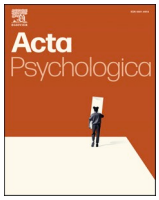
Acta Psychologica 238 (2023) 103946

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy



# The mediating role of rumination between stress appraisal and cyberchondria

Agata Błachnio [a,*], Aneta Przepiórka [a], Paweł Kot [a], Andrzej Cudo [a], Eoin McElroy [b]

[a] The John Paul II Catholic University of Lublin, Poland
[b] Ulster University, UK

ARTICLE INFO

*Keywords:*
Cyberchondria
Stress appraisal
Rumination

ABSTRACT

Cyberchondria, defined as excessive concern about one's health and looking for solutions to health problems on the Internet, is becoming increasingly common. This paper examines the relations between the dimensions of stress appraisal (threat, challenge-activity, challenge-passivity, harm/loss) and cyberchondria. We also tested whether these relations were mediated by rumination. The study included a nonclinical sample of $N = 615$ participants aged 18 to 83 years ($M = 43.86$, $SD = 14.57$, 53 % women), who completed the short version of the Cyberchondria Severity Scale, the Rumination Scale, and the Stress Appraisal Questionnaire. We used the Computer-Assisted Web Interview (CAWI) method. The results revealed that rumination was a partial mediator between stress as a threat and cyberchondria and between stress as a harm/loss and cyberchondria. Cyberchondria was positively related to rumination, stress as a threat, and stress as a harm/loss and negatively related to the challenge-activity dimension of stress appraisal. The study indicates that stress appraisal is linked to cyberchondria and that rumination plays an important role in this relationship.

## 1. Introduction

As a result of technological developments enabling its mass and low-cost use, the Internet has become the primary source of information about health (Aulia, Marchira, Supriyanto, & Pratiti, 2020; White & Horvitz, 2009), with studies in various countries showing that 40 % to 72 % of Internet users seek health information online (e.g., Fergus & Spada, 2017; Manganello et al., 2017; Marino et al., 2020; McElroy et al., 2019; Starcevic, Baggio, Berle, Khazaal, & Viswasam, 2019). Access to health information can have undeniably positive effects, such as higher awareness of the signs and symptoms of disorders and better knowledge of positive (preventive) health behaviors (Manganello et al., 2017; McElroy et al., 2019). The importance of the Internet is particularly pronounced in situations when access to medical services becomes difficult due to high costs, understaffing, and long waiting times (which many have experienced recently during the COVID-19 pandemic; Jungmann & Witthöft, 2020).

However, self-diagnosis based on information available online can be problematic (McElroy & Shevlin, 2014; Menon, Kar, Tripathi, Nebhinani, & Varadharajan, 2020). Numerous diseases have similar symptoms, which means online self-diagnosis can be unreliable (Starcevic & Aboujaoude, 2015). By suggesting serious diseases, erroneous self-diagnosis can intensify fears and anxiety even in healthy people with only minor symptoms (White & Horvitz, 2009). Another problem is that, when relying exclusively on information found online, individuals may ignore significant symptoms of a disease or choose ineffective methods of self-treatment (Doherty-Torstrick, Walton, & Fallon, 2016). This may lead them to delay consulting trained medical professionals or question the correct diagnosis and treatment, which in turn may seriously threaten their health (Vismara et al., 2020).

Easy access to health information can lead to excessive focus on one's health and give rise to negative interpretations and concerns about the somatic and mental symptoms coming from one's organism (Doherty-Torstrick et al., 2016). Cyberchondria, which relates to concern about one's health (Starcevic & Aboujaoude, 2015), is becoming an increasingly frequent subject of research. In the literature, cyberchondria is defined as a tendency to experience intense anxiety about one's health and to excessively engage in searching for medical information about symptoms and ailments online. It can take a dispositional form (McElroy & Shevlin, 2014; Starcevic & Aboujaoude, 2015). People affected by this syndrome are afraid that they have contracted or developed a (serious) disease, which is why they intensely search the Internet to learn about

* Corresponding author at: Institute of Psychology, The John Paul II Catholic University of Lublin, Poland, Al. Racławickie 14, 20-950 Lublin, Poland.
*E-mail address:* gatta@kul.pl (A. Błachnio).

https://doi.org/10.1016/j.actpsy.2023.103946
Received 15 March 2022; Received in revised form 18 May 2023; Accepted 19 May 2023
Available online 25 July 2023

the symptoms they believe they have (Newby & McElroy, 2019). Although looking for health information is aimed at reducing tension and anxiety, it can, paradoxically, have the opposite effect (McMullan, Berle, Arnáez, & Starcevic, 2019). Two aspects of cyberchondria can be distinguished: behavioral and emotional (McElroy et al., 2019). The behavioral aspect refers to compulsively searching for health information online—an activity that lasts for a long time or recurs in a person's life. The emotional aspect of cyberchondria is the anxiety or fear caused by the systematic and excessive use of Internet sources to obtain information about one's health and potential diseases.

### 1.1. Stress appraisal and cyberchondria

Although cyberchondria is an area of intense inquiry, the mechanisms underlying this complex emotional and behavioral phenomenon have not been adequately understood (Bailer et al., 2016; Fergus & Russell, 2016; Schenkel, Jungmann, Gropalis, & Witthöft, 2021; Starcevic, Berle, & Arnáez, 2020; Vismara et al., 2020). According to Lazarus and Folkman (1984), emotions and behaviors in response to stressful situations are largely shaped by the way individuals appraise the stress they experience. Stress appraisal depends on personal and situational factors (Włodarczyk & Wrześniewski, 2010). It is theorized in terms of four dimensions: (1) threat, meaning the potential losses one may suffer; (2) harm/loss, namely the harm and losses that one has suffered; (3) challenge-activity, referring to the possibility of coping with a difficult situation and gaining something—and, finally, (4) challenge-passivity, a source of positive changes and an important element initiating action (the behavioral aspect), which consists in perceiving the possibility of changes, but without the activation component (the emotional aspect; see Lazarus, DeLongis, Folkman, & Gruen, 1985; Włodarczyk & Wrześniewski, 2010; Bailer et al., 2016; Jamieson, Hangen, Lee, & Yeager, 2018). Challenge-activity and challenge-passivity appraisals were found to be negatively associated with trait anxiety, while stress appraised as a loss/harm and stress appraised as a threat were positively associated with trait anxiety. Cyberchondria is a type of domain-specific anxiety—namely, health anxiety (McMullan et al., 2019).

Situations perceived as exceeding the capabilities of one's body induce stress (Lazarus & Folkman, 1984). Having or suspecting a disease is precisely this kind of situation (Holmes & Rahe, 1967). Health anxiety is the reason for seeking health information, also on the Internet (Doherty-Torstrick et al., 2016). Stress contributes to the etiology of numerous and various types of diseases and disorders, which is why people experiencing higher levels of daily stress may indeed more often experience symptoms suggesting a worse health condition (e.g., Aneshensel, Rutter, & Lachenbruch, 1991; Cooper, 2005; Holmes & Rahe, 1967; Jamieson et al., 2018). As a result, they may look for health information online and devote increasing amounts of time to this activity (McElroy et al., 2019). However, as studies show (McElroy & Shevlin, 2014; McManus, Leung, Muse, & Williams, 2014; Starcevic, 2017; Jungmann & Witthöft, 2020), excessive use of the Internet for self-diagnosing purposes not only fails to reduce stress but can actually intensify it. The studies mentioned above show a positive relationship between stress and cyberchondria. In other words, higher stress is related to more frequent searching for health information on the Internet.

### 1.2. Rumination and cyberchondria

According to Nolen-Hoeksema (2000), rumination consists in a passive and repetitive focus on one's negative emotions and in dwelling on their causes and consequences rather than trying to change them. The negative affect underlying rumination increases the availability of negative content to the person's consciousness, although this content does not necessarily correspond to their current situation (Nolen-Hoeksema, 1996). Consequently, depressed mood intensifies (Lyubomirsky & Tkach, 2003). Rumination takes the form of obsessive thoughts, a syndrome whose mild version is experienced by almost everyone in everyday life and whose severe version affects some people only; it is a significant symptom of various mental disorders (Hoyer, Gloster, & Herzberg, 2009; McEvoy, Mahoney, & Moulds, 2010; McIntosh & Martin, 1992; Pyszczynski & Greenberg, 1987). Recurring self-critical and self-judging thoughts can become a permanent way of reacting to events, with the individual focusing on negative emotions instead of attempting to change the situation (Smith & Alloy, 2009). Being negative, judgmental, inflexible, irrelevant, unwanted, and recurrent, rumination consumes a large proportion of mental resources. As a result, it hinders solving problems, forming accurate opinions, and making interpersonal evaluations (Hoyer et al., 2009; McIntosh & Martin, 1992). Rumination may concern both the social world and the self (Watkins, 2004). Previous studies found that rumination had a direct effect on smartphone use and smartphone coping (Khoo & Yang, 2021) and was related to problematic Facebook use (Dempsey, O'Brien, Tiamiyu, & Elhai, 2019), which shows its connection with new media use. A high level of negative emotions is considered to be a risk factor for addictions (Griffiths, 2000). Individuals experiencing cyberchondria show a preoccupation with the possibility of developing a serious disease, ruminate on doubts about their health, and engage in compulsive activities to verify these doubts (Fergus & Russell, 2016). This is accompanied by intense negative emotions stemming from concern about health (Bati, Mandiracioglu, Govsa, & Çam, 2018; Muse, McManus, Leung, Meghreblian, & Williams, 2012). Rumination may focus not only on symptoms experienced in the past or on the current health condition but also on negative predictions concerning one's future, including the risk of developing a disease (Sansom-Daly, Bryant, Cohn, & Wakefield, 2014). Health-related rumination is unlikely to be subject to volitional control (Nolen-Hoeksema, 1996). Consequently, mental life is often dominated by constantly recurring ruminative content (Nolen-Hoeksema, 1991), which forces an exaggerated focus on one's health condition and leads to seeking information about it (Gratz & Roemer, 2004). Searching for medical information online is meant to bring temporary relief from recurring thoughts and negative emotions (Fergus & Russell, 2016). As in the case of obsessive–compulsive disorders, emotional balance is briefly restored, but after a while there is a renewed increase in focus on health condition, and the related negative emotional states set in again (Norr et al., 2015).

## 2. The present study

The main aim of the present study was to examine the mediating role of rumination between stress appraisal and cyberchondria (Fig. 1). We approached rumination as a personality trait defined on a continuum from a tendency towards rapid dissipation and weak rumination to a tendency towards slow dissipation and maximum rumination (Caprara, 1986). In regard to stress appraisal, we explored four dimensions: threat, challenge-activity, challenge-passivity, and harm/loss (Włodarczyk & Wrześniewski, 2010). Based on the literature and previous results, we formulated the following hypothesis (H1): Rumination is a mediator between stress appraisal and cyberchondria. Research on rumination (Rosenbaum et al., 2021; Xu, Feng, Tang, & Yang, 2022) reveals that people differ in their tendency to repetitively focus on their difficult situation when experiencing stressful events, and concern about one's

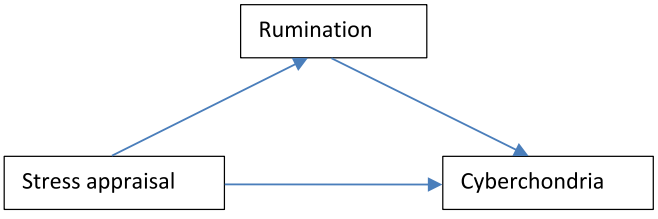



**Fig. 1.** Model of relations between stress appraisal and cyberchondria.

health definitely is a difficult situation (Aneshensel et al., 1991; Gratz & Roemer, 2004). Excessive focus on and prolonged thinking about difficult or threatening situations, characteristic of rumination, intensify the experience of stress and disproportionately strengthen the stress response even to minor stressors (von Hippel, Kalokerinos, Haanterä, & Zacher, 2019; Xu et al., 2022). This indicates a significant relationship between stress and rumination. Therefore, our hypothesis postulated not only a simple correlational relationship between stress appraisal and rumination but also a mediated one between stress and cyberchondria via rumination. Moreover, studies have revealed relationships between rumination and problematic use of new technologies, including cyberchondria (Demirtas et al., 2022; Dempsey et al., 2019; Fergus & Spada, 2017). Like rumination, this syndrome manifests itself in a persistent and recurrent focus on one aspect of reality—in this case, searching for health information online. Cyberchondria also co-occurred with stress in several studies (McElroy & Shevlin, 2014; McManus et al., 2014; Starcevic, 2017; Jungmann & Witthöft, 2020). Based on the interrelations between the three variables (stress appraisal, cyberchondria, and rumination), reported in the studies cited above, we expected not only simple correlations but also a mediating effect of rumination (which is a construct related to loss).

### 2.1. Participants

The study included a nonclinical sample of $N = 615$ individuals aged 18 to 83 years ($M = 43.86$, $SD = 14.57$); 53 % of them were female. All respondents were Polish.

Data were collected using the Ariadna Research Panel (http://www.panelariadna.com). We applied the method known as Computer-Assisted Web Interview (CAWI), which is an online interview. Participants were recruited via the Ariadna panel, in which the registered users constitute a research sample representative in terms of gender, age, and place of residence. The users register in the panel voluntarily, and their anonymity is ensured. Each time when participating in research they earn points, which they can exchange for prizes available in the panel.

Participation in the research was voluntary. Participants received shopping vouchers as a form of remuneration. The study was approved by the Research Ethics Board at the authors' university. The paper presents partial results from a larger project on cyberchondria. Due to the breadth of the issues addressed in the project and for the sake of consistency, only the variables involved in the relationship between rumination, stress appraisal, and cyberchondria are discussed in the present paper. The remaining results will be reported elsewhere.

### 2.2. Measures

*The Cyberchondria Severity Scale—Short Form* (CSS-12; McElroy et al., 2019), which we used to assess cyberchondria, measures health worry and excessive online health research. It consists of 12 items (e.g., "If I notice an unexplained bodily sensation, I will search for it on the Internet") rated on a 5-point scale (1 = *never* to 5 = *always*). The measure has good psychometric properties (McElroy et al., 2019; Marino et al., 2020). Cronbach's α in the present study was 0.92.

*The Dissipation–Rumination Scale* by Caprara (1986), adapted into Polish by Błachnio and Przepiórka (unpublished materials), was used to measure the personality trait defined on a continuum from a tendency towards rapid dissipation and weak rumination to a tendency towards slow dissipation and maximum rumination. It consists of 20 items (e.g., "I will always remember the injustices I have suffered"), rated on a 6-point scale (0 = *completely false for me* to 5 = *completely true for me*). Cronbach's α in the present study was 0.89.

*The Stress Appraisal Questionnaire* (Włodarczyk & Wrześniewski, 2010), which consists of 35 items (e.g., terrifying, activating) was used to measure four dimensions of stress appraisal, namely: threat, harm/loss, challenge-activity, and challenge-passivity. The items were rated on a 5-point scale (0 = *absolutely no* to 4 = *absolutely yes*). The values of Cronbach's α in the present study were as follows: 0.94 for threat, 0.81 for challenge-activity, 0.85 for challenge-passivity, and 0.83 for harm/loss.

### 2.3. Statistical analysis

Descriptive statistics are presented in the form of arithmetic means and standard deviations. We applied Pearson's correlation coefficient to determine the relationships between the variables.

We performed a mediation analysis (Hayes, 2013) to examine the relationship between stress appraisal (stress perceived as a threat, challenge-activity, challenge-passivity, or harm/loss) and cyberchondria via rumination. The PROCESS macro for SPSS (Hayes, 2013) was used to compute mediation effects. We tested four separate models, one for each dimension of stress appraisal: Model 1 for threat, Model 2 for challenge-activity, Model 3 for challenge-passivity, and Model 4 for harm/loss. The indirect effects were tested using bias-corrected bootstrapping ($N = 5000$) with 95 % confidence intervals (CI). If a 95 % bootstrapped CI does not include zero, the effect is statistically significant. Statistical calculations were performed using IBM SPSS 23 software with PROCESS macro (Hayes, 2013).

## 3. Results

The correlation analysis revealed a positive correlation between rumination and cyberchondria ($r = 0.25$, $p < .001$). Cyberchondria was positively associated with two dimensions of stress appraisal: threat ($r = 0.33$, $p < .001$) and harm/loss ($r = 0.23$, $p < .001$). There was also a negative relationship between cyberchondria and the challenge-activity dimension of stress appraisal ($r = -0.12$, $p = .003$). Detailed results of descriptive analysis are presented in Table 1.

As noted above, a separate model was tested for each dimension of stress appraisal. In Model 1, the mediation analysis revealed a significant indirect effect of stress appraised as a threat on cyberchondria via rumination. There was also a significant direct effect between this dimension of stress appraisal and cyberchondria. These results indicate partial mediation. Analyzing Model 2, we found no significant indirect effect of stress appraised as a challenge-activity on cyberchondria via rumination. There was only a negative direct relationship between this dimension of stress appraisal and cyberchondria. Additionally, in this model, rumination was positively associated with cyberchondria. In Model 3, the analysis revealed no significant indirect effect of stress appraised as a challenge-passivity on cyberchondria via rumination. Rumination was positively associated with cyberchondria in this model as well. In Model 4, there was a significant indirect effect of stress as a harm/loss on cyberchondria via rumination. Given the statistically significant direct effect between this dimension of stress appraisal and cyberchondria, it can be concluded that the mediation was partial. Detailed results are presented in Tables 2 and 3.

## 4. Discussion

The present study aimed to examine the mediating effect of rumination between stress appraisal and cyberchondria. Its results showed that cyberchondria was positively related to rumination, stress appraised as a threat, and stress appraised as a harm/loss and negatively related to stress appraised as a challenge-activity. Moreover, through a kind of feedback mechanism, stress can intensify the sense of having disease symptoms, which fuels the person's concerns about their health condition (Cooper, 2005; Lazarus et al., 1985). This in turn intensifies searching for information online (Jungmann & Witthöft, 2020; Muse et al., 2012). The results indicate only partial mediation in the case of stress as a threat and stress as a harm/loss. There was no mediation in the case of the remaining two types of stress appraisal. This means that the hypothesis was only partially supported.

We found that rumination partially mediated the relationships of

**Table 1**
Means, standard deviations, and correlations between the analyzed variables ($N = 615$).

| Variable | | *M* | *SD* | Minimum | Maximum | [1] | [2] | [3] | [4] | [5] | [6] | [7] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1] Cyberchondria | | 29.36 | 8.74 | 12.00 | 60.00 | | | | | | | |
| [2] Rumination | | 3.94 | 0.85 | 1.00 | 6.75 | 0.25*** | | | | | | |
| Stress appraisal | [3] Threat | 11.27 | 5.21 | 0.00 | 27.00 | 0.33*** | 0.26*** | | | | | |
| | [4] Challenge-activity | 9.16 | 2.45 | 0.00 | 15.00 | −0.12** | 0.01 | −0.33*** | | | | |
| | [5] Challenge-passivity | 7.17 | 2.70 | 0.00 | 15.00 | 0.05 | −0.04 | −0.30*** | 0.52*** | | | |
| | [6] Harm/loss | 5.48 | 2.29 | 0.00 | 12.00 | 0.23*** | 0.29*** | 0.73*** | −0.32*** | −0.35*** | | |

*$p < .05$. **$p < .01$. ***$p < .001$.

**Table 2**
Testing the indirect effects of stress appraisal on cyberchondria via rumination.

| Predictor | On rumination | | | | On cyberchondria | | | |
|---|---|---|---|---|---|---|---|---|
| | *B* | *SE* | *p* | β | *B* | *SE* | *p* | β |
| Model 1 | | | | | | | | |
| Stress appraisal: threat | 0.043 | 0.006 | 0.001 | 0.263 | 0.480 | 0.065 | 0.001 | 0.287 |
| Rumination | | | | | 1.822 | 0.401 | 0.001 | 0.177 |
| Constant | 3.457 | 0.079 | | | 16.777 | 1.591 | | |
| $R^2$ | 0.07 | | 0.001 | | 0.14 | | 0.001 | |
| *F* | 45.57 | | | | 49.55 | | | |
| Model 2 | | | | | | | | |
| Stress appraisal: challenge-activity | 0.001 | 0.014 | 0.934 | 0.003 | −0.425 | 0.138 | 0.002 | −0.119 |
| Rumination | | | | | 2.601 | 0.400 | 0.001 | 0.252 |
| Constant | 3.929 | 0.132 | | | 23.004 | 2.049 | | |
| $R^2$ | 0.01 | | 0.934 | | 0.08 | | 0.001 | |
| *F* | 0.01 | | | | 25.75 | | | |
| Model 3 | | | | | | | | |
| Stress appraisal: challenge-passivity | −0.012 | 0.013 | 0.360 | −0.037 | 0.185 | 0.127 | 0.145 | 0.057 |
| Rumination | | | | | 2.619 | 0.403 | 0.001 | 0.254 |
| Constant | 4.023 | 0.097 | | | 17.720 | 1.889 | | |
| $R^2$ | 0.01 | | 0.360 | | 0.07 | | 0.001 | |
| *F* | 0.84 | | | | 21.86 | | | |
| Model 4 | | | | | | | | |
| Stress appraisal: harm/loss | 0.107 | 0.014 | 0.001 | 0.290 | 0.666 | 0.153 | 0.001 | 0.175 |
| Rumination | | | | | 2.075 | 0.415 | 0.001 | 0.201 |
| Constant | 3.352 | 0.085 | | | 17.540 | 1.643 | | |
| $R^2$ | 0.08 | | 0.001 | | 0.09 | | 0.001 | |
| *F* | 56.31 | | | | 30.78 | | | |

*$p < .05$. **$p < .01$. ***$p < .001$.

**Table 3**
Non-standardized indirect effects with 95 % confidence intervals.

| Model pathway | Point estimate | Standard error | 95 % CI | |
|---|---|---|---|---|
| | | | *LL* | *UL* |
| Model 1 | | | | |
| Stress appraisal: Threat ➔ Rumination ➔ Cyberchondria | **0.078** | **0.024** | **0.034** | **0.130** |
| Model 2 | | | | |
| Stress appraisal: challenge-activity ➔ Rumination ➔ Cyberchondria | 0.003 | 0.041 | −0.079 | 0.085 |
| Model 3 | | | | |
| Stress appraisal: challenge-passivity ➔ Rumination ➔ Cyberchondria | −0.030 | 0.038 | −0.111 | 0.044 |
| Model 4 | | | | |
| Stress appraisal: harm/loss ➔ Rumination ➔ Cyberchondria | **0.222** | **0.060** | **0.112** | **0.348** |

*Note.* CI = confidence interval; *LL* = lower limit; *UL* = upper limit; emboldened variables = statistically significant.

stress appraised as a threat and stress appraised as a harm/loss to cyberchondria. The inclusion of these two dimensions of stress appraisal in the model only partially reduced the impact of rumination on cyberchondria. This means the development of cyberchondria is linked both to rumination and to the threat and harm/loss dimensions of stress appraisal. Stress as a threat refers to the perception of a situation as posing a threat (Włodarczyk & Wrześniewski, 2010). A suspected disease or alarming symptoms are undoubtedly a highly threatening situation for many people (Newby & McElroy, 2019). To reduce the sense of threat or anxiety about their health, some individuals excessively search for the health information online (McMullan et al., 2019). Stress is also associated with situations perceived as a loss or harm (Włodarczyk & Wrześniewski, 2010). Health is seen as an important human resource, and its deterioration is perceived as a loss (Vismara et al., 2020). Additionally, when health loss is not caused by negligence (e.g., unhealthy lifestyle), it gives rise to a sense of harm and injustice (Prilleltensky & Prilleltensky, 2021). Regardless of the circumstances in which the loss of good health occurs, increasing numbers of people search for information about it on the Internet (Marino et al., 2020) and have frequently recurring negative health-related thoughts (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008).

The above suggests that stress appraised as a threat may be related to rumination, which in turn may fuel cyberchondria. Similarly, stress

appraised as a harm/loss may increase rumination, thus leading to cyberchondria as well. The significant linkage between stress appraisal (stress perceived as a harm/loss and as a threat) and cyberchondria is supported by previous results, which showed that individuals with maladaptive human capital—for instance, a low level of self-esteem (Bajcar & Babiak, 2021) or low optimism (Maftei & Holman, 2020)—more often had a tendency to experience cyberchondria. Additionally, individuals who focus on their negative emotional states (i.e., those who ruminate) tend to worry about their health and search for information about it online. Studies have revealed relations between worry, depression, anxiety, and rumination (McEvoy et al., 2010; Yook, Kim, Suh, & Lee, 2010). Rumination consists in chronically thinking about negative states (Nolen-Hoeksema et al., 2008); this makes it similar to cyberchondria, in which negative thinking concerns health (Starcevic & Aboujaoude, 2015). The tendency towards slow dissipation and maximum rumination prolongs and intensifies health information seeking (Caprara, 1986), which may become compulsive. Emotional balance restored by checking health information online is usually a short-term outcome only; after some time, there is a renewed focus on health, and the related negative emotional states set in again (Norr et al., 2015). Conversely, a tendency towards rapid dissipation and minimal rumination (Caprara, 1986) can be considered a protective factor against compulsive searching for health information on the Internet and the stress involved in this activity (Nolen-Hoeksema, 2000; Vismara et al., 2020).

In the case of the challenge-activity and challenge-passivity dimensions of stress appraisal, the hypothesized mediating role of rumination in their relationship to cyberchondria was not found. The challenge-activity dimension of stress appraisal concerns the activating effect of stress. A stressful situation can motivate a person to take active action, which makes it a positive event. In the case of challenge-passivity, the stressful situation is also assessed as positive, but it is not a motivator for activity. Thus, the difference between the two types of stress lies in the presence or absence of activity on the part of the person who finds themselves in a stressful situation (Włodarczyk & Wrześniewski, 2010). What these two types of stress appraisal have in common (apart from the fact that rumination does not mediate their relationship to cyberchondria) is the perception of a stressful situation as positive or heralding something beneficial. In contrast, both rumination (Blanke, Neubauer, Houben, Erbas, & Brose, 2022; Nolen-Hoeksema, 1996) and cyberchondria (Bajcar & Babiak, 2021; Starcevic & Aboujaoude, 2015) are regarded as undesirable or even harmful to mental health.

Certain limitations of this study should be noted. First, we used cross-sectional data, which means it is not possible to draw causal conclusions. This limitation is partially offset by the large sample size, which should be considered a strength of our research. Second, the research was conducted during the pandemic, when people's concern about their health and online health information seeking intensified. The study should be re-conducted after the pandemic. Third, we did not ask the participants about the state of their health or about their Internet use. Fourth, we used self-report measures. In future research it would be beneficial to use diary-based techniques that yield longitudinal data. It would also be advisable to apply ecological momentary assessment (EMA; Stone & Shiffman, 1994) to study the dynamics of change in the levels of variables and the situational context. This method has been used to measure mood and anxiety disorders (Thiele, Laireiter, & Baumann, 2002). It would be interesting to establish whether everyday physical well-being has an impact on the relationships investigated. As far as cyberchondria is concerned, the pandemic situation seems to be an interesting direction for research.

An undeniable strength of our study is the possible practical implications of its findings. They can serve as the basis for the development of prevention and treatment programs. For instance, individuals suffering from cyberchondria or health anxiety could be targeted for rumination-focused therapies.

To sum up, the present study indicates that stress appraisal is linked to cyberchondria and that rumination plays an important role in this relationship. Cyberchondria is an increasingly widespread phenomenon and has been referred to as a new cyberpathology (Starcevic & Aboujaoude, 2015). Our results seem to shed new light on this issue and suggest directions for future research.

## Informed consent

Informed consent was obtained from all individual participants included in the study.

## Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## Compliance with ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards.

## Availability of data and materials

The data and materials used in the research are available and can be obtained via email at xxx.

## Declaration of competing interest

The authors declare that they have no conflict of interest.

## Data availability

Data will be made available on request.

## References

Aneshensel, C. S., Rutter, C. M., & Lachenbruch, P. A. (1991). Social structure, stress, and mental health: Competing conceptual and analytic models. *American Sociological Review, 56*, 166–178. https://doi.org/10.2307/2095777

Aulia, A., Marchira, C. R., Supriyanto, I., & Pratiti, B. (2020). Cyberchondria in first year medical students of Yogyakarta. *Journal of Consumer Health on the Internet, 24*(1), 1–9. https://doi.org/10.1080/15398285.2019.1710096

Bailer, J., Kerstner, T., Witthöft, M., Diener, C., Mier, D., & Rist, F. (2016). Health anxiety and hypochondriasis in the light of DSM-5. *Anxiety, Stress, and Coping, 29*(2), 219–239. https://doi.org/10.1080/10615806.2015.103624

Bajcar, B., & Babiak, J. (2021). Self-esteem and cyberchondria: The mediation effects of health anxiety and obsessive–compulsive symptoms in a community sample. *Current Psychology, 40*(6), 2820–2831.

Bati, A. H., Mandiracioglu, A., Govsa, F., & Çam, O. (2018). Health anxiety and cyberchondria among Ege University health science students. *Nurse Education Today, 71*, 169–173. https://doi.org/10.1016/j.nedt.2018.09.029

Blanke, E. S., Neubauer, A. B., Houben, M., Erbas, Y., & Brose, A. (2022). Why do my thoughts feel so bad? Getting at the reciprocal effects of rumination and negative affect using dynamic structural equation modeling. *Emotion, 22*(8), 1773–1786. https://doi.org/10.1037/emo0000946

Caprara, G. V. (1986). Indicators of aggression: The dissipation–rumination scale. *Personality and Individual Differences, 7*(6), 763–769. https://doi.org/10.1016/0191-8869(86)90074-7

Cooper, C. L. (2005). *Handbook of stress medicine and health*. CRC Press.

Demirtas, Z., Emiral, G. O., Caliskan, S., Zencirci, S. A., Unsal, A., Arslantas, D., & Tirpan, K. (2022). Evaluation of relationship between cyberchondria and obsessive beliefs in adults. *Puerto Rico Health Sciences Journal, 41*(4), 233–238.

Dempsey, A. E., O'Brien, K. D., Tiamiyu, M., & Elhai, J. (2019). Fear of missing out (FoMO) and rumination mediate relations between social anxiety and problematic Facebook use. *Addictive Behaviors Reports, 9*, Article 100150.

Doherty-Torstrick, E. R., Walton, K. E., & Fallon, B. A. (2016). Cyberchondria: Parsing health anxiety from online behavior. *Psychosomatics, 57*(4), 390–400. https://doi.org/10.1016/j.psym.2016.02.002

Fergus, T. A., & Russell, L. H. (2016). Does cyberchondria overlap with health anxiety and obsessive–compulsive symptoms? An examination of latent structure and scale interrelations. *Journal of Anxiety Disorders, 38*, 88–94. https://doi.org/10.1016/j.janxdis.2016.01.009

Fergus, T. A., & Spada, M. M. (2017). Cyberchondria: Examining relations with problematic internet use and metacognitive beliefs. *Clinical Psychology & Psychotherapy, 24*(6), 1322–1330. https://doi.org/10.1002/cpp.2102

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment, 26*(1), 41–54. https://doi.org/10.1007/s10862-008-9102-4

Griffiths, M. (2000). Does internet and computer "addiction" exist? Some case study evidence. *CyberPsychology and Behavior, 2*(3), 211–218. https://doi.org/10.1089/109493100316067

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* Guilford Press.

Holmes, T. H., & Rahe, R. H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research, 11*(2), 213–218. https://doi.org/10.1016/0022-3999(67)90010-4

Hoyer, J., Gloster, A. T., & Herzberg, P. Y. (2009). Is worry different from rumination? Yes, it is more predictive of psychopathology! *Psycho-Social-Medicine, 6*, 1–9. https://doi.org/10.3205/psm000062

Jamieson, J. P., Hangen, E. J., Lee, H. Y., & Yeager, D. S. (2018). Capitalizing on appraisal processes to improve affective responses to social stress. *Emotion Review, 10*(1), 30–39. https://doi.org/10.1177/1754073917693085

Jungmann, S. M., & Witthöft, M. (2020). Health anxiety, cyberchondria, and coping in the current COVID-19 pandemic: Which factors are related to coronavirus anxiety? *Journal of Anxiety Disorders, 73*, Article 102239. https://doi.org/10.1016/j.janxdis.2020.102239

Khoo, S. S., & Yang, H. (2021). Mental disengagement mediates the effect of rumination on smartphone use: A latent growth curve analysis. *Computers in Human Behavior, 120*, Article 106757.

Lazarus, R. S., DeLongis, A., Folkman, S., & Gruen, R. (1985). Stress and adaptational outcomes: The problem of confounded measures. *American Psychologist, 40*(7), 770–779. https://doi.org/10.1037/0003-066X.40.7.770

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping.* Springer.

Lyubomirsky, S., & Tkach, C. (2003). The consequences of dysphoric rumination. In C. Papageorgiou, & A. Wells (Eds.), *Rumination: Nature, theory, and treatment of negative thinking in depression* (pp. 21–41). John Wiley and Sons.

Maftei, A., & Holman, A. C. (2020). Cyberchondria during the coronavirus pandemic: The effects of neuroticism and optimism. *Frontiers in Psychology, 11*, 1–7. https://doi.org/10.3389/fpsyg.2020.567345

Manganello, J., Gerstner, G., Pergolino, K., Graham, Y., Falisi, A., & Strogatz, D. (2017). The relationship of health literacy with use of digital technology for health information. *Journal of Public Health Management and Practice, 23*(4), 380–387. https://doi.org/10.1097/PHH.0000000000000366

Marino, C., Fergus, T. A., Vieno, A., Bottesi, G., Ghisi, M., & Spada, M. M. (2020). Testing the Italian version of the Cyberchondria severity scale and a metacognitive model of cyberchondria. *Clinical Psychology & Psychotherapy, 27*(2), 1–16. https://doi.org/10.1002/cpp.2444

McElroy, E., Kearney, M., Touhey, J., Evans, J., Cooke, Y., & Shevlin, M. (2019). The CSS-12: Development and validation of a short-form version of the Cyberchondria severity scale. *Cyberpsychology, Behavior and Social Networking, 22*(5), 330–335. https://doi.org/10.1089/cyber.2018.0624

McElroy, E., & Shevlin, M. (2014). The development and initial validation of the Cyberchondria severity scale (CSS). *Journal of Anxiety Disorders, 28*(2), 259–265. https://doi.org/10.1016/j.janxdis.2013.12.007

McEvoy, P. M., Mahoney, A. E., & Moulds, M. L. (2010). Are worry, rumination, and post-event processing one and the same? Development of the repetitive thinking questionnaire. *Journal of Anxiety Disorders, 24*(5), 509–519. https://doi.org/10.1016/j.janxdis.2010.03.008

McIntosh, W., & Martin, L. (1992). The cybernetics of happiness: The relation between goal attainment, rumination, and affect. In M. S. Clark (Ed.), *Review of personality and social psychology* (pp. 222–246). Sage.

McManus, F., Leung, C., Muse, K., & Williams, J. (2014). Understanding 'cyberchondria': An interpretive phenomenological analysis of the purpose, methods and impact of seeking health information online for those with health anxiety. *The Cognitive Behaviour Therapist, 7*, E21. https://doi.org/10.1017/S1754470X14000270

McMullan, R. D., Berle, D., Arnáez, S., & Starcevic, V. (2019). The relationships between health anxiety, online health information seeking, and cyberchondria: Systematic review and meta-analysis. *Journal of Affective Disorders, 245*, 270–278. https://doi.org/10.1016/j.jad.2018.11.037

Menon, V., Kar, S. K., Tripathi, A., Nebhinani, N., & Varadharajan, N. (2020). Cyberchondria: Conceptual relation with health anxiety, assessment, management and prevention. *Asian Journal of Psychiatry, 53*, Article 102225. https://doi.org/10.1016/j.ajp.2020.102225

Muse, K., McManus, F., Leung, C., Meghreblian, B., & Williams, J. M. (2012). Cyberchondriasis: Fact or fiction? A preliminary examination of the relationship between health anxiety and searching for health information on the Internet. *Journal of Anxiety Disorders, 26*(1), 189–196. https://doi.org/10.1016/j.janxdis.2011.11.00

Newby, J., & McElroy, E. (2019). The impact of internet-delivered cognitive behavioural therapy for health anxiety on cyberchondria. *Journal of Anxiety Disorders, 69*, 1–7. https://doi.org/10.1016/j.janxdis.2019.102150

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*(4), 569–582. https://doi.org/10.1037/0021-843X.100.4.569

Nolen-Hoeksema, S. (1996). Chewing the cud and other ruminations. In R. S. Wyer, Jr. (Ed.), *Ruminative thoughts* (pp. 135–144). Erlbaum.

Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology, 109*(3), 504–511. https://doi.org/10.1037/0021-843X.109.3.504

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*(5), 400–424. https://doi.org/10.1111/j.1745-6924.2008.00088.x

Norr, A. M., Oglesby, M. E., Raines, A. M., Macatee, R. J., Allan, N. P., & Schmidt, N. B. (2015). Relationships between cyberchondria and obsessive–compulsive symptoms. *Psychiatry Research, 230*, 441–446. https://doi.org/10.1016/j.psychres.2015.09.034

Prilleltensky, I., & Prilleltensky, O. (2021). *How people matter: Why it affects health, happiness, love, work, and society*. Cambridge University Press.

Pyszczynski, T., & Greenberg, J. (1987). Self-regulatory preservation and the depressive self-focusing style: A self-awareness theory of reactive depression. *Psychological Bulletin, 102*(1), 122–138. https://doi.org/10.1037/0033-2909.102.1.122

Rosenbaum, D., Int-Veen, I., Laicher, H., Torka, F., Kroczek, A., Rubel, J., … Ehlis, A. C. (2021). Insights from a laboratory and naturalistic investigation on stress, rumination and frontal brain functioning in MDD: An fNIRS study. *Neurobiology of Stress, 15*, Article 100344. https://doi.org/10.1016/j.ynstr.2021.100344

Sansom-Daly, U. M., Bryant, R. A., Cohn, R. J., & Wakefield, C. E. (2014). Imagining the future in health anxiety: The impact of rumination on the specificity of illness-related memory and future thinking. *Anxiety, Stress, and Coping, 27*(5), 587–600. https://doi.org/10.1080/10615806.2014.880111

Schenkel, S. K., Jungmann, S. M., Gropalis, M., & Witthöft, M. (2021). Conceptualizations of cyberchondria and relations to the anxiety spectrum: Systematic review and meta-analysis. *Journal of Medical Internet Research, 23*(11), Article e27835. https://doi.org/10.2196/27835

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaceted construct. *Clinical Psychology Review, 29*(2), 116–128. https://doi.org/10.1016/j.cpr.2008.10.003

Starcevic, V. (2017). Cyberchondria: Challenges of problematic online searches for health-related information. *Psychotherapy and Psychosomatics, 86*, 129–133. https://doi.org/10.1159/000465525

Starcevic, V., & Aboujaoude, E. (2015). Cyberchondria, cyberbullying, cybersuicide, cybersex: "New" psychopathologies for the 21st century? *World Psychiatry, 14*(1), 97–100. https://doi.org/10.1002/wps.20195

Starcevic, V., Baggio, S., Berle, D., Khazaal, Y., & Viswasam, K. (2019). Cyberchondria and its relationships with related constructs: A network analysis. *Psychiatric Quarterly, 90*(3), 491–505. https://doi.org/10.1007/s11126-019-09640-5

Starcevic, V., Berle, D., & Arnáez, S. (2020). Recent insights into cyberchondria. *Current Psychiatry Reports, 22*(11), 1–8. https://doi.org/10.1007/s11920-020-01179-8

Stone, A. A., & Shiffman, S. (1994). Ecological momentary assessment (EMA) in behavorial medicine. *Annals of Behavioral Medicine, 16*(3), 199–202.

Thiele, C., Laireiter, A. R., & Baumann, U. (2002). Diaries in clinical psychology and psychotherapy: A selective review. *Clinical Psychology & Psychotherapy, 9*(1), 1–37. https://doi.org/10.1002/cpp.302

Vismara, M., Caricasole, V., Starcevic, V., Cinosi, E., Dell'Osso, B., Martinotti, G., & Fineberg, N. A. (2020). Is cyberchondria a new transdiagnostic digital compulsive syndrome? A systematic review of the evidence. *Comprehensive Psychiatry, 99*, 152–167. https://doi.org/10.1016/j.comppsych.2020.152167

von Hippel, C., Kalokerinos, E. K., Haanterä, K., & Zacher, H. (2019). Age-based stereotype threat and work outcomes: Stress appraisals and rumination as mediators. *Psychology and Aging, 34*(1), 68–84. https://doi.org/10.1037/pag0000308

Watkins, E. (2004). Adaptive and maladaptive ruminative self-focus during emotional processing. *Behaviour Research and Therapy, 42*(9), 1037–1052. https://doi.org/10.1016/j.brat.2004.01.009

White, R. W., & Horvitz, E. (2009). Cyberchondria: Studies of the escalation of medical concerns in Web search. *ACM Transactions on Information Systems, 27*(4), 1–37. https://doi.org/10.1145/1629096.1629101

Włodarczyk, D., & Wrześniewski, K. (2010). Kwestionariusz Oceny Stresu (KOS) [The Stress Appraisal Questionnaire (SAQ)]. *Przegląd Psychologiczny, 4*, 479–496.

Xu, W., Feng, C., Tang, W., & Yang, Y. (2022). Rumination, posttraumatic stress disorder symptoms, and posttraumatic growth among Wenchuan earthquake adult survivors: A developmental perspective. *Frontiers in Public Health, 9*, Article 764127. https://doi.org/10.3389/fpubh.2021.764127

Yook, K., Kim, K. H., Suh, S. Y., & Lee, K. S. (2010). Intolerance of uncertainty, worry, and rumination in major depressive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders, 24*(6), 623–628. https://doi.org/10.1016/j.janxdis.2010.04.003