influence of the neuroticism dimension of the big-five personality construct fell short of significance after the covariates intolerance of uncertainty and defensive pessimism were evaluated along with personality, in which each covariate exerted a significant main effect on cyber health anxiety (Bajcar & Babiak, 2020).

Obsessional probabilistic thinking style refers to a disposition to make more negative inferences in relation to contamination, making errors, causing harm, and religious and sexual issues. The obsessional probabilistic thinking style as indexed by the Obsessional Probabilistic Inferences Scale was found to be associated with obsessive-compulsive symptoms, obsessional beliefs and depression among clinical samples compared to healthy controls (Gulec, Deveci, Besiroglu, Boysan, Kalafat & Oral, 2014). In a more recent structural equation study, Boysan, Yildirim and Ökmen (2022) identified that obsessional probabilistic thinking contributed to obsessive-compulsive symptoms and dissociation in which the relationships of obsessional thinking and dissociation with metacognitions were mediated by obsessional probabilistic thinking as well.

Given the associations of intolerance of uncertainty with OCD and other anxiety-related disorders (Gentes & Ruscio, 2011), probabilistic reasoning may be used as a maladaptive coping strategy to deal with the uncertainty rather than handling with doubt. Consistent with this premise, Wheaton, Messner, and Marks (2021) revealed that obsessive-compulsive symptoms increased the intolerance of uncertainty, which, in turn, lead to escalating the COVID-19 anxiety. Moreover, previous studies indicated that inflated estimates of threat probability are associated with intolerance of uncertainty (Dugas *et al.*, 2005; Peppardine, Lomax & Freeston, 2018). In a clinical investigation among individuals with anxiety disorders and non-anxious controls, Jacoby, Abramowitz, Buck and Fabricant (2014) used the Beads Task as a behavioral measure of uncertainty that induces probabilistic reasoning processes and found that uncertainty-induced probabilistic reasoning was significantly associated with draws to decision and heightened distress in the anxious group. Given the prevailing notion considering previous findings, it was speculated that individuals more prone to a tendency to obsessional probabilistic inferences might reveal less tolerance to uncertainty and more proneness to fear of COVID-19, which, in turn, lead to more severe cyberchondria.

## PRESENT STUDY

Health-related online information searches seem to be likely to engender health-related anxious arousal that, in turn, leads to

unduly compulsive Internet use, but this is not the case for all individuals. While approximately one-third of the individuals reported increased anxiety in response to online health information (Fergus & Dolan, 2014; White & Horvitz, 2009), respondents with no change in their anxious arousal during online searches were less prone to engage in problematic Internet use as compared to individuals who manifest relief (Fergus & Dolan, 2014). Recent studies about health-related information seeking indicated that increased anxious arousal is probably invoked by fear of infection that may underlie the maladaptive Internet use in terms of cyberchondria. For instance, perceived severity and perceived susceptibility of COVID-19 infection were significantly associated with cyberchondria after controlling for age and gender (Laato *et al.*, 2020). Increased anxiety for the disease and a sense of insecurity may push people towards compulsive checking of health-related online information which, in turn, escalates health anxiety (Jokic-Begic, Lauri Korajlija & Mikac, 2020; Maftei & Holman, 2020). In a more recent investigation by Bottesi, Marino, Vieno, Ghisi and Spada (2021), intolerance of uncertainty significantly contributed to both cyberchondria and problematic Internet use that, in turn, aggravated health anxiety and psychological distress. By this token, after controlling for age and gender, Satici, Saricali, *et al.* (2020) identified significant direct contribution of intolerance of uncertainty to fear of COVID-19, and the indirect linkage between these variables was mediated by rumination as well. In this vein, substantial direct relationship between intolerance of uncertainty and fear of COVID-19 was replicated by Deniz (2021) in which self-compassion was significantly associated with well-being of participants through both intolerance of uncertainty and fear of COVID-19. Accumulated evidence concerned with substantial relationships between cyberchondria, intolerance of uncertainty and fear of COVID-19 have emerged. However, although studies showed the potential influence of reasoning processes on obsessions and intolerance of uncertainty (e.g. Jacoby *et al.*, 2014; O'Connor, 2002), the associations among obsessional probabilistic thinking, cyberchondria, intolerance of uncertainty and fear of COVID-19 have not been explored. Given the extant literature, as depicted in Fig. 1, we speculated that probabilistic thinking as indexed by the Obsessional Probabilistic Inference Scale has both a direct contribution to fear of COVID-19 and an indirect contribution through intolerance of uncertainty. On the other hand, fear of COVID-19 would be associated with cyberchondria severity. The structural associations between the variables of interest were set out to be tested by using structural equation modeling.

## METHOD

### *Participants and procedure*

Participants were 1,049 community individuals recruited online in April 2020. Of the sample, 64.25% consisted of women ( $n = 674$ ), and the age of the participants ranged from 18 to 62 ( $Mean = 25.41$ ,  $SD = 7.54$ ). All participants were briefly informed about the purposes and procedures of the current investigation. Then written informed consent was taken online. The purposes and procedures of the study were granted approval from the local ethical committee of the university.

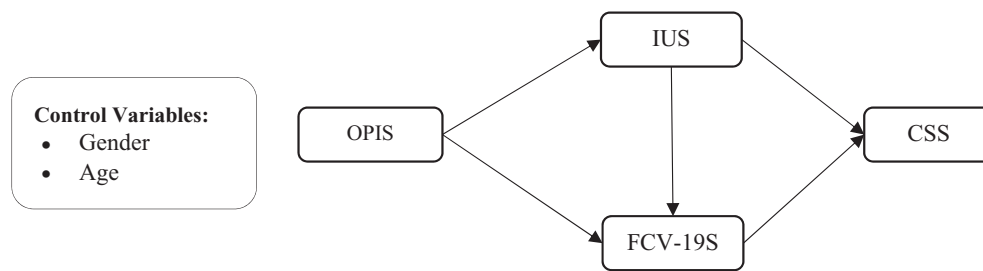


Fig. 1. Hypothesized structural model. OPIS = Obsessional Probabilistic Inference Scale, IUS = Intolerance of Uncertainty Scale, FCV-19S = Fears of COVID-19 Scale, CSS = Cyberchondria Severity Scale.

### Instruments

The Cyberchondria Severity Scale –Short Form (CSS-12), Fear of COVID-19 Scale (FCV-19S), Intolerance of Uncertainty Scale Short Form (IUS-12), and Obsessional Probabilistic Inferences Scale (OPIS) were administered in the current study.

**Cyberchondria severity scale–short form (CSS-12).** The CSS-12 is the shortened version of the CSS initially validated by McElroy and Shevlin (2014). The instrument consists of 12 self-report items, each is asked to the respondents to rate on a five-point scale. Additional to composite scores on the scale, the CSS-12 yields four subscales: Compulsion, Distress, Excessiveness and Reassurance. The higher the score, the higher the severity of cyberchondria (McElroy et al., 2019). The CSS-12 was adapted to Turkish by Yalçın, Boysan, Eşkişu, and Çam (2022) and yielded good validity and reliability with Cronbach's alphas ranging from 0.78 to 0.94. In the present study, The Turkish version of the CSS-12 was found to have high internal consistency with Cronbach's alphas ranging from 0.71 to 0.87.

**Fear of COVID-19 scale (FCV-19S).** We used the FCV-19S to explore a tendency to perceive higher risk of being infected with novel coronavirus. The scale is comprised of seven self-report items. Respondents are asked to rate their agreement with each statement on a five-point Likert type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The FCV-19S measures a unidimensional construct and the greater scores are reflective of greater levels of fear of COVID-19 (Ahorsu et al., 2020). The Turkish version of the FCV-19S, adapted by Satici, Gocet-Tekin, et al. (2021), had comparatively good psychometric properties with a Cronbach's alpha of 0.85. It also revealed good internal consistency for the present data with a Cronbach's alpha of 0.88.

**Intolerance of uncertainty scale short form (IUS-12).** The IUS-12 is a shortened version of the 27-item long version of the Intolerance of Uncertainty Scale (Freeston, Rhéaume, Letarte, Dugas & Ladouceur, 1994) developed to assess individual's responses to ambiguous situations. The IUS-12 consists of 12 self-report items rated on a five-point Likert type scale, ranging from 1 (not at all characteristics of me) to 5 (entirely characteristic of me). The IUS-12 yields two subscales of prospective anxiety and inhibitory anxiety (Carleton, Norton & Asmundson, 2007). The Turkish version of the IUS-12 had a Cronbach's alpha of 0.88 for the overall scale, 0.84 for prospective anxiety subscale and 0.77 for inhibitory anxiety subscale (Sarıçam, Erguvan, Akın & Akça, 2014). For the present data, Cronbach's alphas were excellent for the overall scale ( $\alpha = 0.89$ ), prospective anxiety subscale ( $\alpha = 0.79$ ) and inhibitory anxiety subscale ( $\alpha = 0.84$ ).

**Obsessional probabilistic inferences scale (OPIS).** The OPIS was developed by Gulec et al. (2014) to assess a tendency to over-estimate the probability of threats and harms. The OPIS is a 20-item self-report psychometric instrument. Respondents are asked to rate their probabilistic inference on each item, ranging from 0% to 100%. The summed item scores are averaged to obtain a composite score for the OPIS, and the higher scores represents the predisposition to engage a negative probabilistic reasoning process. The instrument was demonstrated to have good convergent validity and reliability with a Cronbach's alpha of 0.88

(Gulec et al., 2014). The current data also revealed good internal reliability with the Cronbach's alpha of 0.91.

### Statistical analysis

The statistical analyses consisted of: (1) descriptive statistics for the sample; and (2) confirmatory factor analysis for structural equation model of relationships between fear of COVID-19, cyberchondria, intolerance of uncertainty, and probabilistic inferences. The analysis was carried out using MPlus version 8.04 (Muthén & Muthén, 1998-2017). In the structural equation modeling, we used the items of the FCV-19S and the subscales of the CSS-12 and IUS-12 as observed indicators of respective latent variables. Following Russell, Kahn, Spoth and Altmaier's (1998) factor loading ranking procedure, we performed an exploratory factor analysis and formed four parcels for the OPIS. Based on the theoretical considerations we specified the relationships between the variables of interest. In addition adhering to model generating approach (Jöreskog, 1993) through model fit indices and modification indices, we specified additional parameters between error covariances. Maximum likelihood estimation with robust standard errors was used as the estimation method (Satorra & Bentler, 1994). The following goodness of fit indexes and thresholds were applied to the structural equation model being tested (Bentler, 1990; Bentler & Bonett, 1980; Hooper, Coughlan & Mullen, 2008; Hu & Bentler, 1999; Steiger, 1990; Wen, Hau & Herbert, 2004):  $\chi^2 / df$  [1; 4], root mean square error of approximation (RMSEA) [0.05; 0.08], standardized root mean square residual (SRMR) [0.05; 0.08], Tucker–Lewis index (TLI) [0.90;0.95], and comparative fit index (CFI) [0.90,0.95].

## RESULTS

The means, standard deviations, and Cronbach's alphas for the psychometric instruments and correlations between scale scores are presented in Table 1.

The structural model fit indices indicated that specified model fit the data: Satorra–Bentler  $\chi^2(137) = 540.051$ ,  $p < 0.0001$ ; RMSEA = 0.053  $p = 0.145$  (90% Confidence Interval = 0.048–0.058); CFI = 0.952; TLI = 0.940; and SRMR = 0.046.

In the structural model, age was positively associated with the FCV-19S ( $\beta = 0.115$ ,  $t = 3.810$ ,  $p < 0.001$ ) and inversely associated with the OPIS ( $\beta = -0.117$ ,  $t = -3.842$ ,  $p < 0.001$ ), IUS ( $\beta = -0.143$ ,  $t = -4.780$ ,  $p < 0.001$ ) and CSS ( $\beta = -0.064$ ,  $t = -2.240$ ,  $p = 0.025$ ). Being female was positively associated with the FCV-19S ( $\beta = 0.288$ ,  $t = 9.262$ ,  $p < 0.001$ ) and IUS ( $\beta = 0.177$ ,  $t = 5.971$ ,  $p < 0.001$ ). On the other hand, males were more prone to CSS ( $\beta = -0.081$ ,  $t = -2.488$ ,  $p = 0.013$ ).

Considering the associations between latent variables, the OPIS significantly contributed to IUS ( $\beta = 0.354$ ,  $t = 11.706$ ,  $p < 0.001$ ) and FCV-19S ( $\beta = 0.092$ ,  $t = 2.544$ ,  $p = 0.011$ ). IUS was correlated with FCV-19S ( $\beta = 0.306$ ,  $t = 8.255$ ,  $p < 0.001$ ).

Table 1. Descriptive statistics for the psychological instruments

	1	2	2.1	2.2	2.3	2.4	3	3.1	3.2	4	4.1	4.2	4.3	4.4
1. Fear of COVID-19 scale	-													
2. Cyberchondria severity scale	0.30**	-												
2.1 Compulsions	0.27**	0.73**	-											
2.2 Distress	0.32**	0.81**	0.61**	-										
2.3 Excessiveness	0.17**	0.77**	0.33**	0.45**	-									
2.4 Reassurance	0.17**	0.81**	0.35**	0.49**	0.76**	-								
3. Intolerance of uncertainty scale	0.33**	0.23**	0.20**	0.24**	0.15**	0.13**	-							
3.1. Prospective anxiety	0.30**	0.21**	0.18**	0.22**	0.15**	0.13**	0.95**	-						
3.2. Inhibitory Anxiety	0.32**	0.22**	0.21**	0.24**	0.14**	0.12**	0.93**	0.78**	-					
4. Obsessional probabilistic inference scale	0.16**	0.16**	0.19**	0.12**	0.11**	0.06*	0.31**	0.28**	0.31**	-				
4.1. OPIS 1	0.16**	0.12**	0.13**	0.09**	0.10**	0.07*	0.25**	0.22**	0.25**	0.87**	-			
4.2. OPIS 2	0.16**	0.20**	0.21**	0.16**	0.14**	0.10**	0.31**	0.28**	0.31**	0.82**	0.61**	-		
4.3. OPIS 3	0.16**	0.15**	0.21**	0.13**	0.08**	0.03	0.25**	0.21**	0.26**	0.82**	0.61**	0.60**	-	
4.4. OPIS 4	0.06	0.07*	0.12**	0.05	0.05	0.01	0.23**	0.21**	0.22**	0.80**	0.53**	0.56**	0.62**	-
Mean	18.56	31.62	5.71	8.01	9.90	9.50	39.67	23.78	15.90	28.10	31.88	30.90	24.83	23.18
Standard deviation	5.59	8.12	2.45	2.62	2.79	2.67	9.74	5.53	4.80	13.55	16.15	17.60	15.93	15.58
Cronbach's alpha	0.877	0.872	0.804	0.710	0.842	0.712	0.890	0.787	0.839	0.914	0.834	0.770	0.780	0.784

\* $p < 0.05$ ,

\*\* $p < 0.01$ .

Finally, FCV-19S was significantly linked to CSS ( $\beta = 0.405$ ,  $t = 10.672$ ,  $p < 0.001$ ).

Turning on to the indirect relationships, the OPIS significantly contributed to the FCV-19S through the IUS ( $\beta = 0.108$ ,  $t = 6.488$ ,  $p < 0.001$ ). The substantial indirect relationships between the OPIS and CSS were mediated by both the FCV-19S ( $\beta = 0.037$ ,  $t = 2.451$ ,  $p = 0.014$ ) and IUS ( $\beta = 0.044$ ,  $t = 5.372$ ,  $p < 0.001$ ). Lastly, the IUS contributed to the CSS through the FCV-19S ( $\beta = 0.124$ ,  $t = 6.394$ ,  $p < 0.001$ ). Findings are presented in Fig. 2.

DISCUSSION

In the current study, we sought to further our understanding of the associations between cyberchondria, fear of COVID-19, intolerance of uncertainty and a tendency to make negative probabilistic inferences. Results from the current research replicated and expanded the previous findings in the literature. Our main findings were that probabilistic thinking was a significant antecedent of both intolerance of uncertainty and fear of COVID-19, whereas fear of COVID-19 exacerbated the cyberchondria severity.

A factor analytic investigation of health-related information seeking as indexed by the CSS and health anxiety symptoms as indexed by the Short Health Anxiety Inventory supported the assertion that these two constructs represent distinct behavioral

patterns. The former was strongly associated with functional impairment; on the other hand, the latter was moderately linked to a significant decrease in quality of life (Mathes, Norr, Allan, Albanese & Schmidt, 2018). In a similar vein, a network analysis of cyberchondria symptoms in relation to health anxiety, obsessive-compulsive disorder, problematic internet use, anxiety, depression, and somatic symptoms showed that health-related online information enquiry that results in anxious arousal is a relatively exclusive psychological construct with distinct characteristics and interrelated symptoms (Starcevic, Baggio, Berle, Khazaal & Viswasam, 2019). An investigation into the meta-analytic linkages between cyberchondria and health anxiety in a sample of 20 relevant studies identified a medium sized positive relationship within these constructs which can be interpreted as experienced health anxiety may be one of the risk factors underlying cyberchondria to an extent; nevertheless, there should be more psychological mechanisms taking place in unduly online health-related information seeking (McMullan, Berle, Arnaez & Starcevic, 2019). Those individuals high in intolerance of uncertainty, particularly inhibitory anxiety were more likely to experience health-related anxious arousal and cyberchondria (Bajcar & Babiak, 2020; Fergus, 2013). Inhibitory anxiety was found to significantly contribute to escalation in online health-related inquiries that lead to increased distress after controlling for health anxiety (Fergus, 2015; Norr *et al.*, 2015). However, research showed that tentative influence of intolerance of

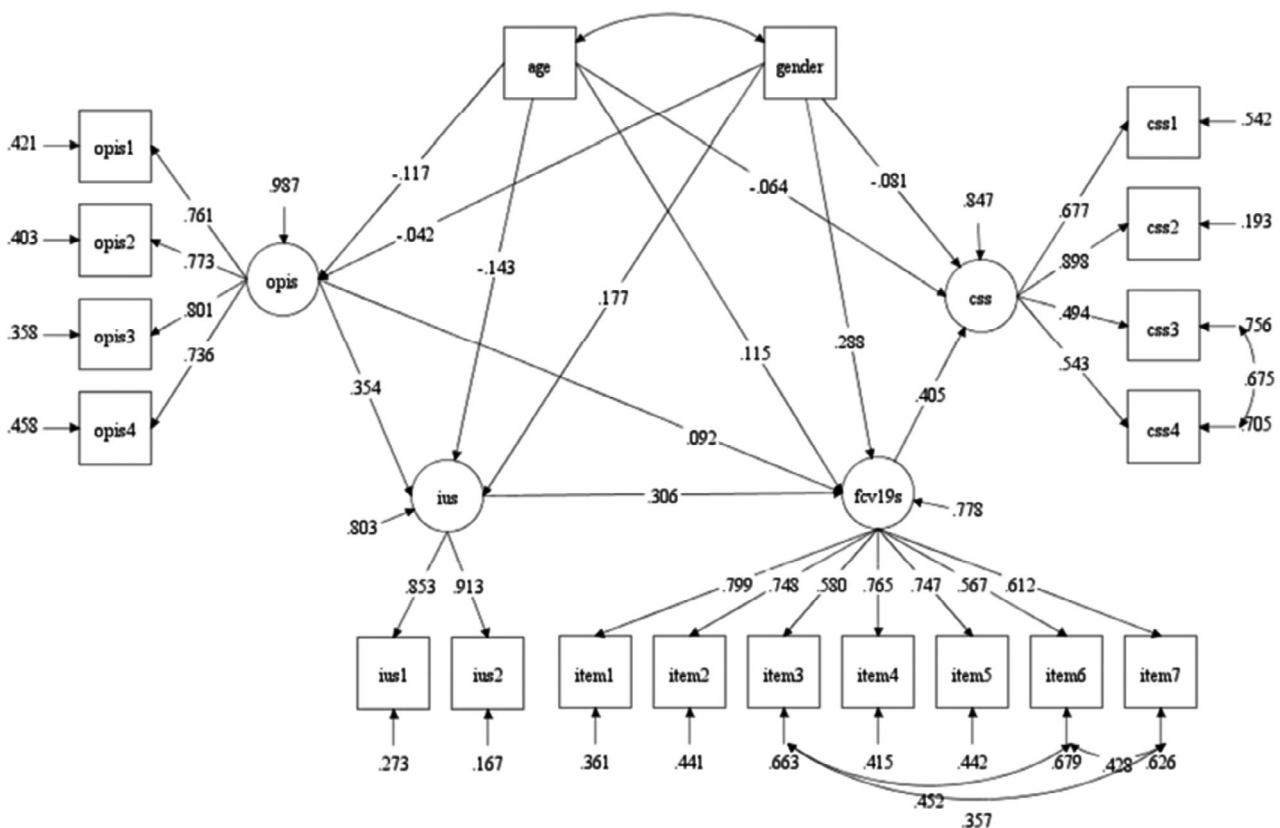


Fig. 2. Structural model of associations between cyberchondria, intolerance to uncertainty, probabilistic thinking, and fears of COVID-19. CSS = Cyberchondria Severity Scale, css1 = Compulsions, css2 = Distress, css3 = Excessiveness, css4 = Reassurance, IUS = Intolerance of Uncertainty Scale, ius1 = Prospective Anxiety, ius2 = Inhibitory Anxiety, OPIS = Obsessional Probabilistic Inference Scale, opis1 = Parcel 1, opis2 = Parcel 2, opis3 = Parcel 3, opis4 = Parcel 4, FCV-19S = Fears of COVID-19 Scale.

uncertainty on general cyberchondria fell short of significance after controlling for metacognitive beliefs (Fergus & Spada, 2017, 2018; Marino *et al.*, 2020). Moreover, at the time of the pandemic, research has indicated that fearful attributions related to COVID-19 infection was a significant predictor of health-related problematic Internet use (Laato *et al.*, 2020). Another investigation by Wu *et al.* (2021) in a sample of community participants showed that COVID-19-related fear and anxiety significantly contributed to cyberchondria as well as indirectly through intolerance of uncertainty. On the other hand, in a two-wave longitudinal investigation suggested that safety behaviors concerned with COVID-19 infection were induced by cyberchondria (Jokic-Begic *et al.*, 2020). Our findings are in line with previous data that fear of COVID-19 which was significantly induced by intolerance of uncertainty was significantly associated with increased cyberchondria severity. Additionally, a tendency to generate probabilities of threat and harm which results in development and maintenance of obsessive-compulsive disorder (Boysan *et al.*, 2022; Gulec *et al.*, 2014; O'Connor & Aardema, 2011) was significantly tied to intolerance of uncertainty and fear of COVID-19. Moreover, participants more prone to negativistic attributions in terms of obsessional probabilistic inferences reported higher scores on the CSS and IUS through increased fear of COVID-19 infection. These relationships should be interpreted with caution that the data were cross-sectional. More investigations with longitudinal research design should warrant these findings in the future.

#### Limitations and implications

Bearing in mind some limitations of the current study, the present data should be interpreted with caution. First and foremost, the use of a normative sample relatively limits the generalizability of the current data to patients with clinically severe psychopathology. Therefore, studies can be carried out to investigate how the negative effects of the COVID-19 pandemic are observed in people with psychological or psychiatric diagnoses and similar subgroups (OCD, panic disorder, etc.). In addition, the participants were recruited through online crowdsourcing that such an online population may particularly more receptive given the cyberchondria. Finally, given the cross-sectional research design of the present study, a longitudinal research design could have provided with more profound information about the causal relationships between the variables of interest. Notably, however, given the paucity of the data on potential influences of 2019-nCov breakout that has dominated worldwide health concerns, this investigation may be regarded as a preliminary contribution to further our understanding of health-related-fear peculiar to infection and general health anxiety in relation to escalated online health related inquiry, intolerance of uncertainty, and probabilistic inferences.

Our findings have critical clinical implications. Obsessional probabilistic inferences seem to be a transdiagnostic vulnerability factor that is robustly associated with intolerance to uncertainty, fear of COVID-19, and cyberchondria. These findings are particularly important in understanding determinants of mental health during the COVID-19 pandemic. That is, assessment and interventions concerned with negativistic reasoning processes

along with intolerance of uncertainty can be incorporated into mental health practices with respect to infection anxiety and cyberchondria.

Moreover, because of the uncertain nature of COVID-19, people perform online information-seeking behaviors more frequently and intensely to protect themselves from the disease (Du, Yang, King, Yang & Chi, 2020). A study carried out in China with a general sample revealed that 95.3% of the participants refer to the Internet as a source of information about COVID-19 (Wang *et al.*, 2020). Considering the cognitive behavioral nature of health anxiety, cyberchondria, and similar health-related concepts, and the fact that these conditions come out frequently during the process of COVID-19 pandemic, it can be inferred that the need for intervention programs became obvious. Cognitive Behavioral Therapy (CBT) intervention is an effective approach in reducing health anxiety in individuals. Moreover, it is possible for similar positive effects to occur when this intervention is carried out on the Internet. Newby, Mewton, Williams, and Andrews (2014) applied Internet-delivered cognitive behavioral treatment (iCBT) in ten-week online intervention study including six lessons with 16 participants meeting the DSM-5 Illness Anxiety Disorder or Somatic Symptom Disorder diagnostic criteria. The findings revealed that the intervention was effective in reducing health anxiety of the participants. In addition, a 12-week iCBT intervention program consisting of six lessons was implemented by Newby and McElroy (2020) with 45 participants who met the diagnostic criteria of Illness Anxiety Disorder (IAD) or Somatic Symptom Disorder (SSD) in DSM-V. This program was found to be effective in reducing the cyberchondria behaviors and health anxiety of the participants in the experimental group. For this reason, the iCBT approach can be used in intervention programs to be applied for anxiety, health anxiety, and cyberchondria behaviors brought about by the process of the COVID-19 pandemic and its uncertainties. The approach is effective in dealing with such problems, and it can also be considered as a useful and economical approach since it is applied online.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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