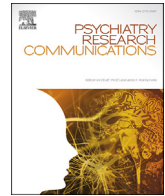


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The pathways from online health information seeking to cyberchondria: A perspective from moderated mediation

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ABSTRACT

This study explores a theoretical framework evaluating the antecedents of cyberchondria. In doing so, we not only examined perceived severity as an intervening factor through which online health information seeking (OHIS) may influence cyberchondria but also sought to trace moderators that serve as boundary conditions. To explore the proposed framework, we collected data via a survey. Data were analyzed using conditional process analysis through the regression-centric procedure. We observed that the association between OHIS and cyberchondria is mediated by perceived severity. In addition, neuroticism & beliefs about rituals serve as the first and second stage moderators in influencing the antecedents of cyberchondria. Thus, unlike previous studies which mostly focus on direct effects, in this research, we focus on the mediation, moderation, and moderated mediation effects for hypothesis testing. Therefore, this research broadens our view of the antecedents of cyberchondria from a more systematic standpoint.

1. Introduction

Using the internet, people can now easily access medical information. At present, most people (about 50%) in the U.K. search for online information about health topics (Prescott, 2016), and in the USA, it is more than 70% (HINTSS, 2019). An online search for health information has the potential to be cost-effective because of its easy accessibility. Moreover, people can search anonymously (Vismara et al., 2020). Despite these conveniences, online medical information seeking brings concerns like cyberchondria. Cyberchondria is defined as excessive or recurrent online health information seeking that is linked to greater degrees of health anxiety or discomfort over one's health (Starcevic, 2017). Cyberchondria incorporates time-consuming and repetitive online health information searches, unpleasant emotional states corresponding to online health exploration, and the disruption or negligence of other tasks as a result (McElroy and Shevlin, 2014). Aside from wasting time instead of doing productive activities, another negative consequence of cyberchondria is that the internet can also be used in self-diagnosis by users. Moreover, while searching for the keyword "cancer" on the internet, 47% of Google searches for symptoms result in individuals thinking they have cancer (Wooller, 2018). Furthermore, due to an increase in online health information searches and cyberchondria, health anxiety among US clinic

patients increased from 14.9% to 19.9% (Tyrrer et al., 2019). Thus, cyberchondria could be a significant public health threat because of the prevalent use of the internet and the probable detrimental impacts of examining health information online in an unmoderated environment (Mathes et al., 2018).

However, studies with respect to this grave issue are at a very early stage (Zheng et al., 2020). In addition, no studies have examined the link between online health information seeking (OHIS) and cyberchondria by simultaneous examination of a mediator like perceived severity and moderators like neuroticism & beliefs about rituals within the context of a holistic framework. We conceptualize online health information seeking (OHIS) as an active search for health information on the internet to meet health or wellbeing informational demands or goals (Boyce et al., 2022; Niederdeppe et al., 2007). On the other hand, perceived severity is an individual's assessment of the severity of the event in terms of personal health effects. (Ling et al., 2019). Because of the vagueness of online health information, problems in sifting, evaluating, and obtaining precise information are crucial anxiety-intensifying aspects (Boyce et al., 2022). As such, the greater the propensity of online health information seeking, the more severe the user's perspective of the situation. Neuroticism is the tendency of individuals to experience negative emotions, including emotional lability, impulsiveness, anger, and anxiety (Bajcar and

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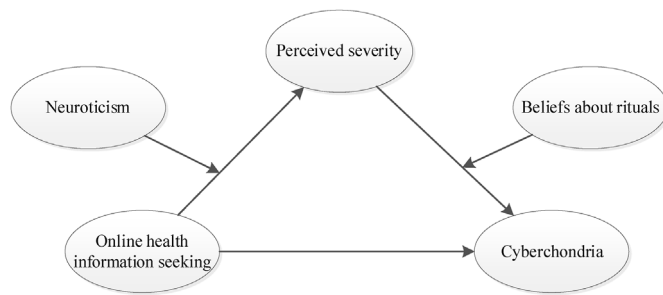


Fig. 1. Theoretical framework.

Babiak, 2020). The proclivity of neuroticism to emotional stress responses develops maladaptive manners like being sensitive to threats, stress, and impulsive behaviors (Bajcar and Babiak, 2020; Allen and DeYoung, 2017). From the perspective of cyberchondria, an individual's tendency to consider the repeated urge to seek online health information as part of regular formalities is coined as beliefs about rituals (Fergus and Spada, 2018). The 'self-regulatory executive function' or (S-REF) model serves as the origin of the disorder-centric viewpoint of obsessive-compulsive disorder (OCD), which was developed by Wells (2002). Self-understanding regarding coping, according to the S-REF model, leads to self-governing attempts that eventually perpetuate and increase emotion-centric suffering. Persons with OCD have beliefs about rituals that shed light on the significance of managing feelings and sensitive conditions (for example, anxiety). Accordingly, beliefs about rituals represent an approach to dealing with unpleasant inner thoughts (Fergus and Spada, 2018).

Understanding how and to what extent OHIS influences online health information seekers' behaviors will provide healthcare professionals the capability to advance the perspective to curb cyberchondria. As such, a nuanced insight is necessary for academics and healthcare professionals. For this reason, in our research, we examine the following research questions: 1) Does perceived severity mediate the relation between OHIS and cyberchondria? and 2) How do neuroticism and beliefs about rituals moderate the associations among OHIS, perceived severity, and cyberchondria? To address these questions, our research has a specific objective to initiate an integrated and holistic theoretical perspective by examining the antecedents of cyberchondria (see Fig. 1). To do so, we are going to examine the following hypotheses:

- H1.** Perceived severity mediates the association between online health information seeking and cyberchondria.
- H2.** Neuroticism positively moderates the effect of online health information seeking on perceived severity.
- H3.** Neuroticism positively moderates online health information seeking's indirect effect on cyberchondria mediated by perceived severity such that online health information seeking's indirect effect will vary depending upon neuroticism (moderated mediation).
- H4.** Beliefs about rituals positively moderate the effect of perceived severity on cyberchondria.
- H5.** Beliefs about rituals positively moderate online health information seeking's effect on cyberchondria mediated by perceived severity, such that online health information seeking's indirect effect will vary depending upon beliefs about rituals (moderated mediation).
- H6.** The indirect effect of online health information seeking on cyberchondria depends on the positive moderating effects of both neuroticism and beliefs about rituals at the first and second stage respectively (dual stage moderated moderated mediation).

2. Methods

2.1. Sample and data collection

A survey instrument was developed from extant studies to measure the focal constructs. We collected the data from Amazon Mechanical Turk (MTurk) by posting an online survey link to recruit participants from the USA. At α error probability of 0.05, at least 124 observations were necessary to achieve a power of 0.80 and an effect size of 0.10, (Soper, 2022). Thus, the collected sample of 533 from the MTurk tops the minimum sample size requirement. The demographic outline of the survey respondents is given in Appendix A.

To deal with the common method bias, we told the survey participants that their responses are anonymous. We also informed them that there were no wrong or right answers. Moreover, we asked the participants to address the questions fairly (Podsakoff et al., 2003). We included the demographic questionnaire that needs little cognitive effort at the very end of the survey instrument to avert monotony (Lindell and Whitney, 2001). From the statistical standpoint, the commonly used techniques such as the unmeasured latent marker variable approach and Harman's single component test have limitations in terms of statistical approaches (Chin et al., 2012). Hence, following the approach adopted in Boyce et al. (2022), Moqbel and Kock (2018), Ahmed et al. (2020), and many more studies, a conservative method endorsed by Kock (2015) was used. Common method bias was ruled out because the variance inflation factor was less than 2.5.

2.2. Measures

Online health information seeking was evaluated by adapting the items from Niederdeppe et al. (2007) and Dillard et al. (2021). The items measured the propensity of the respondents to search eagerly and to what extent they out the way on the internet to find health information. Higher scores indicate higher online health information seeking propensity. Cronbach's α for this scale was 0.74.

Cyberchondria was evaluated using the scale developed by Jokić-Begić et al. (2019). Items were rated from 1 (completely disagree) to 5 (completely agree). The relevant items were measured with respect to evaluating confusion, distress, frustration, etc. Higher scores indicate more severe cyberchondria. Cronbach's α for this scale was 0.92.

Neuroticism was evaluated by adapting the items from Duffy, M (2006) & Ong et al. (2006) within the context of cyberchondria. The relevant items were then used to measure the level of nervousness, tense state, insecurity, and discontent state of the respondents. Higher scores indicate a higher degree of neuroticism. Cronbach's α for this scale was 0.87.

The scale introduced by Fergus and Spada (2018) was used to measure beliefs about rituals. The relevant items were then measured with respect to evaluating peace of mind, losing control of thoughts, always feeling bad, etc. Higher scores indicate higher degree of beliefs about rituals. Cronbach's α for this scale was 0.92.

We measured perceived severity by adapting the items from Laato et al. (2020); Ling et al. (2019). Relevant items measuring symptom severity, seriousness, and significance were used. Higher scores indicate higher perception of the severity situation. Cronbach's α for this scale was 0.87.

The description indices (i.e., M and SD) along with the correlation results of these variables are shown in Appendix B.

3. Results

Because all the hypotheses consisted of moderation and mediation exploration, we used the Hayes PROCESS (Hayes, 2022). As the

Table 1
Hypothesis 1 evaluation (PROCESS model 4).

	Path	Effect	Bootstrapped SE	Bootstrapped C.I.
Online health information seeking - > Perceived severity	a	0.2493	0.0421	[0.1799, 0.3187]
Perceived severity - > Cyberchondria	b	0.6629	0.0321	[0.6100, 0.7158]
Mediated effect: (Online health information seeking - > Perceived severity - > Cyberchondria)	ab	0.1652	0.0310	[0.1156, 0.2171]
Direct effect: Online health information seeking - > Cyberchondria	c'	0.1075	0.0321	[0.0546, 0.1605]

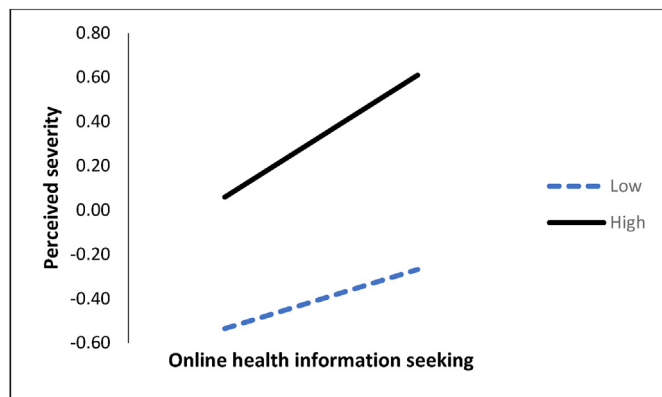


Fig. 2a. Moderating effect of neuroticism
Note: The scale and origin of perceived severity are arbitrary as composite latent score derived from SEM was used.

Table 2
Hypotheses 2 and 3 evaluations (PROCESS Model 7).

Variables	Effect	Standard error	C.I.
<i>Mediator - Perceived severity</i>			
Predictor: Online health information seeking	0.2360	0.0395	[0.1709, 0.3012]
Moderator: Neuroticism	0.3292	0.0404	[0.2626, 0.3958]
Interaction: Online health information seeking x Neuroticism	0.0713	0.0376	[0.0093, 0.1333]
Gender (control)	0.0148	0.0803	[-0.1174, 0.1471]
<i>Outcome - Cyberchondria</i>			
Predictor: Online health information seeking	0.1075	0.0321	[0.0546, 0.1605]
Mediator: Perceived severity	0.6629	0.0321	[0.6100, 0.7158]
Gender (control)	-0.0915	0.0633	[-0.1957, 0.0127]
Moderator level	Indirect effect	Bootstrapped SE	Bootstrapped C.I.
Low neuroticism	0.1009	0.0456	[0.0285, 0.1790]
High neuroticism	0.2081	0.0390	[0.1467, 0.2738]

hypotheses examined in our study are directional by nature, as per the advice of Cho and Abe (2013), we resorted to a one-tail evaluation along with a 90% confidence interval so that the resulting bounds (both upper and lower) represent one-sided 95% CI. For analysis purposes, gender

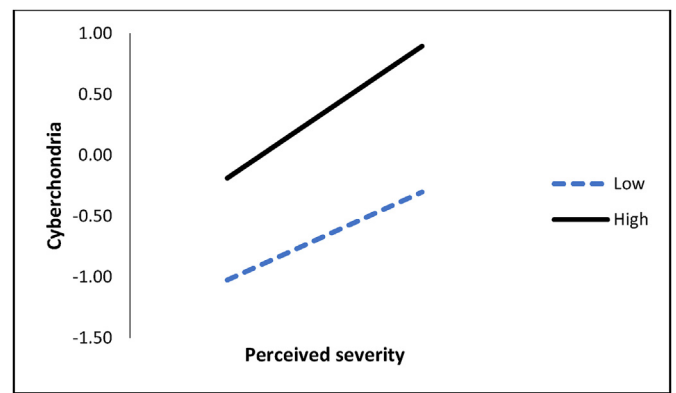


Fig. 2b. Moderating effect of beliefs about rituals
Note: The scale and origin of cyberchondria are arbitrary as composite latent score derived from SEM was used.

was included as a covariate. At first, we explored perceived severity's mediating behavior between online health information seeking (OHIS) and cyberchondria by the PROCESS Macro's model 4 (Hayes, 2022). Following the guideline of Hayes (2022), a bootstrap model consisting of 5000 observations were created. The overall indirect effect of OHIS on cyberchondria through perceived severity was significant (Table 1). Therefore, supporting H1, perceived severity mediates the relation between OHIS and cyberchondria. Afterward, PROCESS Model 7 (Hayes, 2022) was used to evaluate neuroticism's moderating roles (Hypothesis 2 & 3). The findings corroborated that there is an interactive effect of OHIS and neuroticism (0.0713, CI = 0.0093, 0.1333) on perceived severity, corroborating hypothesis 2. Therefore, neuroticism moderates OHIS's impact positively on perceived severity. OHIS's impact on perceived severity at different levels of neuroticism has been displayed in Fig. 2a. We see that when neuroticism is high compared to when it is low, OHIS has a larger effect. Spotlight analysis (Hayes, 2022) was used to probe the interaction. Moderator levels were set at a high (84th) percentile and low (16th) percentile of the moderator. Spotlight analysis shows that when neuroticism is low, OHIS's influence on perceived severity is significant (0.1522; CI = 0.0588, 0.2457). In addition, the conditional effect of OHIS on perceived severity is statistically substantial and positive as well (0.3139; CI = 0.2160, 0.4118) when neuroticism is higher. Therefore, the effect of online health information seeking (OHIS) on perceived severity rises as neuroticism rises.

Subsequently, we examined OHIS's conditional indirect effects on cyberchondria. OHIS's indirect bootstrapped effects were computed via PROCESS model 7, at various levels of neuroticism. The indirect influence of OHIS on cyberchondria through perceived severity is substantial and positive (Table 2) when neuroticism is small. Moreover, in the case of neuroticism being high, OHIS forms an effect on cyberchondria via perceived severity. Therefore, when neuroticism varies from low to high, OHIS's indirect effect on cyberchondria exacerbates. Hence, H3 is supported. Thus, the findings validate a conditional process such that influence of online health information seeking (OHIS) on cyberchondria via perceived severity varies depending upon neuroticism.

Next, PROCESS Model 14 (Hayes, 2022) was used to evaluate beliefs about rituals' moderating effect. The findings corroborated the interactive outcome of perceived severity and beliefs about rituals (0.0750, CI = 0.0317, 0.1183) on cyberchondria, therefore validating H4. As expected, beliefs about rituals influence the relation between perceived severity and cyberchondria in a positive way. From Fig. 2b, we see positive relations between perceived severity and cyberchondria at beliefs about rituals' both low and high degrees are present. However, if degree of beliefs about rituals is high compared to when it is low, perceived severity has a greater effect. (Fig. 2b). Afterward, for the purpose of probing conditional effects of perceived severity at beliefs about rituals' various values, a spotlight analysis was done. Beliefs about rituals were

Table 3
Hypotheses 4 and 5 evaluations (PROCESS Model 14).

Variables	Effect	Standard error	C.I.
<i>Mediator - Perceived severity</i>			
Predictor: Online health information seeking	0.2493	0.0421	[0.1799, 0.3187]
Gender (control)	-0.0564	0.0856	[-0.1973, 0.0846]
<i>Outcome - Cyberchondria</i>			
Predictor: Online health information seeking	0.0194	0.0284	[-0.0274, 0.0662]
Mediator: Perceived severity	0.4151	0.0364	[0.3550, 0.4751]
Moderator: Beliefs about rituals	0.4793	0.0356	[0.4207, 0.5380]
Interaction: Perceived severity x Beliefs about rituals	0.0750	0.0263	[0.0317, 0.1183]
Gender (control)	0.0486	0.0554	[-0.0426, 0.1398]
<i>Moderator level</i>	<i>Indirect effect</i>	<i>Bootstrapped SE</i>	<i>Bootstrapped C.I.</i>
Low beliefs about rituals	0.0812	0.0193	[0.0532, 0.1173]
High beliefs about rituals	0.1219	0.0268	[0.0821, 0.1705]

conditioned at a high (84th) percentile and low (16th) percentile. Analysis reveals that beliefs about rituals' effect on cyberchondria is significant (0.3260; CI = 0.2606, 0.3913) if the degree of beliefs about rituals is low. In addition, in the case of beliefs about rituals being high, perceived severity's conditional effect on cyberchondria is positively significant (0.4890; CI = 0.4049, 0.5730) as well. Thus, we see a positive effect of perceived severity on cyberchondria at both levels of beliefs about rituals. However, the conditional effect is higher in the case of beliefs about rituals being greater.

To corroborate hypothesis 5, OHIS's conditional indirect effects on cyberchondria were evaluated via Process model 14. From Table 3, we see that at a low level of beliefs about rituals, indirect influence of OHIS on cyberchondria through perceived severity is significant. Moreover, in the case of beliefs about rituals being greater, indirect influence of OHIS perception on cyberchondria via perceived severity is significant as well. Therefore, when the degree of beliefs about rituals varies from low to high, OHIS's indirect effect on cyberchondria intensifies. Hence, H5 is supported. Taken together, we find support for the assertion that online health information seeking's (OHIS) indirect effect on cyberchondria is moderated by beliefs about rituals.

Finally, PROCESS Model 21 using 5000 bootstrap samples was used to examine the dual stage conditional process (H6). We found significant interaction between OHIS and neuroticism in predicting perceived severity (0.0713, CI = 0.0093, 0.1333). We also found that as far as predicting cyberchondria is concerned, perceived severity and beliefs

about rituals interact significantly (0.0750, CI = 0.0317, 0.1183), providing support for interaction effects at both stages in the hypothesized underlying paths (Table 4). Therefore, varying degree of indirect effects depending upon the two moderators is observed.

4. Discussion

This research contributes to the existing cyberchondria literature in various ways. First, this study shows OHIS's influence on cyberchondria through perceived severity. Consequently, this study complements the current literature by revealing a significant connection between OHIS and cyberchondria via the evaluation of perceived severity as a mediator. Perceived severity's mediating influence conveys the notion that to study cyberchondria, it is necessary to consider perceived severity as a validating point. Thus, it would be very unwise of health professionals to consider that monitoring OHIS only is adequate to curb propensity of cyberchondria. Also, it appears that individuals with high neuroticism are more prone to be vulnerable to excessive OHIS. Such individuals experience higher stages of perceived severity and get entangled in cyberchondria. As a result, the results are unique in emphasizing the significance of neuroticism in determining whether excessive OHIS establishes itself in a higher degree of perceived severity. This chain of events, as previously pointed out, unfortunately, results in the unwanted outcome of cyberchondria. This study also acknowledged beliefs about rituals as a factor that moderates the strength of the indirect effect of OHIS on cyberchondria. This study is the initial effort in the cyberchondria domain to examine the beliefs about rituals' conditional moderating effect. This study conveys the notion that while encountering excessive OHIS tendency, an individual has the possibility of being affected by beliefs about rituals, thus worsening the situation. This study pinpoints that while being influenced by beliefs about rituals, an individual tends to construe the online health information seeking pattern via optimistic association; therefore, deteriorating the situation with respect to cyberchondria. Finally, this research supports the overall dual stage moderated mediation conditional indirect effects model. Our results suggest that the mediation chain between OHIS and cyberchondria is moderated by neuroticism at the first stage & by beliefs about rituals at the second stage. These findings have important implications for curbing cyberchondria. The theoretical framework developed in this study provides a foundation pointing to the requirement to concentrate on these aspects while developing an effective approach to influence an individual's mind in an optimistic way. As far as strategy is concerned, it is not viable to be effective when appropriate aspects are considered disjointedly rather than encompassing these in an incorporated context like ours that we have formed in this study. Therefore, this study responds to the call of Marino et al. (2020) by responding to the examination of the mechanics that form the antecedents of cyberchondria.

There are a few limitations to this study. First, using a cross-sectional, self-report approach limits the current findings. Future studies employing

Table 4
Hypothesis 6 evaluation (PROCESS Model 21).

Variables	First stage (DV: Perceived severity)			Second stage (DV: Cyberchondria)		
	Effect	SE	C.I.	Effect	SE	C.I.
Constant	-0.0247	0.1201	[-0.2225, 0.1732]	~		
Online health information seeking	0.2360	0.0395	[0.1709, 0.3012]			
Neuroticism	0.3292	0.0404	[0.2626, 0.3958]			
Online health information seeking x Neuroticism	0.0713	0.0376	[0.0093, 0.1333]			
Constant		~		-0.1157	0.0838	[-0.2538, 0.0225]
Online health information seeking				0.0194	0.0284	[-0.0274, 0.0662]
Perceived severity				0.4151	0.0364	[0.3550, 0.4751]
Beliefs about rituals				0.4793	0.0356	[0.4207, 0.5380]
Perceived severity x Beliefs about rituals				0.0750	0.0263	[0.0317, 0.1183]
Gender (control)	0.0148	0.0803	[-0.1174, 0.1471]	0.0486	0.0554	[-0.0426, 0.1398]
Model R square	0.1858			0.6247		

experimental and longitudinal study methodologies will help determine the causal framework with respect to cyberchondria. Moreover, although the study sample was more typical of the overall population of the United States, MTurk samples are younger and more educated than the average population of the United States (Chandler and Shapiro, 2016). Future research can thoroughly explore the effects of personality traits on societal characteristics and socio-demographics (for example, ethnicity and gender). In addition, future studies could take a more comprehensive approach to examine the effects of defensive pessimism, information overload, and self-esteem to gain a deeper understanding. Last but not least, through the lens of Hofstede's cultural norms, we should think about whether our research framework is appropriate in different cultures.

Author statement

RA is the project leader and contributed to the conceptualization, data collection, analysis, and manuscript writing. GP and VP assisted in the development and design of the study as well as in editing the manuscript. All authors provided feedback and final approval of the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.psychom.2022.100069>.

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