Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Understanding individual psychological and behavioral responses during COVID-19: Application of stimulus-organism-response model

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ABSTRACT

To comprehend the nature, implications, risks and consequences of the events of the COVID-19 crisis, individuals largely relied on various online information sources. The features of online information exchange (e.g., conducted on a massive scale, with an abundance of information and unverified sources) led to various behavioral and psychological responses that are not fully understood. This study therefore investigated the relationship between exposure to online information sources and how individuals sought, forwarded, and provided COVID-19 related information. Anchored in the stimulus-organism-response model, cognitive load theory, and the theory of fear appeal, this study examined the link between the online consumption of COVID-19-related information and psychological and behavioral responses. In the theory development process, we hypothesized the moderating role of levels of fear. The research model included six hypotheses and was empirically verified on self-reported data (N = 425), which was collected in early 2021. The results indicate that continuous exposure to online information sources led to perceived information overload, which further heightened the psychological state of cyberchondria. Moreover, the act of seeking and providing COVID-19 information was significantly predicted by perceived cyberchondria. The results also suggest that higher levels of fear led to increased levels of seeking and providing COVID-19-related information. The theoretical and practical implications of these findings are presented, along with promising areas for future research.

1. Introduction

With over 6.8 million COVID-19-related deaths (World Health Organization, 2023), the recent COVID-19 pandemic has proven to be one of the most severe, lengthy, and challenging crisis events in the history of the modern world and has led to significant changes in various aspects of human behavior. A specific feature of this crisis has been the massive circulation of often conflicting, unreliable, and unsystematic information (Soroya et al., 2021). The uncontrolled circulation of inaccurate information sourced from a plethora of information sources may have very negative long-term consequences (Apuke and Omar, 2021) and may have significantly hindered the ability of authorities to control the crisis.

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Brug et al. (2009) found that the greater the severity of a crisis event, the more individuals will be inclined to mitigate the perceived risks by consulting a variety of sources (e.g., social networks, search engines, etc.) in an attempt to enlarge their information base. Historically, information sources (e.g., internet, TV, newspapers) have played a major role in the initial understanding of crises such as the COVID-19 pandemic (Farooq et al., 2021), the Zika virus (Chan et al., 2018) and the H1N1 flu in Taiwan (Dudo et al., 2007). Therefore, it is imperative to investigate the effects of these sources during times of crisis. Similarly, Choi et al. (2017) provided evidence that crises and events creating insecurity influence individuals' behavior and communication patterns as exposure and the variety of information increases. Many scholars have called for more empirical studies examining online information flow during times of crisis (e.g., how information is obtained and shared, perceptions of the plethora of information sources, psychological and behavioral responses, etc.) (Chawla et al., 2021; Gever et al., 2021; Lu et al., 2022). According to many (e.g., Cuan-Baltazar et al., 2020; Donthu and Gustafsson, 2020; Nilashi et al., 2021; Panagiotopoulos et al., 2016; Zheng et al., 2020), such studies are critical in dealing effectively with crisis events and emergencies.

Although informational behavior online (information seeking, forwarding, and providing) has received a certain amount of research attention (e.g., Chu and Kim, 2011; Farías, 2017; Lee and Choi, 2019a; Mladenović et al., 2020), these studies were exclusively focused on the consumer domain and were not conducted in the context of COVID-19 pandemic. Notable, they did not take into consideration information overload and cyberchondria, which are psychological states that are becoming increasingly relevant (Zheng et al., 2020). Hence, there has been a lack of research on the influence of various exogenous variables on the propensity of individuals to engage in information flow online and on the general role of information sources. More specifically, there is nothing in the literature that explains the relations between information sources, psychological states of cyberchondria and information overload, and the engagement of individuals in information flow online, especially when individuals are exposed to sudden and repetitive waves of often conflicting information that they need to comprehend in a short period. Thus, it is imperative to understand the effects of information sources on information flow online during a time of crisis for various reasons (Laato et al., 2020a). Firstly, affected stakeholders (e.g., authorities, and healthcare providers) can prepare response scenarios for similar events. Secondly, they can formulate appropriate measures during a crisis (e.g., compose messages that target specific demographic segments with specific information). Lastly, to lay the foundations for a better understanding of the phenomenon of "infodemic" during a crisis (Tangcharoensathien et al., 2020). The infodemic related to the recent crisis (Lee et al., 2021) largely influenced individuals' psychological (e.g., stress, anxiety, fear, insecurity) and behavioral responses and well-being (e.g., the problematic and intensive searching for health-related information, i.e., cyberchondria).

Given the above-mentioned deficits, the COVID-19 pandemic has provided a rare and useful opportunity for investigating individuals' psychological and behavioral responses in the context of a large-scale crisis. Although the prime context is COVID-19, the findings may apply to both the ongoing pandemic and any future events that are characterized by considerable environmental disruption.

Therefore, we decided to investigate the relations between information sources, information overload, cyberchondria, and informational behavior online. We draw upon literature in this field and rely on the stimulus-organism-response (S-O-R) framework (Sherman et al., 1997), cognitive load theory (CLT) (Kirschner, 2002), and the theory of fear appeal (TFA) (Addo et al., 2020) to propose and empirically test a research framework. We used the S-O-R model to formalize the relationship between exposure to online information sources (stimulus), information overload (organism), cyberchondria, and seeking, forwarding, and providing COVID-19-related information (behavioral and psychological responses). In addition, given that escalating fear can impede the more active exchange of information (Yuen et al., 2022) fear is included as a moderator in the model. The proposed model was tested on self-reported data collected at the beginning of 2021, i.e., a period in which the world was experiencing some of the most severe consequences of the COVID-19 crisis.

This research makes four notable contributions to the existing body of knowledge. Firstly, it responds to direct calls for more empirical investigations on information flow and information sources online (Chawla et al., 2021; Gever et al., 2021; Lu et al., 2022; Natalia, 2022). Secondly, it is one of the first studies that draw upon CLT and TFA theories in quantifying the direction and nature of relations between information sources, information overload, and cyberchondria. Thirdly, it verifies the robustness and reliability of the S-O-R framework in the context of the current crisis, as the majority of hypothesized relations were supported. Finally, the findings contribute to the emerging domains of online crisis communication and information retrieval research insofar as it indicates that exposure to a plethora of information sources induces the adverse psychological response of information overload, which further induces the behavioral response known as cyberchondria.

2. Literature review and hypothesis development

2.1. Theoretical foundations

2.1.1. Stimulus-organism-response model (S-O-R)

S-O-R is one of the most influential and overarching models used as a theoretical foundation for consumer behavior. Previous studies reflect its significant predictive power when investigating individuals' reactions to novel and sudden external stimuli (Sherman et al., 1997). S-O-R is widely used to understand the influence of so-called environmental factors (Laato et al., 2020a; Xu et al., 2014) and the behavioral intentions of individuals (Islam et al., 2021). Essentially, S-O-R implies that the behavior of individuals takes place in a broader environment, which implies a variety of *stimuli* that differ in severity, frequency, and impact. Exogenous stimuli influence the *organism* (individuals, groups, etc.) in various capacities, and in turn trigger and motivate *responses* (e.g., behavioral and psychological) as a meaningful reaction to the preceding stimuli (Russell and Mehrabian, 1974).

The model is suitable for this research because it has both theoretically and practically validated that various exogenous impulses affect the psychological states of individuals and further induce specific behavioral intentions and/or actual behavior (e.g., Islam et al., 2021; Kumar et al., 2021). Therefore, drawing upon the S-O-R framework, we included exposure to online information sources as an exogenous stimulus. To quantify the cognitive load and overwhelming extent of COVID-19-related information we operationalized the information overload variable (organism). Finally, we included one psychological response (cyberchondria) and three behavioral responses (seeking, forwarding, and providing COVID-19-related information). In addition, we rely on postulates from Cognitive Load Theory and the Theory of Fear Appeal to examine the nature of the respective relations between the observed variables.

2.1.2. Cognitive load theory (CLT)

Given that the goal was to examine the role of online information sources, CLT is particularly suitable. Essentially, CLT postulates that human cognitive capabilities are limited in the short term, a condition that may induce various reactions (Kirschner, 2002). For example, only fragments of newly acquired information can be comprehended, while the bulk of unstructured information collides with the individual's limited cognitive capacity and makes decision-making more unreliable and problematic. In the context of the online environment, where information is abundant (Liu et al., 2021), it is particularly important to consider the human ability to digest information in any type of situation. CLT was originally used in the fields of instructional science and learning (Chandler and Sweller, 1991), but since the emergence of virtual environments, it has been increasingly used in examining individuals' perceived and actual behavior in various domains (e.g., marketing communication, information retrieval, crisis public relations, social media, consumer behavior, etc.). The literature in this field suggests that the information overload variable is successful in portraying the decisions and cognition of individuals, and thus we included it as a component of the proposed research model.

In the context of the COVID-19 crisis, we consider that a stimulus can be continuous exposure to an overwhelming amount of online information sources from which individuals source new information, which is similar to the reasoning of Laato et al. (2020). The quality and quantity of COVID-19-related information during the crisis can certainly influence the information retrieval and sharing behavior of individuals (Mladenović et al., 2020). Therefore, it can be assumed that if the cognitive capacity of individuals is overloaded, then their individual and group responses can potentially be exercised in an irrational fashion (Kirschner, 2002). Laato et al. (2020) believe that although the environment dictates the reactions, individuals may take a two-fold course of action, i.e., to oppose and amplify the effect of the original stimuli (e.g., information overload). Furthermore, CLT proposes that after being cognitively overloaded (e.g., information, communication, psychologically, etc.) (Dhir et al., 2019), individuals tend to retreat to their perceived safer positions (e.g., by collecting more information or sharing the information they possess).

In our research model, we focus on information overload to relate stimuli to the organism aspect of the S-O-R framework.

2.1.3. Theory of fear appeal (TFA)

The theory of fear appeal postulates that when fear is present individuals attempt to mitigate the expected negative impact or adverse influence (Boss et al., 2015; Shen and Dillard, 2014). Fear triggers certain reactive behavior against the risk/crisis event with the main goal of reducing the negative implications. For example, in the context of COVID-19, individuals would gather information and knowledge on the topic that induced increased fear. As Witte and Allen (2000) noted, TFA not only formalizes the threat or risk itself but indicates the respective actions to address the adverse outcomes. For instance, to reduce the probability of adverse COVID-19 consequences, individuals should familiarize themselves with the primary symptoms, the testing procedures, the stay-at-home orders, how to communicate with infected individuals, etc. Essentially, TFA literature implies two fundamental pillars: the threat (e.g., becoming infected with COVID-19) and the action component (Tanner et al., 1991). Our study focuses on the action component of TFA that formalizes various actions and procedures that can be performed by individuals to curb negative feelings such as fear and anxiety (e.g., information collection, opinion sharing, knowledge accumulation, etc.)(Brennan and Binney, 2010; Tanner et al., 1991).

Therefore, TFA can assist in examining the relationship between information overload and cyberchondria, and cyberchondria and information flow. TFA is well suited to this research context for two main reasons. Firstly, information on crisis events normally evokes a certain measure of fear and negative feelings that undermines decision-making. Thus, we use TFA to portray the influence of adverse messages on further information consumption (which eventually leads to cyberchondria). Secondly, given that some scholars have indicated that fear appeal may be a significant variable during so-called impulsive consumer behavior (Addo et al., 2020; Ahmed et al., 2020; Eger et al., 2021), TFA is well suited for formalizing the reactive courses of actions that are observed (information sharing, forwarding and seeking). Previously, TFA has mostly been applied in studies in the field of marketing and advertising where the focus has been on products that "*safeguard from situations in which life is endangered*" (e.g., health insurance, safety features of products, etc.) (Addo et al., 2020, p. 475).

Drawing on TFA, we assert that information overload may lead to enhanced sharing, forwarding and even seeking of COVID-19-related information. However, exposing individuals to information they have issues processing (e.g., due to terminology, complexity, etc.) may lead to cyberchondria, whereby, as a response to already acquired COVID-19 information, individuals tend to do further searches that can potentially lead to increased anxiety. In our research model, we focus on cyberchondria and information flow to relate the response aspect of the S-O-R framework.

2.2. Information overload as a consequence of exposure to online information sources

Nowadays, individuals are exposed to many different kinds of information sources (e.g., radio, TV, email, social media, and news portals) which they can consume in a practically unlimited fashion. In the context of the COVID-19 pandemic, the role of the internet is particularly significant (Farooq et al., 2020). This is primarily due to the considerable presence of internet communication channels in

peoples' daily informational behavior and communication with their social networks. Moreover, the internet is a communication and social environment that has very low entry barriers for information seekers and providers (Cuan-Baltazar et al., 2020). As such it is fertile ground for the emergence of a plethora of sources of information, some of which are of questionable reliability.

Continuous exposure to a large number of online information sources is not uncommon, but gained momentum during COVID-19, as individuals drastically increased the average amount of time they spent online (Liu et al., 2021; Soroya et al., 2021). Exposure to a multitude of information sources combined with difficulties in processing and comprehending (often conflicting) online information (Talwar et al., 2020) is an evident problem. Exposure to online information sources can also contribute to information overload by creating a feeling of constant connectivity and pressure to stay up-to-date (Matthes et al., 2020). The 24/7 nature of online news and social media platforms means that individuals may feel compelled to stay engaged and informed at all times, leading to a constant stream of information and potentially overwhelming amounts of content. This is particularly critical during a crisis or non-recurring events, as the overall abnormality of the situation and its implications does not allow for the thorough and detailed processing of information that hinders the appearance of unverified information (Ahmed et al., 2020). CLT assumes individuals possess only limited cognitive capacity to thoroughly process and understand information. This means that the moment the amount and complexity (e.g., due to the terminology used) of acquired information exceeds cognitive capabilities, information overload is likely to occur (Malik et al., 2020). Beaudoin (2008, p.552) defines information overload as a situation when handling and processing a wealth of information from multiple information sources becomes cumbersome. Given that the cognitive processing capabilities of individuals are limited in the short-term (Kirschner, 2002) and are very dependent on their knowledge, experiences, skills, and various internal and external factors, it is unreasonable to expect individuals to be capable of short-term adjustments to their cognitive processing capacities.

Based on the assumptions presented above, we propose that when individuals are continuously exposed to an excessive amount of information, their internal cognitive capabilities become overwhelmed (Bermes, 2021; Liu et al., 2021; Soroya et al., 2021). Thus, they may end up in a psychological state known as information overload. Therefore, we posit:

H1: Continuous exposure to excessive amounts of online COVID-19-related information sources is directly and positively related to information overload.

2.3. Cyberchondria and information overload

Cyberchondria can be defined as a state of anxiety or fear (Jokić-Begić et al., 2019) that is caused by the repetitive, compulsive, and continuous urge to search for medical information on topics that are related to existing concerns (Vismara et al., 2020). Nevertheless, it is important to distinguish health information searches in normal circumstances (everyday searches) from those done in times of crisis or sudden events. A major problem arising from the considerable online information retrieval capabilities available is the fact that online users tend to poorly evaluate the credibility and relevance of online information sources (Huang et al., 2022; Kareklas et al., 2015). Given the fact that online information sources contain information that varies considerably in relevance, credibility, and complexity (Laato et al., 2020b), the likelihood of consuming information that lacks a proper informative, and rigorous basis is high. This is even more so in the case of non-recurring situations such as health emergencies where individuals are exposed to large amounts of information that lacks a proper systematic, methodological, and scientific basis (Laato et al., 2020a). In addition, exposure to online information sources and information that conflicts with prior beliefs or conventional attitudes can induce further information searches (Schmidt et al., 2021). In the case of COVID-19, we assume that information overload can exacerbate cyberchondria, leading individuals to engage in excessive searching for health-related information online (e.g., seeking out multiple sources of information, constantly monitoring news, etc.). This can perpetuate their anxiety and worry, leading to a heightened sense of hypervigilance and concern about health. Moreover, information overload can contribute to the phenomenon of "infodemic," where the sheer volume of information available about COVID-19 can create confusion and misinterpretation of the facts (Lee et al., 2021). This can lead to individuals misinterpreting symptoms or believing inaccurate information about the virus, which can further fuel cyberchondria. In the context of information overload, we propose that the continuous consumption of conflicting, unverified, and methodologically unsystematic information (and misinformation) will lead to the psychological state of cyberchondria. Therefore, we pose the following hypothesis:

H2: Information overload is directly and positively related to cyberchondria.

2.4. The role of cyberchondria in providing, forwarding, and seeking COVID-19-related information online

Some scholars have investigated informational behavior online through concepts of information seeking, forwarding, and providing (e.g., Cheong and Mohammed-Baksh, 2020; Chu and Kim, 2011; Farías, 2017; Lee and Choi, 2019; Mladenović et al., 2020). These three concepts largely formalize information flow (see Kucukemiroglu and Kara, 2015; Lee and Choi, 2019; Mladenovic et al., 2019).

The topic of **information providing** has long been an area of interest for scholars due to its important role in individuals' willingness to engage in information sharing (Cheong and Mohammed-Baksh, 2020). The online environment, as a socially intense setting, provides fertile ground for information dislocation for so-called opinion leaders (Babić Rosario et al., 2020; Kucukemiroglu and Kara, 2015). The exceptional growth of online communication platforms that allow individuals to communicate with others offers opinion leaders a very effective means of sharing information. Opinion leaders normally have significant capabilities in terms of domain knowledge (Mladenović et al., 2020a) and use their social influence and recognition (Cheong and Mohammed-Baksh, 2020) to share accumulated knowledge.

Nevertheless, the idea of information providing is based upon the assumption that others seek information (as indicated by the number of individual searches). Therefore, it is central that online information providers also exercise the role of information seekers, given their presumed willingness to acquire more domain knowledge (Y. Zhao et al., 2020b). **Online information seeking** is based on search queries (Liu, 2020) as information seekers look for information online (Hennig-Thurau et al., 2004). Generally, individuals extensively seek information online to make more informed decisions (Leonhardt et al., 2020). Individuals are increasingly using search engines to seek health-related information (Jokić-Begić et al., 2019) without proper consultation with medical staff. An extensive study by Microsoft revealed that online information sources are dominated by content that depicts serious but rare diseases and does not focus on the more benign elaboration of common symptoms (such as headaches) (Bochet et al., 2014). In the context of the COVID-19 pandemic, we assume that individuals looking to acquire information online possess shallow COVID-19 domain knowledge and are looking to reduce their health-related risks.

Lu et al. (2022) argued that **information forwarding** (or passing) is more likely to take place online, as the characteristics of this environment facilitate multi-directional communication. Similarly, Arruda Filho et al. (2021) concluded that individuals can almost effortlessly disseminate information online on a massive scale. Nevertheless, some scholars claim that information forwarding is an important and overlooked construct (Babić Rosario et al., 2020; Kim et al., 2018). In broad terms, it implies forwarding content through online channels (Lee and Choi, 2019) for various motives (such as altruism, fear, and empathy), and it potentially mediates the relationship between information seekers and information providers (Mladenovic et al., 2019). Information forwarding implies that individuals selectively pass COVID-19-related information to those socially close or distant individuals whom they perceive will be interested in it (e.g., due to their medical history, interests, etc.).

Online environments are a vast, convenient, and always available source of health-related information. They facilitate information sharing, retrieval, and forwarding on a massive scale. This can be attributed to previous extensive COVID-19 information searches that lead to cyberchondria, given the stance that individuals tend to get involved in information sharing and forwarding once they have a solid information base (Jokić-Begić et al., 2019; Laato et al., 2020a). In some cases, cyberchondria implies extreme involvement in information retrieval and the accumulation of health-related information. The COVID-19 pandemic has created varying degrees of health concerns, anxiety, and instability (Eger et al., 2021). Given its main postulates, TFA is well suited to the elaboration of cyberchondria. Based on TFA, we assume that individuals will provide and forward accumulated knowledge on their social networks. Consequently, they will further seek COVID-19 information to extend their information bases. In the context of COVID-19, TFA implies that if COVID-19-related information (e.g., symptoms, prevention, etc.) is not sought, forwarded, and provided on broader social networks (e.g., close and distant social circles), the overall consequences may be significantly negative (e.g., an increase in COVID-19 cases and deaths, economic slowdown, movement restrictions, etc.). Essentially, TFA suggests that individuals' response to information about a threatening or potentially harmful situation is influenced by their level of fear and the perceived efficacy of the recommended actions. For illustration, cyberchondria (during COVID-19) can influence individuals' informational behavior by increasing their level of fear and anxiety about the virus, potentially leading to maladaptive behaviors (e.g., information sharing, giving, and forwarding). Therefore, we assume that the level of health fear would influence not only information retrieval (further increasing cyberchondria), but also intentions to share and forward relevant health-related information (e.g., current COVID-19 restrictions) thus helping prevent further health-related risks (e.g., by improving the information bases of others). Although TFA is used in communication campaigns concerning product safety features, health, and health insurance promotion (see, for example, Addo et al., 2020; Ahmed et al., 2020; Laroche et al., 2001), there has been no research on its use in investigating information dynamics (seeking, forwarding and providing) in periods of crisis and emergencies.

Drawing on TFA postulates with regard to cyberchondria, based on the argumentation above, we propose the following hypotheses:

H3: Cyberchondria is directly and positively related to the seeking of COVID-19-related information.

H4: Cyberchondria is directly and positively related to the forwarding of COVID-19-related information.

H5: Cyberchondria is directly and positively related to the providing (giving) of COVID-19-related information.

The moderating role of fear levels on seeking, forwarding, and providing (COVID-19) information online.

Epidemics are not an uncommon crisis event in the broader context. The world has faced many epidemics of various lengths and severity in recent history (e.g., SARS, Spanish flu, H1N1 virus, etc.) (Lucas et al., 2020). What they have in common is that they are stressful experiences that may trigger an array of psychological states. For example, any large-scale health crisis normally has two types of direct effects on individual behavior (Wang et al., 2020). Firstly, it significantly affects everyday consumer behavior patterns (e.g., selection of products, impulsive buying, shopping frequency, etc.). Secondly, due to the increased health-related risks (e.g., the imminent risk of contracting COVID-19), individuals alter their health risk mitigation behaviors (Loxton et al., 2020; Schmidt et al., 2021), for example, by wearing facemasks or getting vaccinated as a proactive measure against the virus. Essentially, individuals alter their behavior due to the fear of potentially severe consequences (e.g., hospitalization due to COVID-19) if the risk is not properly recognized and mitigated.

Many authors argue that increased levels of fear and stress can induce more active individual approaches, which include broadening the information base needed for further decision-making (see, for example, Burroughs and Rindfleisch, 2002; Duhachek, 2005). Given that individual decision-making in crisis periods is significantly influenced by information from peers rather than from public service announcements (Chawla et al., 2021), it is reasonable to believe that individuals will increasingly become involved in information exchange during volatile periods such as the COVID-19 pandemic. Therefore, we assume that perceived levels of fear affect the propensity of individuals to engage in seeking, forwarding, and providing COVID-19-related information. This is based on the argument that the perceived higher level of (health or economic) fear is anchored in the potential negative societal and individual implications (Addo et al., 2020; Ahorsu et al., 2020). To prevent them from occurring (or to at least diminish their potential impact), individuals communicate important information through their social networks. Given the above-mentioned suggestive evidence, we

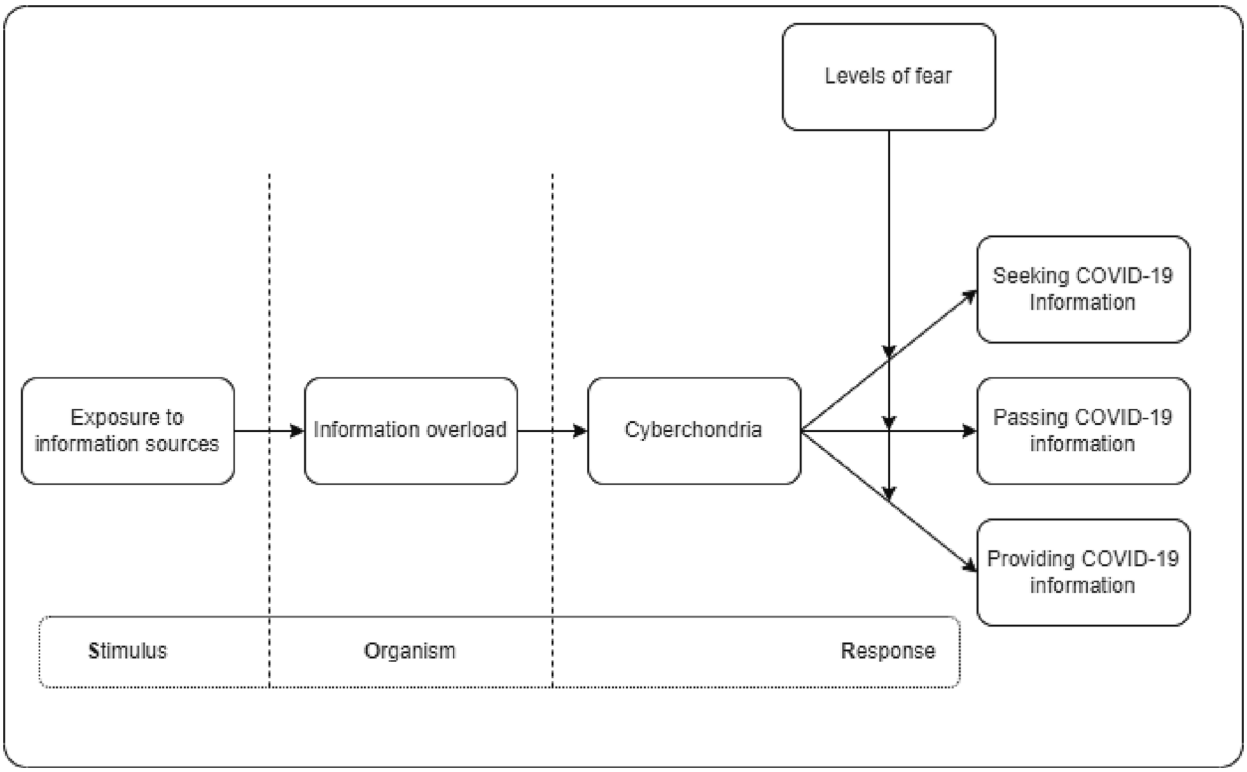

Fig. 1. Proposed research framework Source: Authors' elaboration.

posit the following:

H6: The level of fear moderates individuals' involvement in (a) seeking, (b) forwarding, and (c) providing COVID-19-related information (Fig. 1).

3. Methodology

To test the research model, data was collected via an online self-administered questionnaire. The questionnaire survey method was selected because of the advantages of this data collection method (Evans and Mathur, 2005) and the COVID-19 movement restrictions in place at the time of data collection. The data was collected in the period January-March 2021 in Georgia. To test the data collection method a pilot study was performed in December 2020 on a sample of 31 online respondents, as a result of which minor amendments to certain items were made. We excluded disengaged respondents by following the procedure suggested by Oppenheimer et al. (2009).

3.1. Measures

To capture various aspects of the behaviors of individuals, we largely adopted and amended the scales and items formulated in previous studies. We used Laato et al.'s (2020a) approach to model exposure to online information sources. In addition, the items for information overload were taken from Whelan et al. (2020) and those for cyberchondria from Jokić-Begić et al. (2019). To measure the seeking, passing, and providing of COVID-19-relevant information, we amended the scales from Lee and Choi (2019). The fear construct was measured using the five-item Fear of COVID-19 Scale (FCV-19S) scale developed by Ahorsu et al. (2020). All items were translated into the Georgian language using the double translation procedure proposed by Eremenco et al. (2005). To reduce the possibility of issues related to common method bias, we separated the independent and dependent constructs (as per the procedure suggested by Podsakoff et al., 2003). The online questionnaire survey consisted of closed-ended questions with 7-point Likert-type scales (1 – strongly agree, 7 – strongly disagree). The questionnaire consisted of four sections: (a) environmental stimuli variable – exposure to online information sources; (b) organism variables – information overload and cyberchondria; (c) response variables – information seeking, passing, providing, and FCV-19S items; and (d) demographic section.

3.2. Sample

To collect the data, we contacted online respondents in Georgia. We supplied them with the general contextual information related to the study, and a link to the questionnaire and requested that they complete it as best they could. To increase the likelihood of a

response, we followed the recommendation of Kees et al. (2017) and only contacted online respondents between Monday and Thursday. The sample size was calculated using the a priori approach proposed by Soper (2022). Given an anticipated effect size of 0.20 (Cohen, 1992), a targeted power level of 0.95, and 4 independent variables and 19 measured items with a 0.05 probability level, the required sample size was 215. In total, 572 online respondents were contacted, as a result of which 425 fully completed surveys were submitted for further processing. To increase the generalizability of the findings, respondents with diverse backgrounds (age, gender, education, residence, etc.) were selected (as per Mladenović et al., 2020). Approximately 63% of respondents identified as females, with the most populous age segments being 18 to 24 years (47%) and 25 to 35 years (33%). The basic demographic features of the sample are presented in Table 1.

4. Results

Before testing the research model, we performed multiple checks to ensure the reliability and validity of the collected data. To test the structural model itself, we used SmartPLS 3, since it is a widely used and reliable tool for detecting existing paths in covariance-based modeling (Goodhue et al., 2012; Hair et al., 2019).

4.1. Measurement model

First, we checked the internal consistency of the data by checking the convergent validity (Fornell and Larcker, 1981). We observed (a) individual item loadings, (b) composite reliability (CR), and (c) average variance extracted (AVE). As for the loading of the individual items, it had to be higher than the 0.7 benchmark. The results in Appendix 1 indicate that two items were below the minimum, and therefore they were excluded from further processing. CR had to be at least 0.8 and our data fully met this criterion. Finally, AVE had to be 0.5 or higher, a criterion that data successfully met. We concluded that the data had satisfactory convergent validity. Next, we checked the discriminant validity of the data by observing the correlation matrix (Table 2) and square roots of AVEs. The square roots of AVEs were higher than the correlation values in all cases. According to Field (2013), this indicates a sufficient level of discriminant validity.

Given the reliance on self-reported data, we performed Harman's single-factor test to check for common method bias, as per the procedure in Tehseen et al. (2017). Four factors were reported, of which the first factor (cyberchondria) explained 19.02% of the total variance, which is significantly below the 50% mark and indicates that there is no problem with common method bias in the model (Tehseen et al., 2017). Given that the sample contained a 63.5% female cluster, we wanted to check for eventual bias and performed a Chi-square test (as suggested by Mclaughlin and Drasgow, 1987). With a degree of freedom of 4 and a Chi-square value of 18.25, the results should not be biased (at a significance value of 1%). Finally, we checked for eventual differences between "early" and "late" respondents. Following the procedure by Shankar et al. (2020), the *t*-test indicated no significant variations in responses (demographic profiles, responses).

Table 1
Demographic profile of the sample (N = 425).

Variable	Frequency (Percentage)
Age	
18–24	200 (47,1%)
25–35	138 (32,5%)
36–45	29 (6,8%)
46–55	30 (7,1%)
56 and older	28 (6,5%)
Gender	
Male	155 (36,5%)
Female	270 (63,5%)
Education	
Pre-high school	39 (9,2%)
Vocational	26 (6,1%)
Bachelor's degree	164 (38,6%)
Master's degree	150 (35,3%)
Ph.D. and higher	46 (10,8%)
Occupation	
Student	134 (31,5%)
Owner/entrepreneur	27 (6,4%)
Government employee	73 (17,2%)
Private employee	174 (40,9%)
Other	17 (4%)

Source: Authors' elaboration.

Table 2
Correlation matrix.

	Items	1	2	3	4	5	6
Information Overload	3	**0.85**[a]	0.67[b]	0.48	0.50	0.60	0.55
Cyberchondria	4	0.66[c]	**0.82**	0.50	0.61	0.60	0.69
Seeking COVID-19 information	5	0.61	0.59	**0.76**	0.39	0.56	0.50
Passing COVID-19 information	5	0.58	0.51	0.49	**0.79**	0.49	0.39
Providing COVID-19 information	3	0.48	0.64	0.59	0.49	**0.72**	0.48
Fear	6	0.50	0.81	0.61	0.59	0.59	**0.85**

Note. SD: standard deviation, AVE: average variance extracted. Composite reliability is along the diagonal. [b] Correlations are above the diagonal. [c] Squared correlations are below the diagonal.
Source: Authors' elaboration.

4.2. Structural model

Having found that the scales used were valid and reliable and that the dataset was a good foundation for further analyses, we used SmartPLS 3 to test the proposed model (Fig. 2). This is a suitable tool as it produces robust and reliable outputs, even for smaller and diverse samples (Goodhue et al., 2012; Hair et al., 2019), and has been used in similar studies (Apuke and Omar, 2021; Apuke and Omar, 2020; Farooq et al., 2021; Kalia et al., 2021; Laato et al., 2020a).

The results of PLS-SEM indicate a satisfactory model fit ($\chi^2 = 287.01$, df 25, $\chi^2/df = 1.998$, $p < 0.001$, GFI = 0.88, AGFI = 0.79, CFI = 0.82 and RMSEA = 0.050). As predicted, perceived continuous exposure to online information sources had a positive and direct effect ($\beta = 0.92$, $p < 0.01$) on information overload (H1 was supported). Moreover, H2 was also supported, confirming a statistically significant relationship between cognitive overload and cyberchondria ($\beta = 2.40$, $p < 0.01$). With regard to the relationship between cyberchondria and seeking COVID-19-related information, the statistical outputs confirmed the significance ($\beta = 1.31$, $p < 0.01$) and positive influence in the predicted direction (i.e., H3 was supported). Contrary to the proposed hypothesis on the relationship between forwarding COVID-19-related information and cyberchondria, no evidence of a significant relationship was found (i.e., H4 was rejected). Finally, H5 was supported by the model ($\beta = 1.67$, $p < 0.05$), implying that a statistically significant relationship exists between cyberchondria and providing COVID-19-related information.

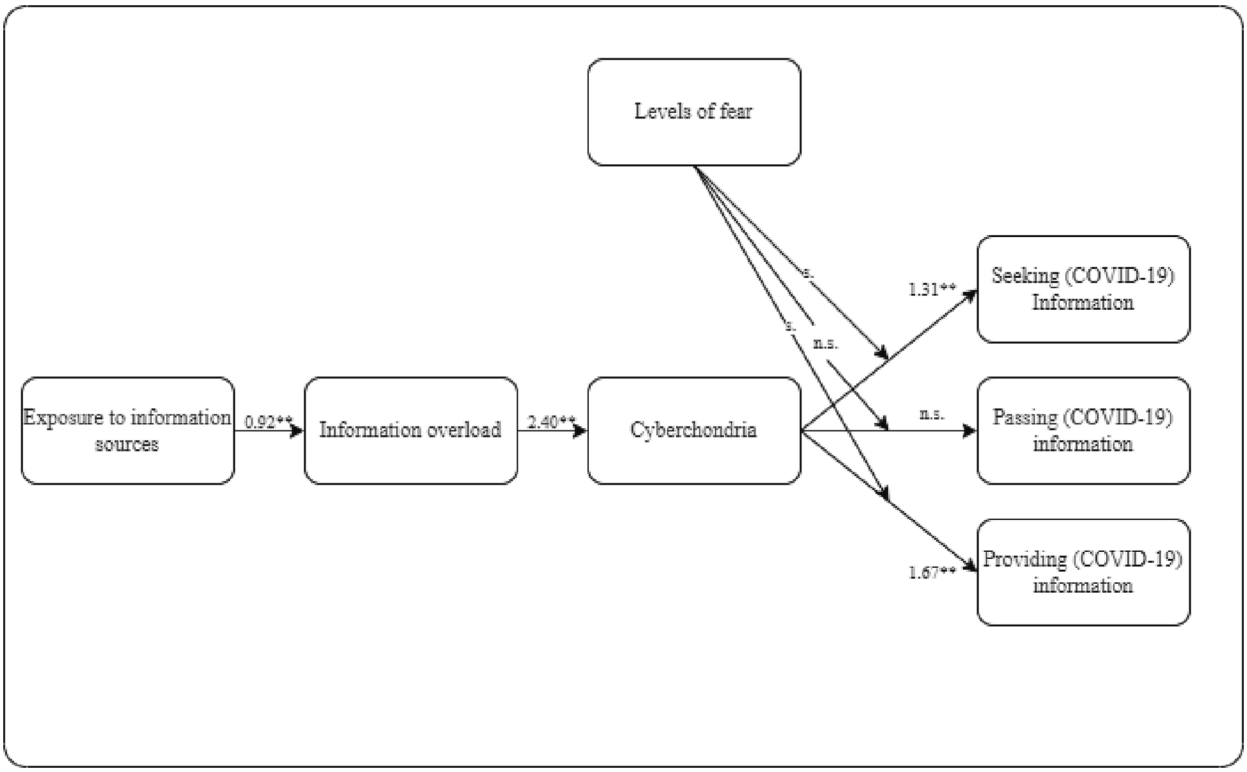

Fig. 2. Model results Source: Authors' elaboration; Note: s. – supported; n.s. – not supported; *p < 0.05; **p < 0.01.

4.3. Moderation analysis

Before testing for a moderation effect of the level of fear, we performed an invariance test as suggested by Steenkamp et al. (1995). The respondents (N = 425) were divided into three groups based on their perceived levels of fear (low, moderate, and high). There were two models: (a) a non-restricted model ($\chi^2 = 359.101$, df = 305, $\chi^2/df = 1.505$, $p < 0.001$, NFI = 0.870, CFI = 0.923, TLI = 0.904, RMSEA = 0.051) and (b) a full-metric invariance model ($\chi^2 = 391.142$, df = 294, $\chi^2/df = 1.998$, $p < 0.001$, NFI = 0.955, CFI = 0.973, TLI = 0.972, RMSEA = 0.060), which both had a statistically relevant fit, implying full metric invariance.

Results indicate (Table 3) that cyberchondria leads to the increased seeking of COVID-19-related information for all three observed levels of fear (low, moderate, and high). Moderate and high levels of fear were significant at a 1% level of significance. In the case of cyberchondria and forwarding COVID-19-related information, PLS-MGA indicates that only a low level of fear was significantly related to the forwarding of information (at a 5% level of significance). Finally, cyberchondria was directly related to providing COVID-19 information for all three levels, with moderate and high levels of fear at a 1% level of significance.

5. Discussion

The COVID-19 crisis led to informational confusion, driven by the online dissemination of massive amounts of contradictory, unreliable, and unsystematic information (Lu et al., 2022). This study developed and tested six hypotheses with the aid of PLS-SEM and multigroup analysis (PLS-MGA) to verify the possible moderation effects of online consumption of COVID-19-related information on psychological and behavioral responses. This is the first study to combine postulates of CLT (Kirschner, 2002), TFA (Addo et al., 2020; Boss et al., 2015; Shen and Dillard, 2014), and the S-O-R framework (Sherman et al., 1997) to investigate informational behavior during the crisis. In terms of the theory, it advances all of these areas, since it applies them in a crisis context. Almost all of the hypotheses were supported with convincing and strong results (except for H4).

The study found that exposure to COVID-19-related information sources influences people's psychological states and behavioral responses. The results strongly confirm the CLT-based assumption that individuals possess a limited capacity to process information (Kirschner, 2002). The results unambiguously indicate that continuous exposure to an overwhelming amount of online information sources has a positive and direct effect on perceived information overload, as predicted. This resonates with the reality that online users are overwhelmed with content. Moreover, it supports the literature that makes similar claims (Malik et al., 2020; Whelan et al., 2020). Notably, the study reveals that information overload is a strong predictor of the psychological state known as cyberchondria. This somewhat surprising finding supports our assumption that online users have tended to perform extensive information searches as a result of the massive amounts of inconsistent information they have received during the crisis.

In the context of the influence of cyberchondria and information flow, our results extend the existing body of research, which has not yet reflected the unique COVID-19-related communication environment. We discovered that cyberchondria is a solid predictor of information seeking and providing. This confirms that TFA (Eger et al., 2021) is a suitable framework for investigating the phenomenon, as the fear appeal reportedly influences users to seek additional information and provide their opinions to others. On the other hand, it does not seem to affect the forwarding of COVID-19-related information. This can be attributed to the fact that users tend to attach their own beliefs and perceptions to the original information (Jacobs et al., 2017; Kim and Kim, 2020) and therefore they do not forward only the original information itself. Moreover, given the induced fear appeal (Eger et al., 2021) and altruistic motives for communicating important information in times of crisis (Chawla et al., 2021), users tend to attach their own opinions. This is a promising research avenue given the fact that the online environment considerably enhances bi-directional information passing (Chawla et al., 2021; Rrustemi et al., 2021).

Fear is known to change individuals' propensity to engage in the proactive mitigation of consequences of risky events (Burroughs and Rindfleisch, 2002; Duhachek, 2005; Eger et al., 2021). Our results reveal that the level of fear moderates the relationship between cyberchondria and information seeking and providing. Notably, regardless of the level of perceived fear (low, moderate, or high), users tend to increasingly engage in information seeking and providing. Only a low level of perceived fear is related to induced information forwarding. This can be explained by the fact that users faced with higher levels of fear are more involved in communication, tend to grasp the holistic picture, and provide additional insights (Zhao et al., 2020a). Alternatively, social media companies may have introduced measures to curb the mass forwarding of COVID-19-related information (e.g., WhatsApp) (Laato et al., 2020b; Laato et al., 2020a).

The results have certain theoretical and practical implications for information retrieval, crisis communication, cyberchondria, and information overload during periods of crisis.

Table 3
PLS-MGA results for levels of fear.

Hypothesis	Relationship	Level of Fear		
		Low	Moderate	High
H6a	Cyberchondria -> Seeking (COVID-19) information	0.25*	0.49**	0.66**
H6b	Cyberchondria -> Forwarding (COVID-19) information	0.12*	0.26	0.16
H6c	Cyberchondria -> Providing (COVID-19) information	0.54*	0.61**	0.57**

Note: Significant at: *p < 0.05; **p < 0.01; S – supported; NS – Not supported.
Source: Authors' elaboration.

5.1. Theoretical implications

The major theoretical contribution of this study lies in the development of a theoretical model that explains the relationships between information sources, information overload, cyberchondria, and informational behavior. By confirming the proposed hypotheses, the results significantly expand the domain knowledge around CLT and TFA. Specifically, results add new insights in terms that excessive exposure to online information sources leads to information overload (see, for example, Bermes, 2021; Laato et al., 2020b, 2020a; Liu et al., 2021). The results also confirmed Laato et al.'s (2020a) reasoning that cyberchondria induces further behavioral responses. Consequently, extensive seeking and providing of (COVID-19-related) information. Strikingly, information forwarding has not been related to cyberchondria (H4). This opens up the debate on a wider set of research fields where information overload and cyberchondria can influence behavioral and psychological responses.

Secondly, unlike previous studies that focused on relationships between cyberchondria and intention to isolate (Farooq et al., 2020), unusual purchase (Laato et al., 2020a), and information avoidance (Kim et al., 2020; Soroya et al., 2021), this study captured the impact of cyberchondria on informational behavior during the global crisis, a largely unexplored context to date (Honora et al., 2022). Results allowed us to portray the adverse influence of cyberchondria on information flows during a crisis. Essentially, we responded to recent calls for more empirically based studies in the domains of online information sources and information flow and retrieval (Chawla et al., 2021; Gever et al., 2021; Honora et al., 2022; Lu et al., 2022). By revealing that exposure to an excessive amount of information sources leads to information overload, which further induces cyberchondria, we mapped the relationship between heavy exposure to information sources online and cyberchondria.

The data was collected in Georgia, a country that has largely gone unnoticed in scientific terms in the context of informational behavior, cyberchondria, information overload, and COVID-19 (Georgia). Consequently, we were able to largely verify the built-up theoretical framework in a novel and unexplored country context. Findings reveal a significant level of convergence with insights already accumulated in developed countries, which supports the global identity argument (Makri et al., 2021). Moreover, abysmal variations in online informational behavior patterns between different countries and cultures. On a methodological note, we translated and verified the reliability of the used scales in the Georgian language. Therefore, scholars may use those in their future endeavors.

Finally, the S-O-R model proved to be a reliable theoretical framework in the context of crisis events. We employed information sources as *stimuli*, information overload as an *organism*, and the cyberchondria and information flow constructs as *responses*. Given that the model supported almost all of the hypotheses, we can conclude that it is a useful aid in portraying users' behavior during crisis events.

5.2. Practical implications

The results of the study have two important societal implications. Firstly, findings reveal a strong relationship between exposure to online sources and information overload, and between information overload and cyberchondria. Therefore, (health) authorities must pay utmost attention to providing relevant and timely information through credible sources, to curb the adverse effects of information overload and cyberchondria (e.g., anxiety, anger, depression, decreased processing capacity, etc. To do so, a series of nudging interventions can be an effective method (Cesareo et al., 2022) (e.g., frequent communication, messages adapted to various formats and online channels, strict penalties for disseminating spurious information, etc.). To date, nudging measures have been successful in combating "benign" misinformation and hearsay (Kim and Dennis, 2019), but there has been no empirical verification in a crisis context.

Secondly, given that cyberchondria has been found to trigger more information seeking and providing, authorities must coordinate the communication of important information with other stakeholders (e.g., news portals, search engines, journalists, etc.). In a certain way, Google led the way during the pandemic and channeled users primarily to credible and relevant sources (e.g., the World Health Organization, the websites of local health authorities, etc.)(Laato et al., 2020b). Nevertheless, this is an isolated case and Google is not the leading search engine in all countries (Mladenović et al., 2022). Therefore, we suggest the creation of a constellation of critical stakeholders that would disseminate information (e.g., journalists, TV and radio stations, news portals, search engines, health authorities, research institutions, etc.) and prepare a multi-layered crisis communication scenario. Given the dominant virtual prefix of information retrieval nowadays (Ireland, 2018), social media platforms must also be involved in this task. Although the task may seem elaborate, it certainly reflects the complexity of the phenomenon we have tried to decipher.

Essentially, there is an escalating urge for more responsible and methodologically sound informational behavior online. Individuals must be aware that exposure to numerous information sources online progressively leads to unfavorable psychological and behavioral reactions over time (e.g., anxiety, anger, depression, cyberchondria, information overload, etc.). As a general recommendation on an individual level, individuals must equip themselves with the necessary skills to recognize, retrieve, and disseminate only relevant and credible information. Although, that may prove to be a demanding and long-term task nowadays.

5.3. Limitations of the study and future research

There are several limitations associated with this study. Firstly, although Georgia is a suitable environment for obtaining strong empirical evidence, other countries may exhibit different communication patterns and health-mitigation strategies. Given that culture is a broad framework that influences individual behavior (Leonhardt et al., 2020), it would certainly be beneficial to replicate our study design in more (culturally) distant countries. We did not observe causality between the variables, as we relied on a self-administered questionnaire as the data collection method. For a better understanding of information overload, cyberchondria, and crisis

communication it would be beneficial to use experimental designs or more qualitative approaches to investigate in-depth background dynamics (Maier et al., 2023). Similarly, our research design could be replicated and tested using other statistical approaches (e.g., sequential mediation modeling) to draw more reliable conclusions on the role of various mediators (information overload, cyberchondria). The study examined a single moderator (level of fear), but there could be other moderators or mediators in the model (e.g., social tie, conformity, cultural dimensions, psychological traits, etc.). Taken together they represent a promising area for future research. Although information seeking, forwarding, and providing have received a certain amount of research attention, to verify the accumulated findings we studied these variables in the context of a time of crisis, i.e., during the COVID-19 pandemic. Nevertheless, for a deeper understanding of individual crisis communication, it would be beneficial to capture the post-crisis communication dynamics (e.g., post-COVID-19), as they may differ significantly. Our results unexpectedly indicated that the forwarding of COVID-19-related information is not induced by the psychological state of cyberchondria. Future studies could investigate this finding to better comprehend the causes. Finally, the sample in this study was somewhat unbalanced in terms of the represented age groups (around 60 % were under the age of 35). Given that different generations tend to have different communication habits (Martin et al., 2019), understandings of crisis (Eger et al., 2021), and perceptions of health-related risks (Han et al., 2022), we suggest that future studies focus on older individuals (given that they were were most affected during the COVID-19 pandemic).

6. Conclusion

This study relied on the S-O-R model, CLT, and TFA to theoretically anchor, quantify, analyze, and comprehend the communication dynamics between exposure to online sources of information and the seeking, forwarding, and providing of COVID-19-related information. We collected data from a diverse sample of Georgian respondents (N = 425) at the beginning of 2021 (at a time when Georgia was experiencing a severe COVID-19 crisis). The empirically verified outputs indicate that individuals perceived that continuous exposure to online information sources led directly to information overload, which subsequently had a direct effect on the psychological state known as cyberchondria. Cyberchondria, in turn, is significantly related to the seeking and providing of COVID-19-related information. Contrary to one of our hypotheses, cyberchondria did not predict the forwarding of COVID-19-related information, which can be considered a significant research prospect given the ease of forwarding information online (Rrustemi et al., 2021). It must be noted that our conclusions are based on the analyzed theoretical constructs and that other variables may impede the observed relationships (e.g., moderate, meditate, etc.). Generally, given that times of crisis are anomalies rather than the norm, data collection presents a major challenge. Therefore, we encourage academicians and authorities (such as statistical offices) to collect data whenever the exogenous context presents itself, to contribute to the understanding of individual communication patterns in times of crisis and a broader understanding of the observed variables.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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