

**NANYANG
TECHNOLOGICAL
UNIVERSITY**

SINGAPORE

**DEVELOPING A THEORETICAL MODEL TO EXAMINE THE
ANTECEDENTS TO CYBERCHONDRIA AMONG CHINESE
INTERNET USERS**

ZHENG HAN

WEE KIM WEE SCHOOL OF COMMUNICATION AND INFORMATION

2022

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INFORMATION**

A thesis submitted to the Nanyang Technological University in partial
fulfilment of the requirement for the degree of
Doctor of Philosophy

2022

Statement of Originality

I hereby certify that the work embodied in this thesis is the result of original research, is free of plagiarised materials, and has not been submitted for a higher degree to any other University or Institution.

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Zheng Han

Supervisor Declaration Statement

I have reviewed the content and presentation style of this thesis and declare it is free of plagiarism and of sufficient grammatical clarity to be examined. To the best of my knowledge, the research and writing are those of the candidate except as acknowledged in the Author Attribution Statement. I confirm that the investigations were conducted in accord with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice.

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Prof Theng Yin Leng

Authorship Attribution Statement

This thesis contains material from two papers published in the following peer-reviewed journals in which I am listed as an author.

Chapter 3 is published as **Zheng, H.**, Sin, S.-C. J., Kim, H. K., & Theng, Y.-L. (2021). Cyberchondria: A Systematic Review. *Internet Research*, 31(2), 677–698.

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The contributions of the co-authors are as follows:

- I designed the study. I also searched for the literature and selected the sample articles.
- I prepared the manuscript draft. Dr Theng Yin Leng, Dr Sin Sei Ching Joanna, and Dr Kim Hye Kyung provided comments and edits, and I revised the manuscript based on their feedback.

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The contributions of the co-authors are as follows:

- I designed the study. I also collected and analyzed the data.
- I prepared the manuscript draft. Dr Theng Yin Leng, Dr Sin Sei Ching Joanna, and Dr Kim Hye Kyung provided comments and edits, and I revised the manuscript based on their feedback.

Please note that some content in the two publications is also used in Chapter 1 and 2 such as research background and definition of cyberchondria.

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Zheng Han

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ABSTRACT

Cyberchondria refers to a state in which a person experiences several behavioral, cognitive, and affective patterns, including excessive online health information seeking, along with distress, compulsion, and reassurance. As a nascent research area, limited research has explored the complex processes underlying how cyberchondria arises during online health information searches. Therefore, the purpose of this thesis was to develop a theoretical model to explicate the process of cyberchondria development and examine the antecedents to cyberchondria among Chinese Internet users.

This doctoral thesis consists of three studies. Study One conducted a systematic review to summarize the measurements of cyberchondria as well as antecedents and consequences of cyberchondria, providing an overview of empirical research on cyberchondria. Next, informed by information management theories and the hybrid model of cyberchondria, this thesis proposed an integrative theoretical model, cyberchondria development model, to explain how individuals develop cyberchondria when searching for health-related information on the Internet.

Study Two tested the applicability and validity of the cyberchondria development model on a sample of 426 Internet users in China using a cross-sectional online survey. Results of this study provided support to the process of cyberchondria development as depicted in the theoretical model, where perceived health threat of common symptoms can be a trigger of health anxiety, which motivates online health information seeking (OHIS) through the perception of information insufficiency, the gap between perceived current knowledge and sufficiency threshold. Additionally, source beliefs can strengthen the effect of information insufficiency on OHIS. Further, regular OHIS may result in cyberchondria, especially for people with negative metacognitive beliefs. Theoretical and practical implications of this study were discussed.

To address the limitation of cross-sectional design in the previous study, Study Three conducted a three-wave longitudinal panel study to examine the cross-lagged effects of health anxiety, information insufficiency and OHIS on cyberchondria. Results showed that (a) health anxiety at Wave 1 had a cross-lagged effect on information insufficiency at Wave 2; (b) there was a reciprocal relationship between information insufficiency and OHIS from Wave 1 to Wave 2; (c) information insufficiency at Wave 1 increased OHIS at Wave 2, which further predicted cyberchondria at Wave 3; (d) OHIS at Wave 2 decreased health anxiety at Wave 3, while OHIS at Wave 2 increased cyberchondria at Wave 3; and (e) the three antecedents (i.e., health anxiety, information insufficiency, and OHIS) were directly and positively related to cyberchondria across the waves, except that information insufficiency at Wave 1 did not predict cyberchondria at Wave 2. In summary, this study further revealed the complex and dynamic processes underlying the development of cyberchondria.

In conclusion, this thesis has addressed important research gaps in the existing cyberchondria literature and provided a more nuanced understanding of this new phenomenon in the digital age. It is hoped that the findings of this thesis can advance the field of cyberchondria research theoretically and practically, through conceptualizing cyberchondria as a multidimensional phenomenon, systematically summarizing the empirical landscape, developing an integrative theoretical framework, as well as empirically validating the framework using both cross-sectional and longitudinal designs.

CHAPTER ONE: INTRODUCTION

1.1 Background

The Internet has become commonplace for individuals to seek medical information in the past two decades (Kaya & Gündoğan, 2018; Murero & Rice, 2006; Rice & Katz, 2001). For instance, 72.7% of American adults would prefer to use the Internet as a primary source to obtain information about health or medical topics (HINTS5, 2019). Similarly, a multinational survey of 9,086 smartphone users found that a large proportion of people in Asian countries such as Vietnam (86%) and China (79%) frequently search for health information on the Internet (Wang & Lee, 2020). These trends are not surprising because online health information seeking (hereafter referred to as OHIS) offers a variety of benefits, such as acquiring information at lower costs and with greater convenience and efficiency (Starcevic, 2017). Internet-based health information can help people make informed health decisions and empower them to better communicate with physicians about their health problems (Murero & Rice, 2006; Rice & Katz, 2001).

Despite tangible benefits from using the Internet to search for medical information, certain qualities of medical information online can lead to unintended effects. First, some content might be too technical for lay persons to comprehend (Chung, 2013). Second, the use of online information is often disorganized and of low quality, and information from different sources might be conflicting and inaccurate. These features can make the search results less meaningful and useful compared to the information obtained from medical professionals (Starcevic & Berle, 2013). Third, being confronted with a great amount of medical information online, users might have problems with the selection and identification of credible and useful information (McManus et al., 2014). Hence, these characteristics of online medical information may cause unnecessary

worry or concern about health as well as further continuous checking (Doherty-Torstrick et al., 2016).

The phenomenon of individuals who are increasingly worried or anxious about their physical health conditions while excessively searching for medical information online is referred to as “cyberchondria” (Starcevic, 2017). The term “cyberchondria” was first proposed by news media to describe the adverse impact associated with digital technology in 1999 (Starcevic & Berle, 2013; Zheng & Tandoc, 2020), but it has only been received attention from researchers and healthcare professionals in recent years (Fergus & Dolan, 2014; Norr et al., 2015b). After that, a number of documents, within or outside of academia, report that individuals are spending more and more time on searching for health information on the Internet, which is related to increased health anxiety (BBC News, 2001; Doherty-Torstrick et al., 2016; Harding et al., 2008; Muse et al., 2012; Starcevic, 2017; Wells, 2002). For instance, a non-clinical study conducted by White and Horvitz (2009b) found that more than 40% of people who frequently engaged in online health searches experienced more health anxiety.

The phenomenon of cyberchondria is particularly evident in the context of public crises. For instance, during the COVID-19 pandemic, the Internet has become a main source for those who are quarantined at home to obtain virus-related information (Li & Zheng, 2020). While such Internet use can be a safety-seeking behavior such as researching precautionary measures against virus infection, a plethora of unverified information online might make people feel more uncertain about the situation and worry about their health (Xie et al., 2020). Evidence suggests that people affected by quarantine suffer from anxiety symptoms and they tend to frequently seek more information about the pandemic for reassurance (Jungmann & Witthöft, 2020), which might be a precondition for developing cyberchondria. Therefore, investigation of possible

factors associated with cyberchondria can help better understand its development and maintenance in this particular situation.

Although it is premature to classify cyberchondria as a clinical disorder, previous research has indeed found that cyberchondria is associated with some negative consequences such as functional impairment and poor quality of life (Mathes et al., 2018). Moreover, Barke et al. (2016) found that cyberchondria is related to an increased level of healthcare utilization, measured by the number of visits to medical professionals. Consequently, cyberchondria is qualified as a public health problem, which has increasingly received attention from academic scholars in recent years (Starcevic et al., 2020). Emerging research is moving towards investigating how individuals develop cyberchondria when they search for health-related information on the Internet (Fergus & Spada, 2018).

1.2 Research Gaps

Despite a growing number of studies dedicated to understanding the phenomenon of cyberchondria, research on cyberchondria is still in its infancy and there remain several major gaps that need to be addressed. First and foremost, one of the main gaps is that there is little systematic knowledge regarding the current state of cyberchondria research. In particular, it is unclear how cyberchondria has been operationalized and measured in the literature. Also, factors related to cyberchondria are not systematically examined. Since cyberchondria is a new concept in academic literature, it is especially important for scholars to measure this type of health-related issue empirically, which can further help the development of effective treatment interventions. Some early studies have investigated cyberchondria through measuring the relationship between health anxiety and OHIS behavior (e.g., Baumgartner & Hartmann, 2011;

Fergus, 2013; Muse et al., 2012). Subsequently, McElroy and Shevlin (2014) developed and initially validated a multidimensional construct named the Cyberchondria Severity Scale (CSS), and a series of studies used this scale to measure cyberchondria and examine factors related to cyberchondria (e.g., Fergus & Spada, 2017, 2018; Mathes et al., 2018). However, these studies were conducted in different contexts and populations, and it still lacks a clear overall picture of how existing studies have measured cyberchondria and what factors are related to cyberchondria.

The second gap in cyberchondria research exists in the lack of a theoretical model from an information seeking perspective to explain the process of cyberchondria development among Internet users. Some scholars (Brown et al., 2019; Starcevic, Berle, et al., 2020) have suggested that the concept of cyberchondria is consistent with several models of health anxiety, such as cognitive behavioral models of health anxiety (Taylor & Asmundson, 2004; Warwick & Salkovskis, 1990). While these models suggest that excessive searches for health information can contribute to the maintenance of health anxiety, they typically draw such conclusions from psychology research, and regard cyberchondria as a type of mental disorders. However, cyberchondria has not yet been classified as a clinical disorder in medical research (Starcevic & Berle, 2015). Understanding cyberchondria from an information seeking perspective is important because cyberchondria describes not only a negative emotional state (i.e., heightened health anxiety), but also an abnormal and pathological information seeking in an online context (Starcevic et al., 2019; Starcevic & Berle, 2013). As a result, further conceptualization and investigation are required to reflect the multidimensional nature of cyberchondria.

Also, it is still unclear about how and why cyberchondria arises when individuals search for medical information online. Instead of regarding cyberchondria as a reflection of a stable level of increased health anxiety, developing conceptualizations to detail the process of

cyberchondria development should be more significant and meaningful (Fergus & Spada, 2018). This can help healthcare professionals and researchers propose evidence-based treatment strategies for this new but common health-related issue. For information science scholars, it is pertinent to draw from existing information seeking models and develop a refined and integrative model from both psychology and information seeking perspectives. Such theories or theoretical models can provide a more comprehensive examination of the phenomenon and offer insights into the process of cyberchondria development systematically.

The third gap of cyberchondria research is that much of existing empirical work overly focus on examining a wide range of psychological factors related to cyberchondria; however, the roles of social and communicative factors that might have an impact on its development are neglected. For example, several studies have demonstrated that cyberchondria is positively associated with psychological factors such as obsessive-compulsive disorder (OCD), anxiety sensitivity, and intolerance of uncertainty (e.g., Fergus, 2014, 2015; Norr et al., 2015c). However, the risk information seeking and processing (RISP) model suggests that health-related information seeking may also be triggered by social or communicative factors such as informational subjective norms (Griffin et al., 1999; Yang et al., 2014). As cyberchondria comprises of a type of addictive information seeking behavior, these factors may provide more insights on how normal OHIS becomes abnormal and pathological. Therefore, more theoretically-driven empirical attempts are needed in this nascent area to further investigate antecedents to cyberchondria.

The fourth gap is a lack of in-depth studies to look into how potential factors can contribute to the development of cyberchondria over time. Cyberchondria is a complex phenomenon that develops in the process of searching for medical information on the Internet,

and it can last for a certain period if individuals keep such behavior (Starcevic & Berle, 2017). While a group of studies has shown the correlations between various factors (e.g., intolerance of uncertainty, problematic Internet use, anxiety sensitivity, etc.) and cyberchondria (e.g., Fergus & Spada, 2018; Mathes et al., 2018), the majority of these studies used a cross-sectional study design, indicating that the evolving effects of these factors are still unknown. In addition, there might exist some reciprocal relationships between antecedents to cyberchondria (e.g., health anxiety, information insufficiency, and OHIS), which further enhance their impacts on cyberchondria over time (te Poel et al., 2016). Thus, to further understand the potential antecedents to cyberchondria within a theoretical model, it is pertinent to figure out how these variables can predict the development of cyberchondria in a given timeframe, which is beneficial for proposing effective intervention strategies to manage cyberchondria in the future.

1.3 Research Objectives

Considering the research gaps mentioned above, this thesis addressed an overarching research question: “how do individuals develop cyberchondria when they search for health-related information on the Internet?” In particular, there are four specific objectives addressing this research question. First, this thesis investigated and synthesized the empirical literature to provide a landscape of cyberchondria research. Second, based on the existing models related to OHIS and cyberchondria, it attempted to build an integrative theoretical model to explicate how OHIS and its associated factors contribute to the development of cyberchondria. Third, this research examined the antecedents to cyberchondria proposed in the model empirically among a sample of individuals who had the experience of searching for health-related information on the Internet in China. Fourth, this research further explored the evolving effects of these antecedents

on cyberchondria over time. To this end, several key variables in the proposed model were tested using a longitudinal design. In summary, based on the findings of this thesis, theoretical implications are drawn so that information science scholars working in this area can further conceptualize cyberchondria. Also, practical suggestions are proposed for health professionals on how to alleviate the problems associated with cyberchondria in the public.

1.4 Thesis Outline

This thesis report consists of seven chapters. First, the research gaps and objectives of the entire research project have been described in this chapter—Chapter One. The next chapter—Chapter Two—introduces the conceptualization of cyberchondria. Specifically, it reviews the definitions of cyberchondria within and outside of academia. It also seeks to unpack the differences between the terms “cyberchondria,” “health anxiety,” and “hypochondriasis.” Considering the strengths and weaknesses of existing definitions, a refined working definition of cyberchondria for the current research is proposed. Last but not least, it provides an overview of the existing theoretical frameworks or models related to cyberchondria in the literature.

Next, Chapter Three, as the first study in this thesis report, conducts a systematic review to summarize the measures of cyberchondria as well as factors related to cyberchondria. This study aims to address the first research objective. The systematic review follows the guidelines in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Moher et al., 2009) and 40 studies are included in the final sample based on a set of inclusion and exclusion criteria. General characteristics of the studies, approaches to measuring cyberchondria, and antecedents and consequences of cyberchondria in these studies are reported. Implications of the systematic review are discussed in the end.

Chapter Four aims to build an overarching theoretical model specifically for cyberchondria from both psychology and information seeking perspectives. This chapter seeks to address the second research objective. First, informed by information management theories such as the risk information seeking and processing model and theory of motivated information management (Afifi & Weiner, 2004; Griffin et al., 1999), it identifies a variety of predictors of OHIS, such as perceived health threat, health anxiety, information insufficiency, and informational subjective norms. Further, drawing upon the hybrid model of cyberchondria (Brown et al., 2019), it explains how some regular OHIS may translate into cyberchondria. More specifically, cyberchondria is envisaged as a negative outcome of regular OHIS, and negative metacognitive beliefs provide a boundary condition in this process. In short, this integrative model connects two research areas (i.e., OHIS and cyberchondria) and theorizes the process of cyberchondria development. At the end of this chapter, several hypotheses are proposed for further empirical testing.

Chapter Five presents the second study of this thesis, and it seeks to test the model proposed in Chapter Four empirically on a sample of 426 Chinese Internet users. This study aims to address the third research objective. Data were collected using an online cross-sectional survey. Structural equation modelling, a sophisticated statistical approach, was adopted to analyze the data. The results indicate that the majority of the hypotheses are statistically significant, providing support for the process of cyberchondria development depicted in the theoretical model.

Chapter Six presents the third study of this thesis, addressing the fourth research objective. It aims to examine how three key antecedents in the proposed model, including health anxiety, information insufficiency, and OHIS, contribute to the development of cyberchondria

over time. To this end, a 3-wave longitudinal panel study was conducted to test the evolving effects of the three variables on cyberchondria. The results demonstrated the cross-lagged effects of the three factors on cyberchondria across study waves, further revealing the dynamic and complex mechanisms underlying cyberchondria development.

Finally, Chapter Seven summarizes the findings from this thesis. Also, several future directions in the area of cyberchondria are discussed. It is hoped that all the studies in this doctoral research project can contribute to a more nuanced understanding of cyberchondria theoretically and practically. In particular, a summary of cyberchondria measures and factors related to cyberchondria gives a sense of the current state of empirical literature in cyberchondria. The proposed model addresses the weaknesses of current theoretical frameworks in cyberchondria literature, and it takes into account affective, cognitive, and social factors to detail the process of how individuals develop cyberchondria in an online context. The two empirical studies test and validate the proposed model and provide implications for advancing the current theoretical frameworks or models of cyberchondria. Figure 1.1 summarizes the outline of this thesis report and how the research gaps will be addressed. Before conducting a systematic review in this new research area, the next chapter gives a detailed introduction of the concept of cyberchondria and relevant theories in this research area.

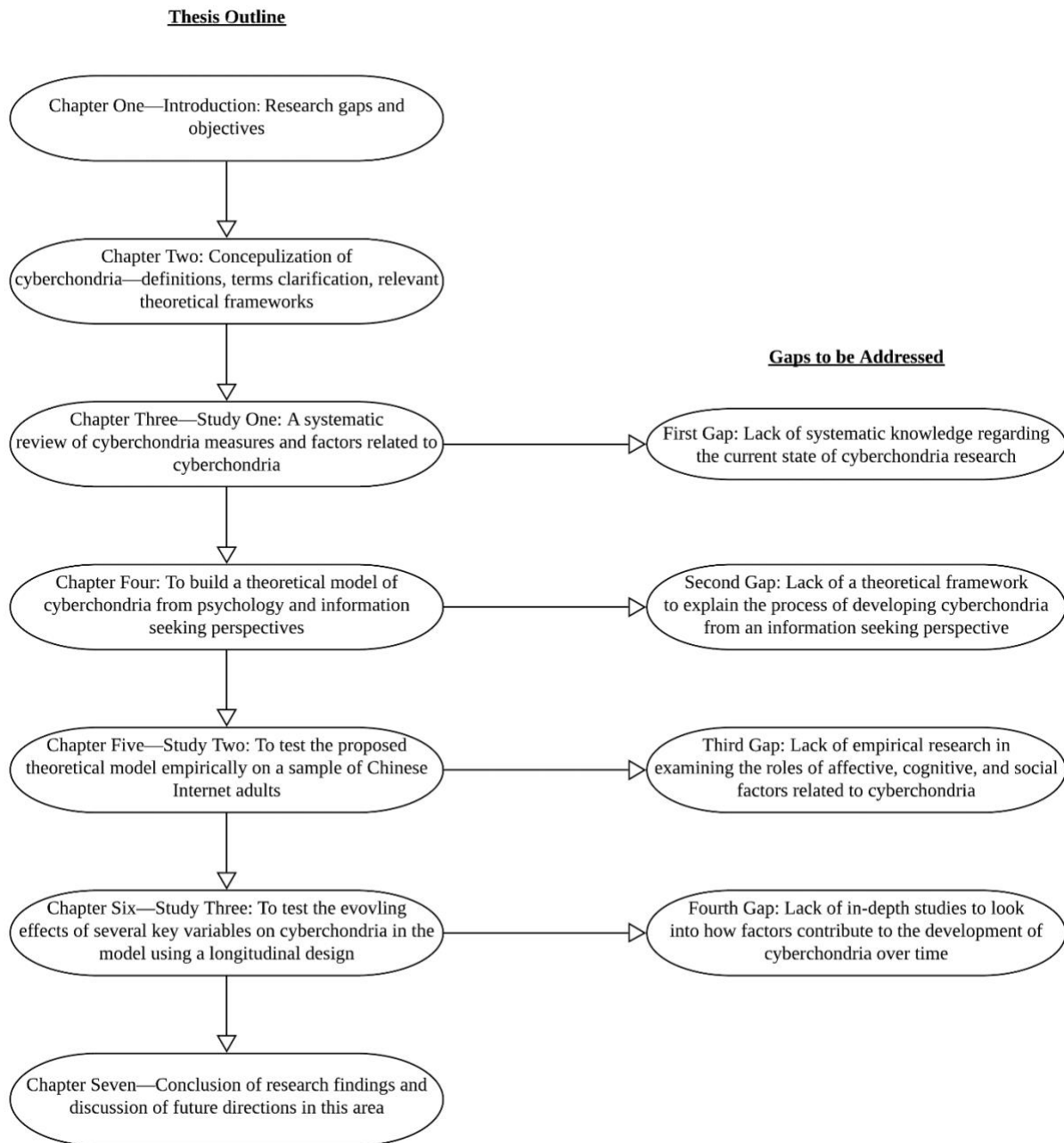


Figure 1.1. Thesis report flowchart.

CHAPTER TWO: CONCEPT OF CYBERCHONDRIA

This chapter seeks to unpack the concept of cyberchondria. Particularly, it consolidates existing understanding of what cyberchondria is by reviewing definitions of cyberchondria in both news media and academic literature. Next, this chapter discusses how the terms “cyberchondria,” “health anxiety,” and “hypochondriasis” are related and distinguished. Considering the terminology confusion between cyberchondria and health anxiety, a refined definition of cyberchondria is proposed in the current research. Lastly, several theoretical frameworks related to cyberchondria in the literature are reviewed and the strengths and weaknesses of these frameworks are assessed.

2.1 Conceptualization of Cyberchondria

2.1.1 Definition of cyberchondria

The term “cyberchondria” describes the relationship between excessive online health searches and increased health anxiety, and it was derived from the words *cyber* and *hypochondriasis*. Hence, from the literal meaning, cyberchondria is a form of hypochondriasis related to the Internet use or even caused by such use. Similar to other pathologies that are attributable to the Internet such as problematic Internet use and Internet addiction, cyberchondria was originally introduced and promoted by news media. In recent years, scholars and medical professional have started to examine this phenomenon (Zheng & Tandoc, 2020). While some researchers claimed that in 1999, the journalist Ann Carrns first mentioned cyberchondria in the *Wall Street Journal*, it is still unclear who first coined the term or when it was used (Starcevic & Berle, 2013). According to the news report, health information on the Internet is unmanageable,

raising people's anxiety levels. Afterwards, the term "cyberchondria" was largely popularized by news media because of its novelty with emphasizing the side effects of technological development as well as potential for making a "good story" (BBC News, 2001; WebMD, 2002).

News media have proposed nuanced definitions of cyberchondria over time, and most definitions view cyberchondria as a disorder and emphasize an element of anxiety. For example, a British news article published in 2001 first wrote that cyberchondria is a new mental illness that sweeps the Internet (Valley, 2001). Some news articles further described cyberchondria as "a state of medical anxiety, caused by researching a medical illness or symptoms" (Kulkarni, 2007). While new media wrote that this pathological state requires formal diagnosis (Belling, 2006), they did not suggest how it is distinct from other psychiatric conditions and how it can be assessed. Also, several news articles equated cyberchondria with hypochondriasis using the terms such as "the online counterpart of hypochondria" (Pickover, 2013) or "a modern form of hypochondria" (Pemberton, 2018). One article argued that cyberchondria can be "even more harmful because of the glut of sometimes dubious material that is available at the click of a mouse" (Innes, 2013). More recently, the *New York Times* defined cyberchondria as "the irrational fear of some phantom illness" (Wollan, 2018), and the *Guardian* wrote that it can be "a vicious cycle of worry" (Dillner, 2016). On the other hand, a few news articles viewed cyberchondria as an information seeking behavior. For example, cyberchondria can be "the practice of leaping to dire conclusions while researching health matters online" (Markoff, 2008), and it is "the excessive use of internet health websites" (Han, 2015).

Therefore, due to its terminological confusion, the term "cyberchondria" has not been accepted by the majority of mental health professionals. More specifically, while cyberchondria can be a manifestation of hypochondriasis in the digital age, which means a type of mental

disorder, it can also be interpreted as a behavior of mere online medical information seeking. As such, the meaning of cyberchondria is ambiguous despite the fact that it has been directly or indirectly exposed in many news articles.

Also, researchers have given much attention to the conceptualization of cyberchondria in recent years, proposing a variety of definitions regarding this phenomenon. The most seminal definition in the early stage is the one proposed by Starcevic and Berle (2013). They defined cyberchondria as “excessive or repeated search for health-related information on the Internet, driven by distress or anxiety about health, which only amplifies such distress or anxiety” (p. 206). Subsequently, many other scholars have shared and used this definition because it contains two key elements of cyberchondria: excessive online health research and increased health anxiety (Doherty-Torstrick et al., 2016; Fergus, 2014, 2015; Fergus & Russell, 2016; McElroy & Shevlin, 2014; Norr et al., 2014; Norr et al., 2015a; Norr et al., 2015b; Singh & Brown, 2014; Tanis et al., 2016; te Poel et al., 2016). Table 2.1 summarizes some definitions of cyberchondria proposed by various scholars in the literature.

In addition, it should be noted that the term “cyberchondria by proxy” is a related concept but distinct from cyberchondria. Cyberchondria describes that an individual experiences more emotional distress in the process of excessive online searches for the sake of their own health. However, cyberchondria by proxy refers to an increase in anxiety when searching for health-related information for others (e.g., family members, friends, etc.) (Aiken & Kirwan, 2014). This thesis mainly focuses on the concept of cyberchondria instead of cyberchondria by proxy because cyberchondria is a more common phenomenon among Internet users in this digital age (Starcevic & Berle, 2015).

Table 2.1. Definitions of cyberchondria.

Source and reference	Definition
Belling, 2006 (p. 385)	“Health anxiety exacerbated by exposure to Internet-based information.”
Harding et al., 2008 (p. 315)	“Excessive health anxiety generated from online health searches.”
White and Horvitz, 2009 (p. 1)	“Unfounded escalation of concerns about common symptomatology, based on the review of search results and literature on the Web.”
Recupero, 2010 (p. 26)	“Escalation of health-related fears by consumers who use the Internet to research health and medical information.”
Fergus, 2013 (p. 735)	“Searching for medical information on the Internet” [that] “is associated with an exacerbation of health anxiety.”
Starcevic and Berle, 2013 (p. 206)	“Excessive or repeated search for health-related information on the Internet, driven by distress or anxiety about health, which only amplifies such distress or anxiety.”
Aiken and Kirwan, 2014 (p. 158)	“Anxiety resulting from health-related search online.”
McElroy and Shevlin, 2014 (p. 259)	“Increase in anxiety about one’s own health status, as a result of excessive reviews of online health information.”
Starcevic, 2017 (p. 129)	“Repeated online searches for health-related information that are associated with increasing level of health anxiety.”
Mathes et al., 2018 (p. 204)	“A clinical phenomenon in which repeated Internet searches regarding medical information result in excessive concerns about physical health.”
Vismara et al., 2020 (p. 1)	“A working definition of cyberchondria includes excessive online health searches that are compulsive and may serve the purpose of seeking reassurance, whilst leading to a worsening of anxiety or distress and further negative consequences.”

2.1.2 Conceptual unclarities regarding existing definitions

Although various definitions have been proposed in the literature, there are some conceptual unclarities regarding these definitions. First, while many definitions include the behavior of seeking for health information on the Internet, cyberchondria is conceptually not the same as regular online health information seeking (OHIS). Cyberchondria is a state that encompasses not only a proclivity to search for medical information online, but also repeated or excessive searches prompted by or leading to increased anxiety (Starcevic & Berle, 2015). Thus, this concept contains both an emotional state and an abnormal behavioral pattern. In contrast, regular searches for health websites can be triggered by just curiosity or a need to obtain knowledge of health issues. Also, although regular OHIS can be repetitive, its purpose is to reassure oneself and to better understand certain symptoms. Hence, it cannot be qualified as cyberchondria, which is the failure of relieving anxiety after excessive online health research.

Indeed, individuals with cyberchondria even feel more anxious or distressed after the seeking process. As Vismara et al. (2020) stated “Initial relief, if obtained, through online searching is short-lived and anxiety or distress usually worsens during these searches and persists afterwards” (p. 7).

Second, as shown in Table 2.1, while these definitions share two common elements, namely, excessive or repeated OHIS and anxiety about health, a consensus has not been reached regarding which element is the starting point of cyberchondria (Starcevic, 2017). Some researchers (e.g., McElroy & Shevlin, 2014; White & Horvitz, 2009) claimed, for instance, that when people have some medical issues, they first suffer from health anxiety, and then they actively search online sources for relevant medical information, which further increases their anxiety levels. Other scholars (e.g., Aiken & Kirwan, 2013; Harding et al., 2008) concluded that seeking information online in an excessive pattern is a key driver of increased health anxiety, regardless of whether people are originally concerned about their health. As a result, the direction of causality between excessive OHIS and health anxiety is still unclear, and it may differ from person to person, leading to the inconsistencies when defining what cyberchondria is. Nevertheless, it is important to note that the level of health anxiety increases compared to that before initiating these searches regardless of whether OHIS or health anxiety occurs first.

Third, another conceptual issue related to cyberchondria is a lack of consensus on what constitutes its essence. Similar to those definitions proposed in news media, it is not clear in the literature regarding whether cyberchondria is a pathological emotional state or abnormal information seeking behavior. While the majority of the definitions comprise of the two elements (i.e., OHIS and health anxiety), only a few indicate that the centrality of cyberchondria is the behavioral aspect, that is, excessive online health searches (e.g., Fergus, 2013; Starcevic, 2017;

Starcevic & Berle, 2013). The conceptualization of cyberchondria as a behavioral aspect of increased health anxiety or a pathological emotional state should be distinct. It may influence the way to propose treatment interventions, particularly when cyberchondria is conceptualized as a pathological emotional state, suggesting that this phenomenon is a type of psychiatric disorder (Starcevic & Berle, 2015).

Considering the above conceptual issues, McElroy and Shevlin (2014) suggested that cyberchondria is a multidimensional construct rather than a relationship. This construct consists of four elements, namely, excessiveness (i.e., excessive and repetitive online health searches), compulsion (i.e., interruption of daily lives such as work or study), distress (i.e., increased negative emotional states), and reassurance (i.e., seeking reassurance checking from other sources such as doctors). These dimensions reflect the postulated components of cyberchondria. McElroy et al. (2019) further portrayed cyberchondria as a distinct syndrome. This is consistent with Starcevic et al. (2019)'s argument that cyberchondria is "a relatively specific syndrome-like construct...consisting of interrelated symptoms" (p. 491).

Taken together, a review of these definitions indicates that a consensus has not been achieved regarding what cyberchondria is in the literature. However, a consensus definition of cyberchondria is an important first step in this nascent research area to allowing standardized investigation of this phenomenon. To this end, Vismara et al. (2020) reviewed 59 research articles that report a definition of cyberchondria and proposed a working definition: "Cyberchondria includes excessive online health searches that are compulsive and may serve the purpose of seeking reassurance, whilst leading to a worsening of anxiety or distress and further negative consequences" (p. 1). Based on this definition, an individual with cyberchondria exhibits signs such as excessive online health searches as well as an escalation of distress,

resulting in interruptions in their daily activities (e.g., study or work) and further reassurance checking with other sources (e.g., medical consultation). It is important to note that unlike other existing definitions such as the one proposed by Starcevic (2017), this working definition does not focus on which mechanism occurs first (i.e., excessive OHIS or heightened health anxiety). Nevertheless, considering its complexity in an online environment, cyberchondria is better to be conceptualized as a multidimensional phenomenon instead of a mere relationship (Vismara, 2020).

2.2 Cyberchondria, Health Anxiety and Hypochondriasis

After defining what cyberchondria is, it is important to explain the relationships among the three terms “cyberchondria,” “hypochondriasis,” and “health anxiety.” Comparing and contrasting the differences among the three terms would help us better understand what cyberchondria is and highlight the unique characteristics of cyberchondria. First, according to the revised version of Diagnostic Criteria for Psychosomatic Research (DCPR), health anxiety is conceptualized as a generic worry about illness (Fava et al., 2017). Although the terms “health anxiety” and “hypochondriasis” have been used interchangeably in previous research (Braddock & Abramowitz, 2006; Olatunji et al., 2009), the two terms are not synonymous. Health anxiety is characterized by temporal worry about health instead of conviction of illness while hypochondriasis describes a more serious form of health anxiety that involves a persistent fear of suffering from a severe medical condition (Braddock & Abramowitz, 2006; Rachman, 2012).

Moreover, terminologically and conceptually, cyberchondria is linked to hypochondriasis. As mentioned in Section 2.1, many news articles such as *Mail Online* and *Times Malta* reported that cyberchondria is the online equivalence of hypochondriasis

(Pemberton, 2018; Pickover, 2013). Thus, the criteria for hypochondriasis can be potentially used to assess the phenomenon of cyberchondria (Harding et al., 2008) in that unexplained medical problems or appearance of a new illness can cause people with hypochondria to conduct online searches repeatedly.

However, the term “hypochondriasis” has been eliminated from the DSM-5 mainly due to its lack of conceptual clarity and pejorative connotations (American Psychiatric Association, 2013). On the other hand, the revised version of DCPR has included cyberchondria as a distinct syndrome-like disorder, which comprises of both behavior addiction and emotional distress (Fava et al., 2017). Thus, the term “cyberchondria” has been kept and is still being used by medical professionals and researchers with the purpose of facilitating communication. Further, Starcevic (2017) argued that cyberchondria should not be regarded as the modern version of hypochondriasis. In fact, cyberchondria focuses more on pathological online health-related research associated with heightened health anxiety and other negative consequences (e.g., compulsion), which is not sufficient to be an independent diagnostic entity although it is a syndrome-like disorder.

Last but not least, cyberchondria and health anxiety are interrelated as well. Some studies have demonstrated that cyberchondria is positively related to health anxiety, but should be treated as an independent health-related issue (Fergus & Russell, 2016; Mathes et al., 2018; Norr et al., 2015b). This is because the phenomenon of cyberchondria might be more complex and multidimensional, which is not only related to an emotional state, but also a type of behavior addiction. More importantly, scholars postulate that although persons who are worried about their health are more prone to develop cyberchondria after conducting online health research,

those even without health anxiety may also suffer from this syndrome after reading medical information on the Internet (McElroy et al., 2019; Vismara et al., 2020).

Moreover, it is important to note that there is a terminology confusion in some of existing definitions of cyberchondria since these definitions also include the element of health anxiety. The term “health anxiety” in these cyberchondria definitions refers to a stable and elevated level of emotional distress associated with repeated online health searches (Fergus & Spada, 2018; Starcevic, 2017) whereas health anxiety is a generic and temporal worry about illness caused by physical symptoms or past medical experience (Warwick & Salkovskis, 1990). Therefore, considering this terminology confusion about health anxiety in existing definitions, this thesis proposes a refined working definition of cyberchondria based on Vismara (2020)’s definition, which describes cyberchondria as a multidimensional construct. In this thesis, cyberchondria is defined as a state in which an individual exhibits a set of behavioral, cognitive, and affective patterns; these patterns include excessive online health information searching, along with compulsion, distress, and reassurance. This definition has several advantages. First, it conceptualizes cyberchondria as a multidimensional construct given that it is complex syndrome-like phenomenon in this digital era (Starcevic et al., 2019; Vismara et al., 2020). Second, it uses the term “distress” instead of “health anxiety” as an element of cyberchondria to avoid the terminology confusion between cyberchondria and health anxiety. Third, it emphasizes the behavioral aspect of cyberchondria, namely, excessive OHIS because it is too early to diagnose cyberchondria as a real mental illness (Starcevic, 2017).

2.3 Theoretical Frameworks for Cyberchondria

To understand the potential factors contributing to cyberchondria, scholars have adopted or developed several theoretical frameworks to explain its development trajectory. Specifically, there are five theoretical frameworks used in cyberchondria literature: (a) cognitive behavioral model of health anxiety (Warwick & Salkovskis, 1990), (b) metacognitive model of generalized anxiety disorder (Wells, 1999), (c) model of cyberchondria (Starcevic & Berle, 2013), (d) metacognitive conceptualization of cyberchondria (Fergus & Spada, 2018), and (e) hybrid model of cyberchondria (Brown et al., 2019). This section provides an overview of each model and summarizes the strengths and weaknesses of these models. Review of the current models related to cyberchondria can help to better make sense of how cyberchondria can be explained from a theoretical perspective. Additionally, critical assessment of these models can facilitate the identification of research gaps in the literature and propose a refined model specifically for cyberchondria.

2.3.1 *Cognitive behavioral model of health anxiety*

Among these theoretical frameworks, the cognitive behavioral model of health anxiety (CBT; Warwick & Salkovskis, 1990) is the most prominent and used by several scholars to explain the phenomenon of cyberchondria (McManus et al., 2014; Singh et al., 2016; Singh & Brown, 2016) (see Figure 2.1). According to the CBT, individuals tend to develop health anxiety when they have dysfunctional health-related beliefs (e.g., indigestion is a sign of stomach cancer) and such beliefs are often triggered by some internal stimuli (i.e., ailments) or external stimuli (e.g., family illness, media events). In other words, individuals fail to cope with the perceived threat may activate some negative assumptions (e.g., misinterpretation of common physical

symptoms as evidence of a serious illness), which may serve as a constant source of health anxiety. In this situation, people tend to select the information that confirms the thought of getting a serious illness, and to ignore the fact that they are in good health. Hence, misinterpretation of illness can lead to a confirmatory bias in individuals' thinking as well as an increase in health anxiety.

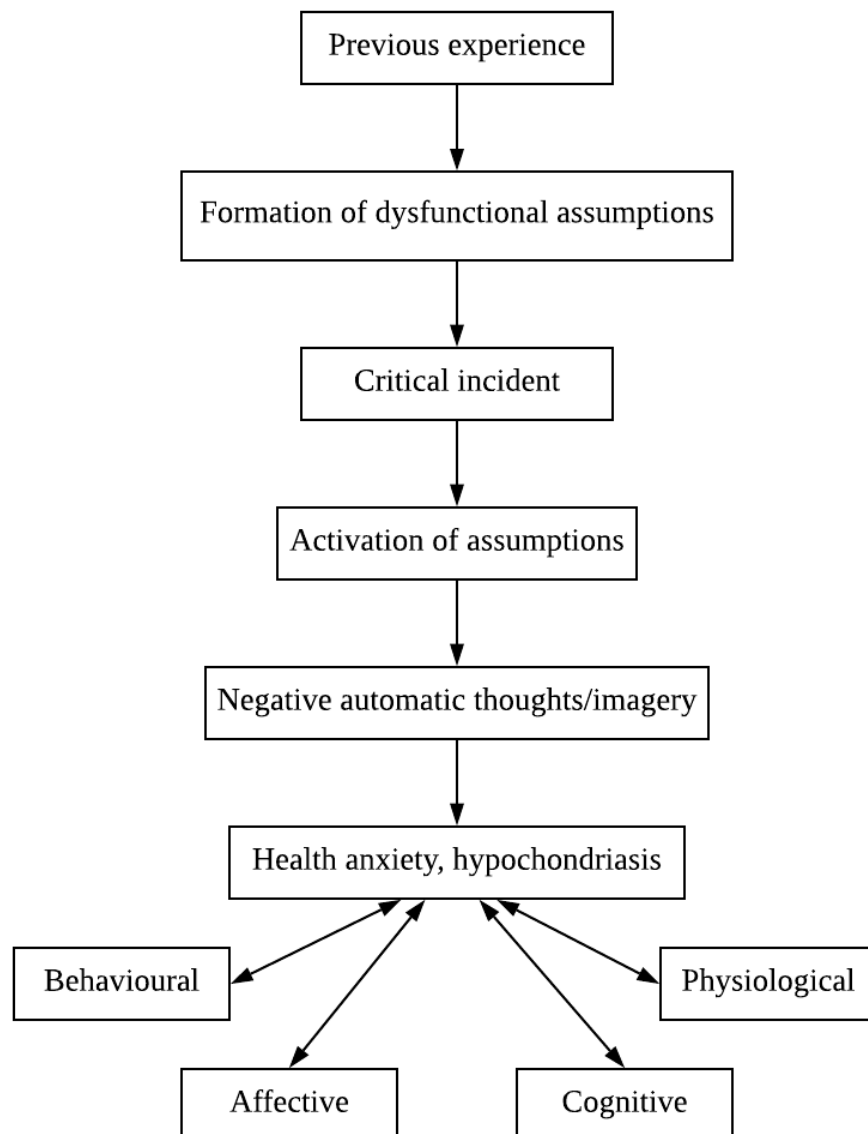


Figure 2.1. Cognitive behavioral model of health anxiety. Reproduced from Warwick and Salkovskis (1990, p. 111).

Once health anxiety has developed and increased, four types of factors are thought to maintain the anxiety level, namely, cognitive factors (e.g., attention to negative health-related information, ignorance of positive information, and helplessness), behavioral factors (e.g., reassurance seeking, and repetitive self-inspection), physiological factors (e.g., increased psychological arousal, sleep disturbance, and changes in body function), and affective factors (e.g., depression, anger, and anxiety). People are not able to evict the idea of currently acquiring a serious illness, and they are intolerant of uncertainty and repeatedly search for health-related information, which in turn triggers more anxiety and illness preoccupation. In an online context, people are exposed to unlimited health resources, and they are more likely to repeatedly search for health information to get desired results (Singh & Brown, 2016). However, in this situation, the possibility of obtaining threatening health information also increases, which leads to heightened health anxiety. Therefore, this model may provide some explanations for how people develop cyberchondria.

2.3.2 Metacognitive model of generalized anxiety disorder

Wells (1999) proposed a metacognitive model of generalized anxiety disorder (GAD) to describe the maintenance of uncontrollable and excessive worry. The metacognitive model of GAD has been adopted by Fergus and Spada (2018) and Brown et al. (2019) to explain the phenomenon of cyberchondria. Before introducing the two novel models (Brown et al., 2019;

Fergus & Spada, 2018) (see Sections 2.3.4 and 2.3.5), it is pertinent to understand the mechanisms in Wells (1999)'s metacognitive model (see Figure 2.2).

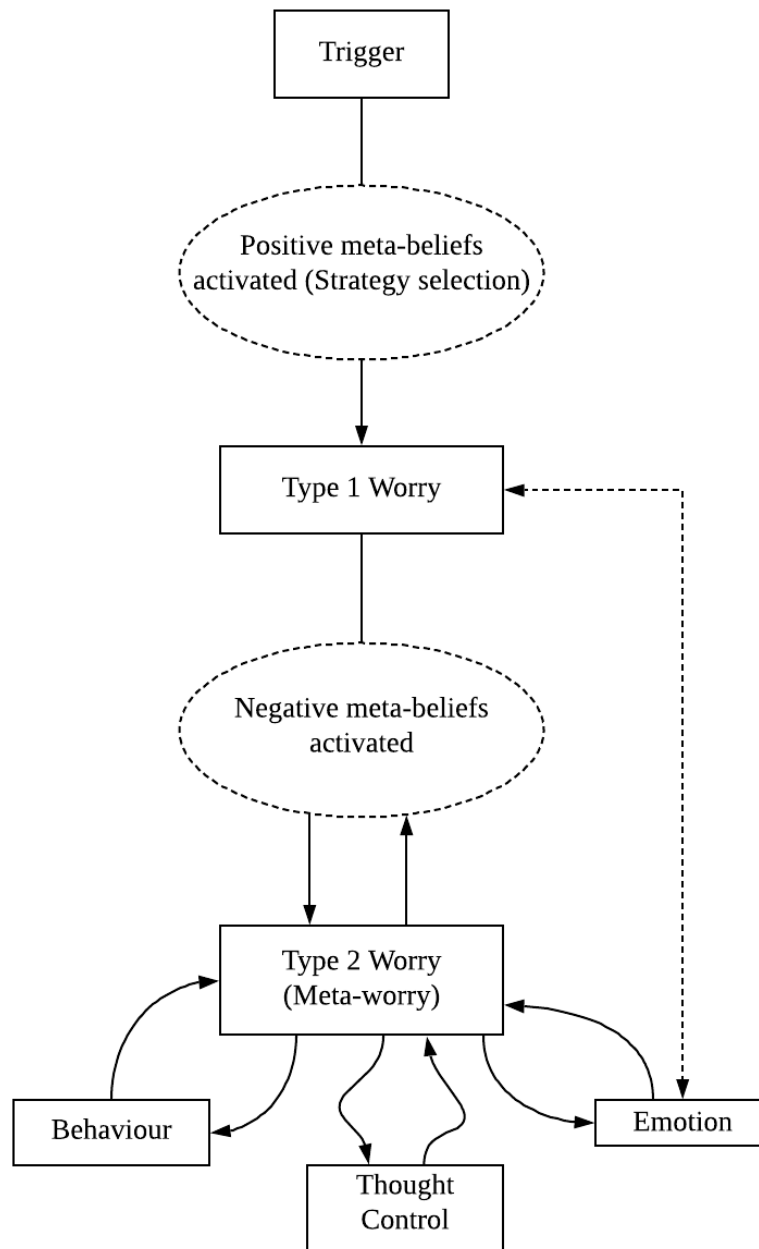


Figure 2.2. Metacognitive model of generalized anxiety disorder. Reproduced from Wells (1999, p. 88).

To conceptualize pathological worrying processes, this model postulates that worry can be classified into two broad types. That is, worry can act as an active style of coping strategy triggered by individuals' beliefs, and it can be a symptomatic consequence of anxiety as well. These two worry types are termed Type 1 and Type 2 worrying in the model. More specifically, the Type 1 worrying indicates worry about internal non-cognitive events or external events (e.g., physical symptoms, media stories) while the Type 2 worrying refers to worry about one's own cognitive events and processes (e.g., worry about worry). The Type 2 worrying is also known as "meta-worry" as it describes individuals' metacognitive processes of assessing and monitoring their own thoughts and beliefs. These processes are a central feature of pathological worry states.

Different from other cognitive models of GAD, metacognitive beliefs are the key concept in Wells (1999)'s model and such beliefs can be either positive or negative. Generally speaking, a worry sequence occurs when people have an intrusive thought that they are not able to cope with a perceived threat (e.g., physical symptoms). In this situation, people will develop positive metacognitive beliefs, and worry will function as a coping strategy to help people mitigate the perceived threat. Individuals with positive beliefs consider that worrying can help them cope and keep them safe. This positive appraisal of worry is referred to as Type 1 worrying, in which people contemplate danger-oriented scenarios (e.g., my symptom is an indicator of a severe illness) and propose potential strategies for dealing with the threat. The content of worrying is related to emotional responses, and the contemplation of dangerous scenarios may lead to the development of health anxiety in a short term. However, the Type 1 worrying can help reduce this anxious effect if appropriate coping strategies are generated. In this way, individuals may hold confidence in the usage of worry to deal with their anticipated danger in future.

On the other hand, individuals can also have negative metacognitive beliefs about their worrying process. For example, some people believe that worrying too much can make them crazy, but they are not able to control their worry. Wells (1999) defined this negative appraisal of worry process as the Type 2 worrying, and it can also affect emotional responses. These emotional responses can be somatic and cognitive symptoms related to anxiety or depression, which is a reflection of loss of control or negative consequence of worrying. Emotion and the Type 2 worrying form a vicious cycle, and this cycle amplifies and maintains health anxiety. Emotional responses can also be interpreted as a failure of using coping strategies to continue and reduce the Type 1 worrying. Thus, the Type 1 worrying can help people to reduce the anxiety whereas the Type 2 worrying may lead to the escalation of anxiety.

In addition to emotional responses, other two mechanisms are thought to maintain this Type 2 worrying, which are behavioral responses and thought control. First, to deal with the negative consequences of worrying, people tend to perform certain behaviors. For example, they may seek reassurance from different information sources to mitigate or avoid worry. However, this reassurance checking process may fail to convince people, which maintain the Type 2 worrying and negative beliefs. Second, thought control refers to the ability to control the worrying process. However, successful interruption or control of worry is difficult to achieve, and it often produces a paradoxical impact that intensifies the Type 2 worrying and negative beliefs. In summary, the interaction between positive and negative metacognitive beliefs about worrying leads to excessive and uncontrollable worry.

In the context of OHIS, people regard OHIS as a reassurance attempt or coping strategy initially and believe that gathering health-related information online can help them get rid of negative thoughts. However, since it is difficult to get satisfied or “perfect” results among a large

amount of online information, users keep worrying and lose control in this process. This further leads to repeated searches and heightened health anxiety (i.e., cyberchondria).

2.3.3 Model of cyberchondria

Starcevic and Berle (2013) proposed a theoretical model to describe the outcomes of OHIS among individuals with health anxiety (see Figure 2.3). This model postulates that when people are anxious about their health, they form a behavior of reassurance-seeking, that is, regular OHIS. Such behavior might lead to an increase in anxiety or a decrease in anxiety. Different from reassurance seeking from medical professionals, reassurance seeking from the Internet is less predictable for those with health anxiety because online search results are not designed to reassure users. Instead, it may provide a list of symptoms based on the search query, and without the help of doctors, users need to distinguish what useful health information is for them. Thus, they may perceive that OHIS sometimes is reassuring, while at other times, it is not (Starcevic & Berle, 2013). This argument is consistent with White and Horvitz's (2009) finding that the effects of OHIS might be different for individuals: about 50 percent of users experienced a decrease in health anxiety after online health searches whereas 40 percent feel more anxious due to their searches. Although the reasons for these distinct effects are still unclear, it can be assumed that high level of health anxiety might serve as a precipitant of more health anxiety after OHIS (Starcevic & Berle, 2015).

Specifically, when individuals with health anxiety successfully find relevant health information on the Internet, as a result, they are reassured by the information and their anxiety level decreases after these initial online health searches. In this case, individuals may also continue to seek more information to enhance their knowledge. However, this behavior is not

related to cyberchondria. It is a form of classical reassurance seeking, which refers to further online health searches driven by a decreasing level of health anxiety as a result of the previous searches (Salkovskis & Warwick, 1986).

On the other hand, when individuals with health anxiety are not reassured by what they find on the Internet, they may even become more worried because of the search results. In response to an increased anxiety, individuals can have two options. The first one is to avoid further online searches and thus anxiety level may decrease over time. The second option is to return to the Internet to conduct further information searches despite a failure of initial reassurance seeking. However, the level of anxiety may continue to increase during individuals' repeated online health searches, which is in line with the phenomenon of cyberchondria. It seems to be puzzling that those who are not reassured by the online information continue their searches since users should not expect that they can find relevant information and ease health anxiety in the next search (Starcevic & Berle, 2013). Thus, it is important to understand factors influencing the maintenance of cyberchondria in the search process.

Starcevic and Berle (2013) proposed four anxiety-amplifying factors that may contribute to the maintenance of cyberchondria in their proposed model, including spurious probabilities, a need for perfect explanation, intolerance of ambiguity and uncertainty, and ambivalence of trustworthiness of online information sources. First, when individuals use the Internet to seek medical information, they are more inclined to be attracted by fascinating and potentially frightening results and click on relevant webpages for more information. For example, a rare and fatal disease might receive more attention than an ailment. The frequency of clicking on certain web pages can contribute to the ranking of search results whereas there is no association between the search word (e.g., a common symptom "indigestion") and a particular result (a serious illness

such as stomach cancer). Joachims et al. (2005) found that information seekers are usually attracted by and click on the top-ranking search results, which maintains the ranking of these health websites. Internet users often fail to distinguish the ranking of search results from the likelihood of getting an illness and tend to believe that top ranking search results indicate a high likelihood of getting the illness (e.g., brain tumor) (White & Horvitz, 2009a). This erroneous belief leads to an escalation of health anxiety and further online searches instead of reassuring OHIS.

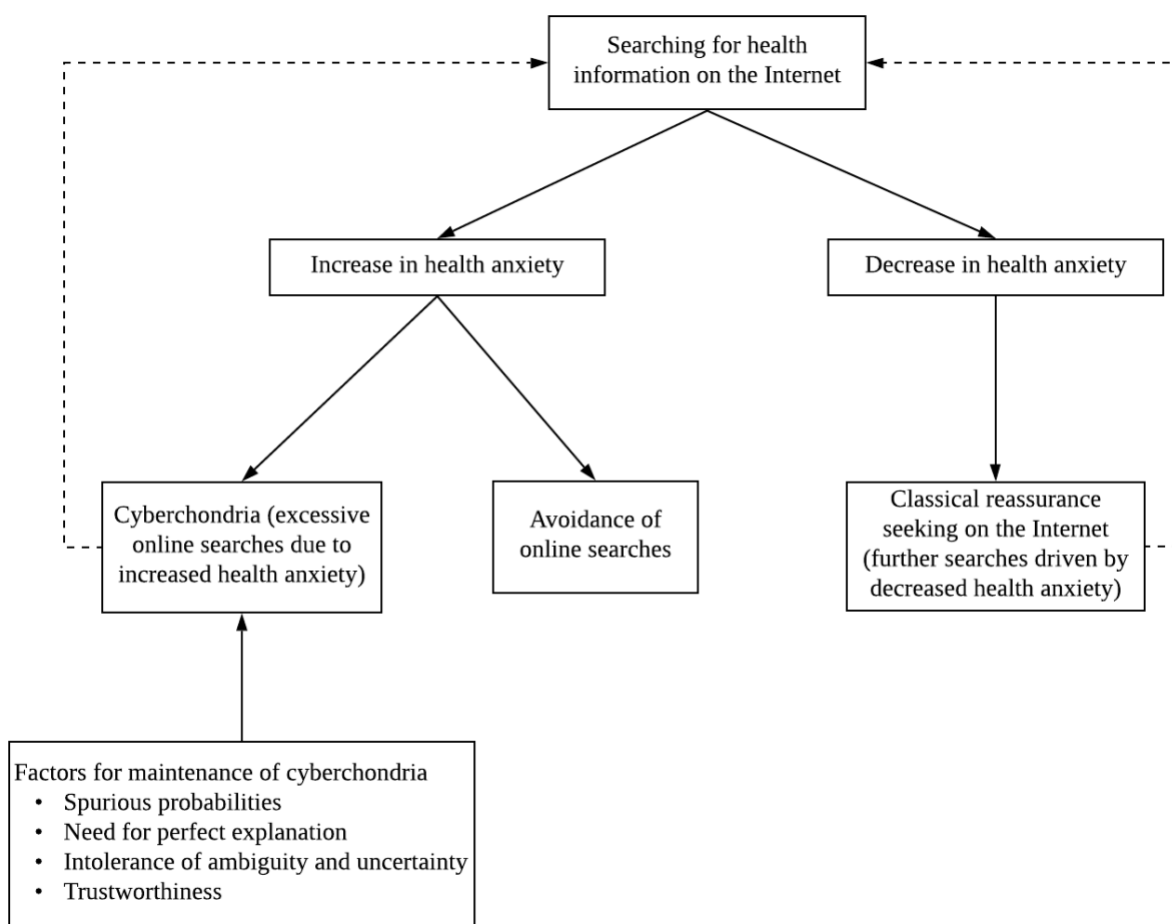


Figure 2.3. Model of cyberchondria. Suggested by Starcevic and Berle (2013, p. 208).

Second, an ocean of online health-related information can be a problem for fueling cyberchondria (Rao & Skoric, 2011). People who are anxious about health conditions may hope that online information can provide them with perfect diagnostic explanations if they keep on looking for it, during which their anxiety level may exacerbate (Sakai et al., 2010). Hence, cyberchondria is a reinforcement process when people need to search for a full and perfect explanation for certain health problems from numerous online information sources.

Third, uncertainty of health-related information on the Internet may lead to the maintenance of cyberchondria. The Internet cannot always provide users with relevant and accurate health information, making the outcome of online searches unpredictable. Evidence supports that uncertainty can either increase or decrease after searching for medical information online (Harding et al., 2008; Wilson et al., 2002), and this depends on users' personality traits and how the information is presented on the Internet. Information seekers face a number of ambiguous medical terminologies or complicated descriptions of various symptoms on the Internet. Excessive searches may occur when they attempt to reduce the fear of uncertainty and to understand the meaning of these medical terms. However, the more they search for, the more they get confused, during which anxiety appears and increases. A qualitative study conducted by Singh et al. (2016) found that cyberchondria is mainly motivated by factors including uncertainty of health problems, curiosity, and perceived disadvantages of doctors (e.g., distrust, inconvenience). Thus, although the purpose of OHIS is to decrease uncertainty, it can lead to the opposite effect due to excessive searches.

Fourth, trustworthiness of online health information plays an important role in developing cyberchondria. A large volume of online information is found to be incomplete, inaccurate and misleading. For instance, part of information in online health communities may be fake stories or

experiences, serving as commercial purposes to draw attention from the audience. People with high anxiety may spend much time in determining if the medical information from a particular online source is trustworthy and reliable. If they do not trust in the information they obtain, they might continue their information seeking as well as worry their health (McManus et al., 2014). On the other hand, trusting in some online sources may also results in the escalation of health anxiety. More specifically, at some point users may perceive that the information from trustworthy websites is unpleasant and anxiety-provoking as well. Instead, they prefer to rely on the information from less trustworthy websites such as online health communities, which provides more reassuring and sympathetic messages. Baumgartner and Hartmann (2011) corroborated this argument by showing that compared to non-health anxious individuals, health anxious individuals suffer greater worries when they gain information from trustworthy websites (e.g., governmental websites). Hence, medical information from more credible sources can also trigger health anxiety.

2.3.4 Metacognitive conceptualization of cyberchondria

Based on the metacognitive model of GAD (Wells, 1999), Fergus and Spada (2018) proposed a metacognitive conceptualization of cyberchondria to describe its development process (see Figure 2.4). This model synthesizes several concepts including metacognitive beliefs, health anxiety, belief about rituals, stop signals and cyberchondria, and describe the interrelations among these concepts. Compared to other cyberchondria-related models, belief about rituals and stop signals are two additional concepts included in Fergus and Spada (2018)'s model. Beliefs about rituals refer to the importance of managing one's thoughts and emotions (e.g., depression), and individuals with such beliefs are able to plan coping strategies for threat

perception (Wells & Matthews, 1996). Stop signals are a type of internal signals to decide when to stop the coping strategies for dealing with emotional responses (Wells, 2002). However, stop signals might be difficult to achieve, and too many coping efforts can cause more anxiety or depression. In the context of OHIS, Starcevic and Berle (2013) also argued that online users adopt “stop rules” to know when to stop their searching activities. However, most of the users fail to stop searching when they acquire sufficient information.

The model proposed by Fergus and Spada (2018) posits that when a trigger (e.g., physical symptom, memory, image) pertaining to a health concern emerges, metacognitive beliefs about health-related thoughts will be activated for self-regulation. These metacognitive beliefs can lead to the development of health anxiety because people tend to worry about their health and fail to cope with the worry. Health anxiety, in this model, refers to a temporal state experience that can potentially turn into a stable level of heightened anxiety. Further, cyberchondria occurs in the process of searching for relevant health-related information to cope with health anxiety regardless of whether this anxiety level is stable or not initially (Starcevic, 2017).

This model also includes beliefs about rituals and stop signals to explain how cyberchondria is distinct from health anxiety. Individuals with cyberchondria have the belief that health information on the Internet can be a useful source to reduce their anxiety (i.e., beliefs about rituals) and they believe they know how much information they need to address the anxiety before stopping seeking behavior (i.e., stop signals). The two factors may lead to repetitive online searches since people continue the seeking process when they have acquired sufficient health information from the Internet. In fact, health anxiety can mitigate without these online searches. However, beliefs about rituals maintain this excessive behavior. Further, ambiguous or complicated health-related medical information can make people feel confused

(Starcevic & Berle, 2013), and contribute to the maintenance of perceived dangers and emotional distress (e.g., anxiety or depression) since stop signals are not easy to achieve in such a seeking process (Wells, 2002).

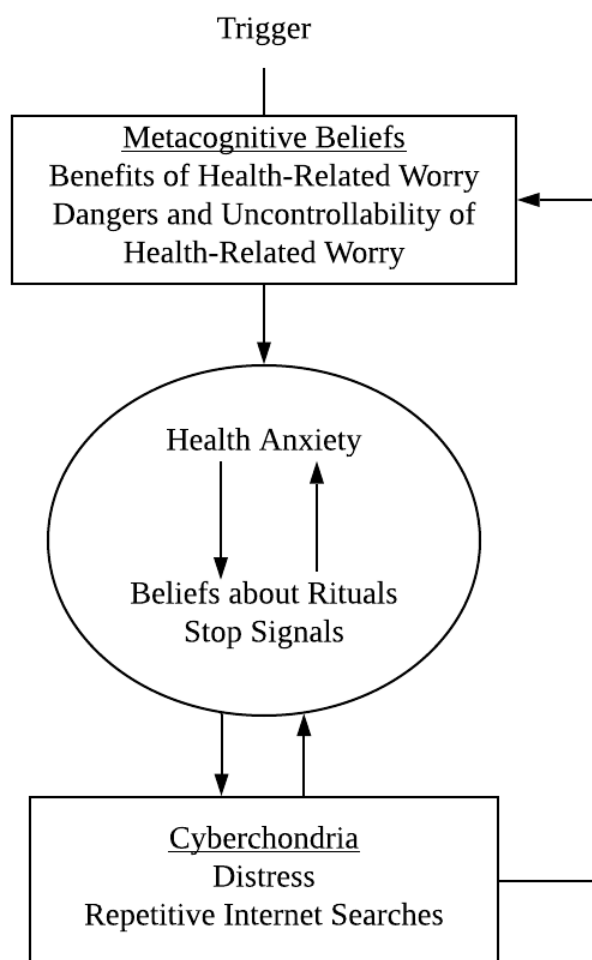


Figure 2.4. Metacognitive conceptualization of cyberchondria. Reproduced from Fergus and Spada (2018, p. 12).

Lastly, the stable level of emotional distress can in turn strengthen metacognitive beliefs about health-related thoughts. In particular, heightened anxiety can lead people to experience the belief that thinking about health concerns is uncontrollable, and they start to perceive such a

belief is beneficial, which is a type of biased thinking (e.g., “worrying about my health will help me cope,” Bailey & Wells, 2015). However, biased thinking about health is problematic, and it continues to maintain the level of cyberchondria (i.e., high level of health anxiety and repeated Internet searches). In summary, this model depicts that cyberchondria arises because of malfunction of self-regulation (metacognitive beliefs, beliefs about rituals, and stop signals).

2.3.5 Hybrid model of cyberchondria

Brown et al. (2019) discuss the association between OHIS, health anxiety and cyberchondria through developing a novel theoretical model (see Figure 2.5). The hybrid model of cyberchondria attempts to integrate existing research and theories regarding the three concepts and address some of the weaknesses in the existing models. More specifically, it takes into account the model of cyberchondria (Starcevic & Berle, 2013), the metacognitive model of GAD (Wells, 1999), and the CBT (Warwick & Salkovskis, 1990), in order to create an integrative framework that distinguishes pathological online searches (i.e., cyberchondria) from regular online health research. The model posits that OHIS is a normal reassurance checking behavior to cope with perceived health threat and this behavior is more common among people with health anxiety as they are more prone to perceive threats to their health. There are two types of outcomes of OHIS. First, individuals feel the online health information is reassuring and the health threat is minimal. In this case, they can terminate OHIS, which fosters their belief that online health research is an effective way to reduce anxiety (i.e., positive metacognitive beliefs). Conversely, when the search outcomes indicate that the health issue is severe or at least ambiguous, individuals will further worry about it. This leads to more online health searches in order to manage their worry. In this situation, the repetitive search process can be anxiety

provoking since health anxious individuals tend to misinterpret search results and feel they get serious illness, especially when query escalation occurs (White & Horvitz, 2009). Query escalation is more common in people who extremely worry about health and feel intolerant of uncertainty.

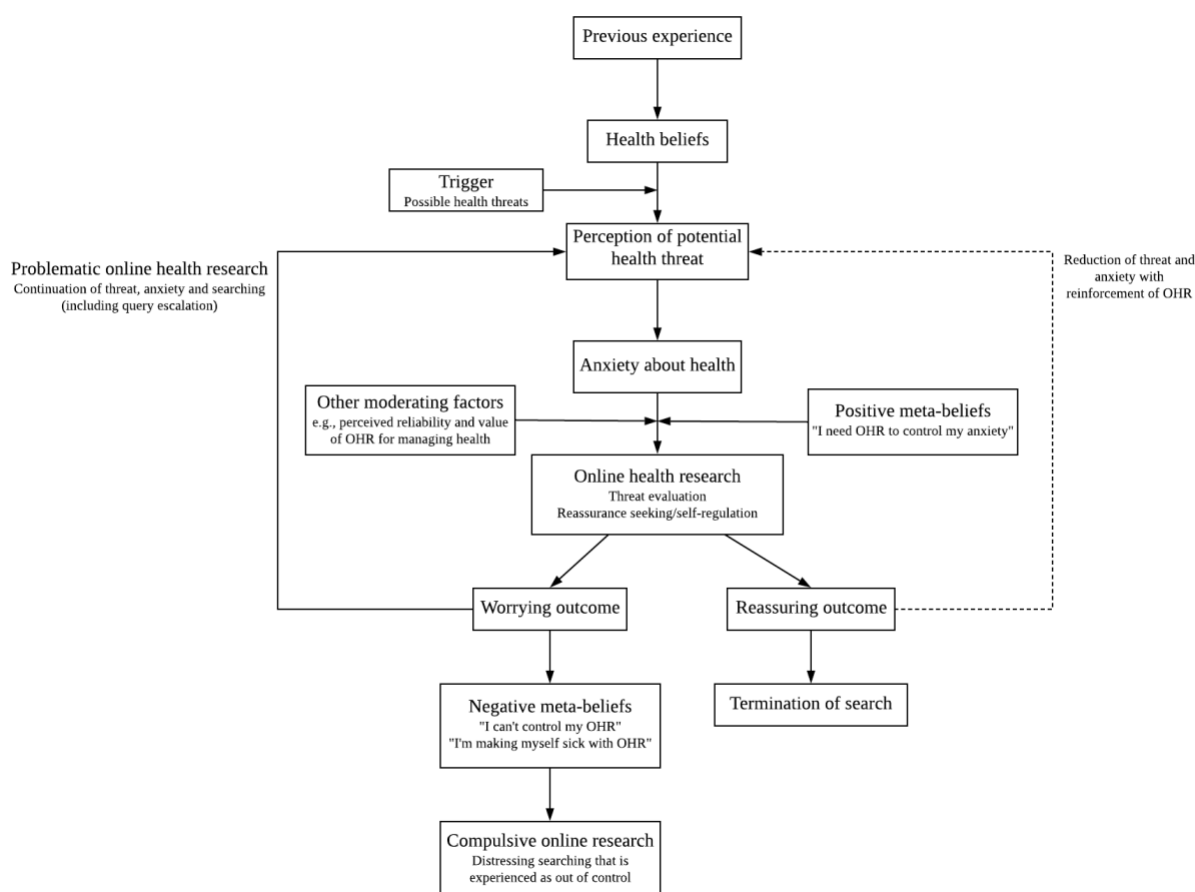


Figure 2.5. The hybrid model of cyberchondria. Reproduced from Brown et al. (2019, p. 14).

Worrying search results can cause the development of negative metacognitive beliefs about the health issue as well as online health research itself. Over time, people may feel a conflict between the belief that online health research can help manage health anxiety, and the perception that online health research is useless. If this conflict cannot be solved successfully, it

can further cause compulsive information seeking behavior, which individuals feel necessary but ultimately undesirable. In the end, people perceive this compulsive and excessive online health research uncontrollable, causing more distress, which is often called cyberchondria.

2.3.6 Strengths and weaknesses of the current frameworks

Altogether, the five frameworks have provided various conceptual perspectives for research on cyberchondria, which significantly contribute to a better understanding of this phenomenon in the digital age. First, cognitive behavioral model of health anxiety (CBT; section 2.3.1) and metacognitive model of GAD (section 2.3.2) describe the detailed process of how people perceive a threat to health and develop health anxiety. Such anxiety may precede reassurance seeking behavior (e.g., OHIS), which in turn maintain or even escalate the level of anxiety. Since cyberchondria is related to health anxiety, these models can provide insights on its development and maintenance from a pathopsychological perspective.

Second, the model of cyberchondria (section 2.3.3) is the first model developed specifically for cyberchondria. It takes into account the outcomes of OHIS (i.e., increase and decrease in anxiety). Cyberchondria occurs when anxiety increases after OHIS. Also, this model proposes four factors related to cyberchondria (i.e., spurious probabilities, need for perfect explanation, intolerance of uncertainty, and trustworthiness). These factors are relevant and specific in the context of OHIS, which can add the understanding of how cyberchondria maintains.

Third, built upon metacognitive model of GAD (Wells, 1999), metacognitive conceptualization of cyberchondria (section 2.3.4) elucidates cyberchondria from a metacognitive perspective, which might provide support for the development and use of

treatment interventions within this model to reduce cyberchondria (Fergus & Spada, 2018). Last but not least, the hybrid model of cyberchondria (section 2.3.5) synthesizes the core elements in previous theoretical models with the aim of building a comprehensive model to describe the development and maintenance of cyberchondria. This model takes into account various types of factors that might contribute to cyberchondria from a comprehensive perspective. It might serve as a basis for building cyberchondria-related theories in future research.

However, there still remain gaps and insufficiencies that impede the development of a comprehensive and specific model in this nascent research area. First, some of the current theoretical frameworks such as the CBT (section 2.3.1) and metacognitive model of GAD (section 2.3.2) regard cyberchondria as a distinct clinical disorder, which seems to be a premature and misleading proposition. For example, while some scholars have adopted the two models to explain the phenomenon of cyberchondria (e.g., Fergus & Spada, 2017; Singh & Brown, 2014, 2016), cyberchondria cannot be equivalent to health anxiety or hypochondriasis (Starcevic, 2017), and thus the development process of cyberchondria might be somehow different. In fact, the core element of cyberchondria should be an abnormal and pathological behavior of OHIS, along with an increased level of emotional distress and other negative consequences. Thus, we should not merely conceptualize cyberchondria as a diagnostic disorder (Starcevic, 2017). Empirical research also recognized that cyberchondria is a specific syndrome-like problem related to, but independent of health anxiety (Fergus & Russell, 2016; Mathes et al., 2018; Norr et al., 2015b). As such, the adoption of models of health anxiety might not be robust enough to show how cyberchondria arises and maintains when seeking health information on the Internet.

Second, while some frameworks describe the detailed process of how and why some Internet users become cyberchondriac, it is difficult to operationalize and test some of the concepts in these models empirically. For example, the model of cyberchondria (section 2.3.3) postulates that maintenance and reinforcement of cyberchondria can be attributable to four anxiety-amplifying factors including spurious probabilities, a need for perfect explanation, intolerance of ambiguity and uncertainty, and trustworthiness of online information sources. However, currently no appropriate assessment tools have been developed for accurately measuring spurious probabilities or a need for perfect explanation. Even if there are, the validity of such measurements still needed further testing in the context of cyberchondria.

Third, few studies have tested these theoretical frameworks empirically in cyberchondria literature. Although several scholars argued that the phenomenon of cyberchondria is consistent with the CBT (Fergus & Spada, 2017; Mathes et al., 2018; Singh & Brown, 2014, 2016), they only described this model conceptually and did not adopt it in their actual studies. Thus far, Fergus and Spada (2018) is the only study that tested their metacognitive conceptualization of cyberchondria (section 2.3.4) whereas the other four models are in the absence of solid and persuasive empirical evidence.

Fourth, some of the frameworks overly focus on psychopathology-related factors without taking into account how other factors related to information seeking can function as antecedents to cyberchondria. For instance, the metacognitive conceptualization of cyberchondria proposed by Fergus and Spada (2018) examines how psychological factors such as metacognitive beliefs, beliefs about rituals, health anxiety are related to cyberchondria. Similarly, while the hybrid model of cyberchondria (Brown et al., 2019) provides a detailed, comprehensive explanation of how cyberchondria emerges with OHIS, it mainly includes some key psychological factors such

as perceived health threat, health anxiety, and metacognitive beliefs in the development trajectory of cyberchondria. The concepts in these models indeed contribute to the understanding of how cyberchondria occurs and maintains. However, as a pathological behavior of OHIS, cyberchondria can be a complex phenomenon, that is often a consequence of a mix of cognitive, affective, and social factors. For example, health information seeking behavior might be triggered by information insufficiency, informational subjective norms, and source beliefs as well (Griffin et al., 1999; Hovick et al., 2014; Yang, 2012), and these factors might also play a role in developing cyberchondria. Therefore, future work should consider other relevant antecedents when theorizing the process of cyberchondria development.

In summary, this section reviewed the five theoretical frameworks related to cyberchondria and highlighted some weaknesses that need to be addressed in future theoretical developments, which include (a) considering cyberchondria as a clinical disorder; (b) difficulty in operationalizing some concepts; (c) lack of empirical testing for some models; (d) lack of social and behavioral factors in these models. Nevertheless, the weaknesses cannot nullify the contributions of these models to the cyberchondria research since they indeed provide valuable knowledge regarding the development of cyberchondria from different theoretical perspectives. In future, refined frameworks could be built upon these existing models.

2.4 Summary

This chapter first provides a review of the definitions of cyberchondria proposed by various scholars. Considering the strengths and weaknesses of existing definitions, Vismara (2020) defined cyberchondria as “excessive online health searches that are compulsive and may serve the purpose of seeking reassurance, whilst leading to a worsening of anxiety or distress and

further negative consequences” (p. 1). Furthermore, this chapter seeks to discuss some of the conceptual knots and examine the differences among the terms “cyberchondria,” “health anxiety,” and “hypochondriasis.” Although cyberchondria is related to health anxiety or hypochondriasis, it focuses more on how some people with health anxiety may act in this digital age, which can be viewed as a multidimensional concept. Its core element is an abnormal behavior of OHIS, together with other psychological dimensions. In addition, due to the terminology confusion about health anxiety in the existing definitions, a refined definition of cyberchondria has been proposed in this thesis. Cyberchondria describes a state in which an individual exhibits a set of behavioral, cognitive, and affective patterns; these patterns include excessive online health information searching, along with compulsion, distress, and reassurance.

Last but not least, this chapter reviews five theoretical models that have been used in the literature to explain the phenomenon of cyberchondria. Also, it further assesses the strengths and weaknesses of these models. Before proposing a refined model for this thesis, it is very important to understand how cyberchondria has been studied empirically and what findings have been reached in this new research area. Additionally, as a multi-dimensional concept, it is meaningful to examine the assessment tools used for cyberchondria. Effective measures of cyberchondria can help identify individuals who are distressed when conducting health-related searches on the Internet (Starcevic, 2017). Thus, the next chapter seeks to conduct a systematic review of quantitative studies on cyberchondria to examine how cyberchondria has been measured and what factors are associated with cyberchondria.

CHAPTER THREE: STUDY ONE: A SYSTEMATIC REVIEW OF CYBERCHONDRIA¹

This chapter seeks to conduct a systematic review that summarizes the empirical landscape of cyberchondria research. Specifically, it first identifies several research gaps in the cyberchondria literature, highlighting the need for consolidating the current empirical studies to provide a comprehensive overview of this nascent research field. Next, it describes the methods used for literature search in several online databases and for article selection process. By analyzing a sample of 40 studies, the study characteristics, measurements of cyberchondria, factors associated with cyberchondria are reported. Finally, theoretical and practical implications of this review are discussed.

3.1 Research Gaps and Study Objectives

While there is an increasing interest in understanding cyberchondria in terms of its conceptualization and operationalization, research on cyberchondria is still in its infancy. In general, there remain three research gaps that need to be addressed. First, previous studies have examined cyberchondria in different contexts and populations, which renders a lack of a clear picture regarding the characteristics of these studies (e.g., country, sample size, research method). For instance, these studies were conducted in western countries (e.g., United States, the United Kingdom) as well as in eastern countries (e.g., India, Indonesia) (Aulia et al., 2020; Fergus & Dolan, 2014; Makarla et al., 2019; McElroy et al., 2019), using various research methods (e.g., survey, experiment, etc.). Also, it is unknown what theories have been adopted in

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this area to inform these empirical studies. Thus, it is pertinent to summarize the characteristics of these studies to provide a landscape of cyberchondria empirical literature.

Second, there is little systematic knowledge regarding how cyberchondria has been operationalized and measured in the literature. On one hand, based on its definition, some studies examined cyberchondria through measuring the positive relationship between health anxiety and OHIS (e.g., Baumgartner & Hartmann, 2011; Doherty-Torstrick et al., 2016; Eichenberg & Schott, 2019; Muse et al., 2012). On the other hand, a group of studies operationalized cyberchondria as a multi-dimensional construct, including excessive online searching, emotional distress, interruption of other daily activities, and unnecessary reassurance checking (e.g., doctor consultation) (e.g., Barke et al., 2016; McElroy et al., 2019; McElroy & Shevlin, 2014). The confusion surrounding the measures of cyberchondria makes it difficult for theory testing. Also, inconsistent measures can be a barrier for medical professionals to select an effective one when assessing cyberchondriacs.

Third, extant cyberchondria research tends to investigate a selected set of antecedents or outcome variables, which often differ across studies. There lacks a clear and comprehensive picture of what factors are associated with cyberchondria. For example, most studies have focused on the relationship between selected psychological factors (e.g., intolerance of uncertainty, metacognitive beliefs, etc.) and cyberchondria (Fergus, 2013; Fergus & Spada, 2017, 2018; Marino et al., 2020). A paucity of studies investigated the role of information-related factors (e.g., information overload) on cyberchondria development (e.g., Laato et al., 2020). Thus, it is critical to have a comprehensive summary of the antecedents and consequences of cyberchondria, so that possible factors and mechanisms behind these relationships can be further explored for theoretical advancement in future research.

In light of the above research gaps, it is vital to conduct a systematic review of the field to gain an overview of existing empirical studies on cyberchondria. There have been four literature reviews of cyberchondria. First, Starcevic and Berle (2013) reviewed cyberchondria at a conceptual level. They presented a hybrid model to describe cyberchondria as a possible outcome of regular OHIS. However, the paper did not employ systematic search strategies to identify relevant articles. Also, there have been more than thirty articles published after their review. Second, McMullan et al. (2019) used a meta-analysis approach to examine the relationships between health anxiety, OHIS, and cyberchondria. Based on the included twenty studies, the study found a positive correlation between health anxiety and OHIS as well as between health anxiety and cyberchondria. However, the paper focused more on the two aforementioned specific relationships. It was not intended to provide a general and comprehensive overview of the current status of research on cyberchondria.

Third, Brown et al. (2019)'s review focused on providing evidence on the relationship between online health research and health anxiety. More importantly, they proposed a theoretical model that integrates findings from existing research to distinguish pathological and compulsive OHIS from regular OHIS. This model also explains the role of metacognitions in process of cyberchondria development. However, although the paper regarded cyberchondria as a negative outcome of online health research, the primary focus of this review was on online health research rather than the phenomenon of cyberchondria. Fourth, Vismara et al. (2020) reviewed the studies on cyberchondria in terms of various aspects such as its definitions, cost and burden, prevention strategies, and the like. They proposed a working definition to describe this complex phenomenon, which portrays cyberchondria as “a clinically relevant transdiagnostic compulsive behavioral syndrome” (Vismara et al., 2020, p. 1). Cyberchondria measurement and several

psychological mechanisms were only briefly mentioned in this review. More detailed assessments of these aspects are still needed.

Overall, given the nascent nature of the field and the above research gaps, future systematic review of the literature will be beneficial to research and practice. For example, since cyberchondria is a new concept in academic literature, it is especially important to understand how to measure cyberchondria so that medical professionals could adopt such measures in practice (Starcevic, 2017). In addition, a summary of factors associated with cyberchondria in the literature could be beneficial in providing a theoretical springboard for scholars working in cyberchondria to engage in relevant theory building in future work (Brown et al., 2019). To recapitulate, periodic reviews of this phenomenon could inform both the literature and medical professionals about the state of the art of cyberchondria, particularly in the context of COVID-19 pandemic, where a high level of anxiety and uncertainty is generated in the public (Menon et al., 2020).

The current review considers a much broader range of findings in cyberchondria literature with the primary aim to better understand how cyberchondria has been empirically examined. More specifically, the objectives of this review were three-fold. First, it seeks to present a comprehensive overview of cyberchondria-related studies by addressing their key characteristics (e.g., country, sample size, research method, etc.). Second, it aims to untangle how the concept of cyberchondria has been operationalized and measured in the literature. Third, it reviews and summarizes what has been known about factors that are closely related to cyberchondria. In summary, this study investigates and synthesizes the literature to provide a landscape of cyberchondria research. The results of this systematic review could provide scholars and medical professionals a more comprehensive understanding of the mechanisms of

cyberchondria and how to assess it, which would subsequently contribute to further investigation of relevant intervention strategies to mitigate cyberchondria. The rest of this chapter will report the method used for this systematic review, results of analyzing the included studies, and discussion of limitations and future directions in this area.

3.2 Method

This study used the systematic review method. The overall procedure of this review followed the guidelines in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Moher et al., 2009). The PRISMA statement contains a 27-item checklist and a flow diagram, which helps authors present the selection process in a transparent way and evaluate the quality of the included studies (Moher et al., 2009). Thus, this method, to some extent, reduces the biases in the article selection process.

First, four major databases – *ScienceDirect*, *PubMed*, *CINAHL*, and *PsycINFO*, which consist of a vast number of health-related studies across multiple disciplines, were used to perform the literature search. Next, since cyberchondria refers to the relationship between OHIS and health anxiety, a keyword search query was developed for database searching: (cyberchondria OR health anxiety OR worry OR hypochondri*) AND (seek* OR search* OR brows*) AND (online OR internet OR web). Additionally, to increase the comprehensiveness of the search results, subject terms with controlled vocabularies were employed in each database. For example, in *PubMed*, the medical subject heading (MeSH) thesaurus was used to retrieve studies indexed under both “Internet” and “health anxiety.”

The search was conducted in June 2020. Articles published in English, covering the time period from 1990 to 2020, were retrieved. Searches were done on the title, abstracts, and

keywords fields of the papers to filter out irrelevant studies that might contain part of the search query words in their main body parts. For other studies that were not detected in the electronic search process but might be relevant to the study, they were manually searched from the reference lists of the included papers. The articles without full-text available in the databases were retrieved using online search engines.

First, titles and abstracts of articles were screened based on search results, and full texts were assessed given that they were potentially relevant to the current research scope. In particular, studies were included if they (a) were published in peer-reviewed journals; (b) were relevant to cyberchondria; (c) were written in English; and (d) had full-text access. Further, the studies were not considered in the final sample if they (a) were conceptual articles related to cyberchondria; (b) used qualitative research methods; and (c) were literature reviews or meta-analysis.

Last but not least, after identifying the final sample, the following information from the included studies was extracted and coded for further analysis: (a) source, (b) country, (c) sample size, (d) sample description, (e) method, (f) measures of cyberchondria, (g) number of items, (h) internal consistency (i.e., Cronbach's α), (i) use of model/theory, and (j) main findings.

3.3 Results

A total of 1,487 records were identified through database searching, and six additional studies were found by searching the reference sections of the included studies. After deleting 828 duplicate records, the titles and abstracts of the 665 remaining articles were first screened. Next, 603 records were removed based on the inclusion criteria listed in the method section, leaving 62 records for full-text assessment. Next, 22 studies were further excluded since they were

conceptual articles ($n = 13$), review articles ($n = 4$), and qualitative research ($n = 5$). Ultimately, 40 studies were selected for this study. Figure 3.1 shows the flowchart of the literature selection process.

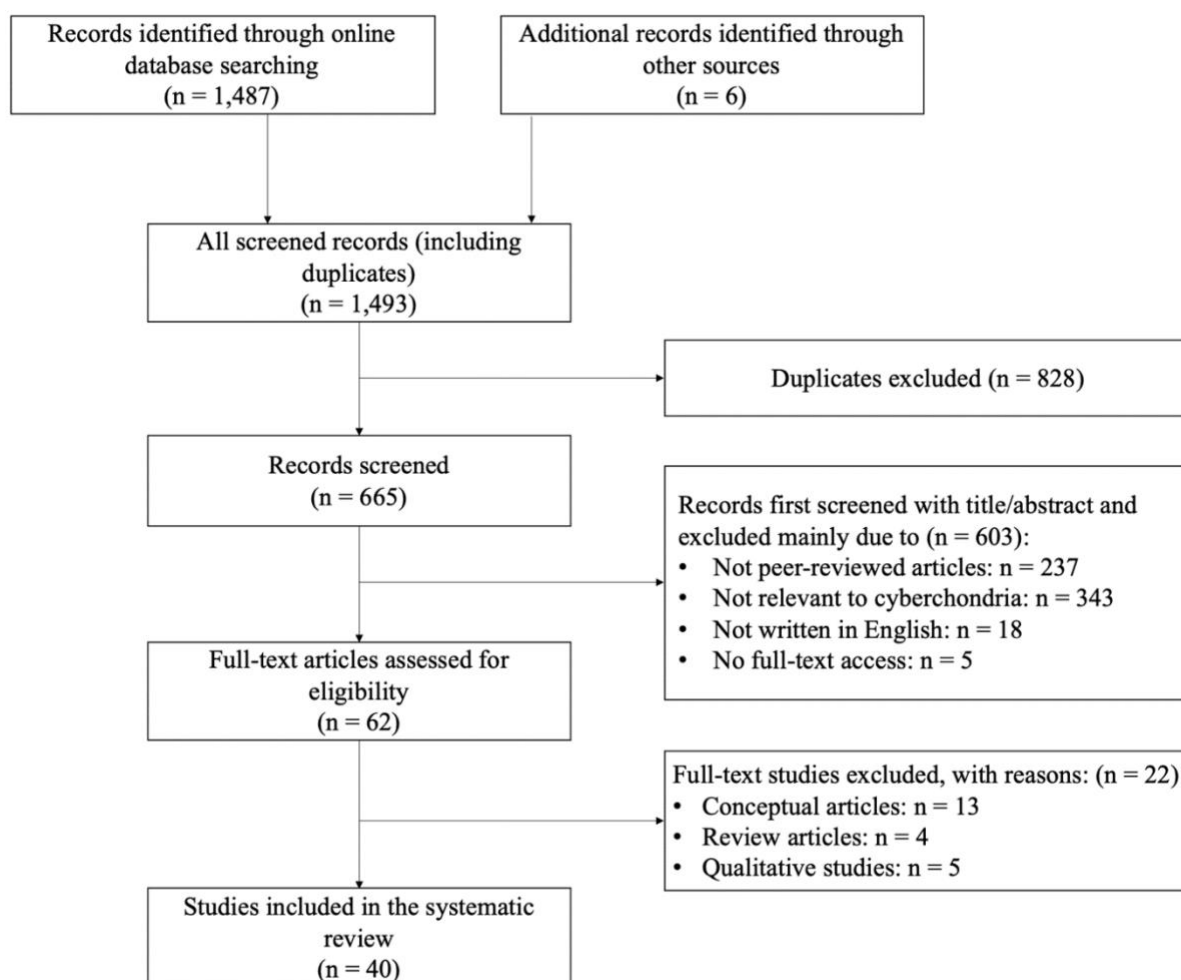


Figure 3.1. Flow diagram of the studies included in the systematic review.

3.3.1 Characteristics of the studies

Table 3.1 summarizes the general characteristics of the included studies. The articles in the final sample were published between 2006 and 2020. Among the 40 articles, most were published from the year 2015 onwards ($n = 32$), and there have already been seven publications

in 2020. Moreover, the majority of the studies were from the United States ($n = 16$), followed by the United Kingdom ($n = 4$), Turkey ($n = 4$), and the Netherlands ($n = 3$).

In general, participants in most studies were university students ($n = 12$) or unknown populations recruited from Amazon's Mechanical Turk (MTurk) ($n = 12$), an online crowdsourcing platform where individuals can complete tasks (e.g., online surveys) for monetary rewards (Fergus, 2014). In terms of data collection methods, the majority of the included studies ($n = 37$) used cross-sectional surveys to investigate the phenomenon of cyberchondria. The remaining three studies adopted an experiment, a 4-wave longitudinal survey, and a mixed research design (i.e., survey and experiment), respectively.

With regard to the use of model or theory in these studies, several studies ($n = 5$) proposed various theoretical frameworks to conceptualize the process of cyberchondria development and tested their frameworks empirically. In particular, two studies explored how cyberchondria develops from the perspective of metacognition (Fergus & Spada, 2018; Marino et al., 2020). Three studies integrated various factors influencing or being influenced by cyberchondria into theoretical models in the context of COVID-19 pandemic (Farooq et al., 2020; Jungmann & Witthöft, 2020; Laato et al., 2020).

Table 3.1. Characteristics of the included studies.

Source	Country	Sample size	Sample description	Method
Akhtar and Fatima (2020)	Pakistan	$N = 150$	Graduates aged more than 35 years, with healthy condition and with access to the Internet	Cross-sectional survey
Aulia et al. (2020)	Indonesia	$N = 162$	Medical students in a university	Cross-sectional survey
Bajcar and Babiak (2019)	Poland	$N = 207$	Polish adults recruited from a community sample using a snowball technique	Cross-sectional survey
Barke et al. (2016)	Germany	Study A: $N = 500$ Study B: $N = 292$	Online sample with participants whose first language was German and aged over 18 years	Cross-sectional survey
Bati et al. (2018)	Turkey	$N = 874$	University students in health science majors	Cross-sectional survey
Batigun et al. (2018)	Turkey	Study 1: $N = 250$ Study 2: $N = 360$	Individuals aged between 18 and 65 years, living in Ankara and using the Internet	Cross-sectional survey
Baumgartner and Hartmann (2011)	Netherlands	Study 1: $N = 104$ Study 2: $N = 120$	Study 1: A convenience sample of nonclinical participants in classes of a Dutch University; Study 2: Recruitment via an online information system of a Dutch university	Cross-sectional survey and experiment
Blackburn et al. (2019)	United States	$N = 104$	Orthopedic patients attending the orthopedic outpatient clinics	Cross-sectional survey
Doherty-Torstrick et al. (2016)	United States	$N = 731$	Individuals recruited from websites	Cross-sectional survey
Eastin and Guinsler (2006)	United States	$N = 240$	Individuals recruited via a commercial permission-based email sampling service	Cross-sectional survey
Eichenberg and Schott (2019)	Austria	$N = 471$	Individuals recruited from multiple online health forums	Cross-sectional survey
Farooq et al. (2020)	Finland	$N = 225$	Students and employees at a university in Finland	Cross-sectional survey
Fergus (2013)	United States	$N = 512$	Healthy adults recruited using Amazon's MTurk	Cross-sectional survey
Fergus (2014)	United States	$N = 539$	Healthy adults recruited using Amazon's MTurk	Cross-sectional survey
Fergus (2015)	United States	$N = 578$	Healthy adults recruited using Amazon's MTurk	Cross-sectional survey
Fergus and Dolan (2014)	United States	$N = 430$	Healthy adults over 18 years old recruited using Amazon's MTurk	Cross-sectional survey
Fergus and Russell (2016)	United States	$N = 375$	Healthy adults recruited using Amazon's MTurk	Cross-sectional survey
Fergus and Spada (2017)	United States	Study 1: $N = 337$ Study 2: $N = 260$	Participants recruited using Amazon's MTurk	Cross-sectional survey
Fergus and Spada (2018)	United States	Study 1: $N = 330$ Study 2: $N = 331$	Study 1: University students; Study 2: Participants from Amazon's MTurk	Cross-sectional survey

Table 3.1. (Continued).

Source	Country	Sample size	Sample description	Method
Gibler et al. (2019)	United States	$N = 221$	University undergraduate students	Cross-sectional survey
Jokić-Begić et al. (2019)	Croatia	$N_1 = 540$ $N_2 = 379$ $N_3 = 594$	A community sample recruited via a snowball technique	Cross-sectional survey
Jungmann and Witthöft (2020)	Germany	$N = 1,615$	Individuals from the German general population	Cross-sectional survey
Laato et al. (2020)	Bangladesh	$N = 294$	University students, faculty and alumni	Cross-sectional survey
Lagoe and Atkin (2015)	United States	$N = 245$	Participants recruited using Amazon's MTurk	Cross-sectional survey
Makarla et al. (2019)	India	$N = 205$	Employees in different IT firms	Cross-sectional survey
Marino et al. (2020)	Italy	Study 1: $N = 374$ Study 2: $N = 717$	Participants recruited from a convenience sample at a university in Italy.	Cross-sectional survey
Mathes et al. (2018)	United States	$N = 462$	Participants recruited using Amazon's MTurk	Cross-sectional survey
McElroy and Shevlin (2014)	United Kingdom	$N = 208$	An opportunity sample of university undergraduate students	Cross-sectional survey
McElroy et al. (2019)	United Kingdom	$N = 661$	University students	Cross-sectional survey
Muse et al. (2012)	United Kingdom	$N = 219$	Recruitment through advertisements at local universities ($n = 187$) and from participants ($n = 32$) in a previous study	Cross-sectional survey
Newby and McElroy (2020)	Australia	$N = 82$	Health anxious patients who met criteria for a diagnosis of SSD or DSM-5	Experiment
Norr et al. (2015a)	United States	$N = 526$	Participants recruited using Amazon's MTurk	Cross-sectional survey
Norr et al. (2015b)	United States	$N = 526$	Participants recruited using Amazon's MTurk	Cross-sectional survey
Norr et al. (2015c)	United States	$N = 468$	Participants recruited using Amazon's MTurk	Cross-sectional survey
Selvi et al. (2018)	Turkey	$N = 337$	University students with an age range of 16 – 55	Cross-sectional survey
Singh and Brown (2014)	United Kingdom	$N = 255$	Undergraduate and graduate students from the University of Manchester	Cross-sectional survey
Starcevic et al. (2019)	Multi-country	$N = 751$	Participants recruited using an online crowdsourcing platform Prolific	Cross-sectional survey
Tanis et al. (2016)	Netherlands	$N = 239$	Patients waiting to see the doctor in six doctors' offices	Cross-sectional survey
te Poel et al. (2016)	Netherlands	$N = 5,322$	Randomly selected household members aged 16 years old or above who had Internet access	Longitudinal survey
Uzun and Zencir (2018)	Turkey	$N = 335$	Employees in a Turkish university	Cross-sectional survey

3.3.2 Measures of cyberchondria

Various approaches have been adopted to operationalize the concept of cyberchondria in the literature. The prominent approaches include (a) measuring components of cyberchondria (e.g., health anxiety and OHIS) separately, and (b) creating new cyberchondria scales. Table 3.2 summarizes the measures of cyberchondria and main findings of the included studies.

3.3.2.1 Measuring components of cyberchondria separately

First, 11 out of the 40 studies investigated cyberchondria through measuring the relationship between health anxiety and OHIS (Baumgartner & Hartmann, 2011; Doherty-Torstrick et al., 2016; Eastin & Guinsler, 2006; Eichenberg & Schott, 2019; Fergus, 2013; Fergus & Dolan, 2014; Lagoe & Atkin, 2015; Muse et al., 2012; Singh & Brown, 2014; Tanis et al., 2016; te Poel et al., 2016). This is because, at the beginning stage of cyberchondria research, there was not a specific assessment tool for cyberchondria. Based on the definition of cyberchondria, researchers operationalized this concept through measuring its two components, health anxiety and OHIS, and examined the relationships between the two components.

The measures of health anxiety and OHIS varied across studies (see Table 3.2). For health anxiety, the Short Health Anxiety Inventory (SHAI) was the most frequently used ($n = 6$). SHAI is an established scale with 18 items to measure health anxiety independent of physical health conditions. In addition, the Whiteley Index (WI), a widely used measurement for worries and beliefs, was adopted in two studies. The Cronbach's alpha for these health anxiety scales (SHAI and WI) ranged from .77 to .92, indicating a relatively high internal consistency among the items. For OHIS, six studies used a single item to ask participants the frequency or duration of using the Internet to search for health information. The other five studies used multiple items to ask participants the extent of Internet use from a more comprehensive perspective. Only one

study reported the reliability of their multi-item measurement of OHIS ($\alpha = .86$) (Lagoe & Atkin, 2015).

Regarding the relationships between the two components, all of the eleven studies corroborated that health anxiety is positively related to the frequency or duration of OHIS, which supports the notion of cyberchondria. However, these studies used different variables for measuring health anxiety and OHIS separately and examined their relationship, which renders the comparison and synthesis of the studies difficult.

3.3.2.2 Creating new cyberchondria scales

Further, several new tools/scales have been developed in the literature to assess the severity of cyberchondria among Internet users ($n = 29$).

Cyberchondria Severity Scale (CSS). McElroy and Shevlin (2014) developed a new self-reported scale with 33 items to assess the level of cyberchondria (the Cyberchondria Severity Scale [CSS]). It is a multi-dimensional measurement instrument, which consists of five components: (1) compulsion: interruption of users' daily lives due to massive online searches; (2) excessiveness: excessive or repeated seeking for medical information on the Internet; (3) distress: negative psychological emotions, such as insomnia and depression caused by online searches; (4) reassurance: reassurance checking from other sources such as medical professionals; and (5) mistrust of medical professionals: conflicts between online health resources and advice provided by medical professionals. As the first assessment tool specifically developed for measuring cyberchondria, the original English version CSS has been adopted and validated in sixteen studies. Additionally, it has been translated to several other languages such as German (Barke et al., 2016), Italian (Marino et al., 2020), and Turkish (Selvi et al., 2018).

The CSS has been demonstrated to be a potentially good scale for measuring cyberchondria. First, McElroy and Shevlin (2014) reported high internal consistency ($\alpha = .94$), as well as good concurrent and convergent validity of this 33-item CSS. Other studies also suggested a good model fit to the data and good internal structure of the CSS, with Cronbach's α ranging from .89 to .96. However, several studies recommended that the *mistrust of medical professionals* dimension should be removed from the CSS. The reasons are that it has a weak correlation with the other four CSS dimensions, and it does not demonstrate robust factor loading on the higher-order factor (i.e., cyberchondria) (Barke et al., 2016; Fergus, 2014; Norr et al., 2015b; Selvi et al., 2018). After excluding the mistrust subscale, the revised CSS with 30 items also demonstrated adequate internal consistency, ranging from .89 to .96 (Gibler et al., 2019; Mathes et al., 2018; Norr et al., 2015b).

Subsequently, Barke et al. (2016) proposed the Cyberchondria Severity Scale Short Form (CSS-15) with 15 items based on the original scale. This new and brief version was developed and validated using a sample of 292 participants whose data were based on online self-reporting. It demonstrated a high internal consistency ($\alpha = .82$), and its five dimensions were confirmed by a confirmatory factor analysis. The CSS-15 was further validated and adopted in three other studies (Bati et al., 2018; Fergus & Spada, 2018), all of which demonstrated a good internal structure of this short version of the CSS.

More recently, McElroy et al. (2019) proposed another short-form version of the CSS. This refined scale, the CSS-12, was developed and validated using a sample of 661 university students. Based on exploratory factor analysis, 12 items from the original CSS were retained for the new version. This CSS-12 scale has four dimensions, namely, *excessiveness*, *reassurance*, *compulsion*, and *distress*. The *mistrust of medical professionals* subscale in the full 33-item

version was omitted. In terms of the reliability and validity of this new scale, first, the CSS-12 had a very good internal consistency ($\alpha = .90$). Second, the confirmatory bifactor model indicated a good model fit to the data. The 12 items could be viewed as a general cyberchondria factor, which accounted for the majority variance shared among items. That is, the CSS-12 can be a unidimensional scale and the 12 items can be summed to a total score. Third, good convergent and divergent validity were demonstrated based on the strong relationship between the CSS-12 and SHAI. Therefore, McElroy et al. (2019) argued that the CSS-12 can be a brief and reliable measure of cyberchondria in the future. A recent study employed this scale to evaluate the level of cyberchondria amid the COVID-19 pandemic. Slight modifications were made to suit the pandemic context (Jungmann & Witthöft, 2020). The adapted scale also showed a good internal consistency ($\alpha = .81$).

Cyberchondria Scale (CS). Batigun et al. (2018) developed a cultural-specific and multidimensional scale named Cyberchondria Scale (CS), with the aim of assessing adult individuals' cognitive, emotional, and behavioral tendencies to cyberchondria in Turkey. This 27-item scale also has five dimensions, namely, *factors increasing anxiety*, *factors decreasing anxiety*, *compulsion*, *doctor-patient interaction*, and *dysfunctional Internet use*. The CS was validated in two different samples ($N_1 = 250$ and $N_2 = 360$), from the population aged between 18-65 years, living in Ankara, Turkey and using the Internet. The confirmatory factor analyses suggested acceptable goodness of fit values and satisfactory reliability ($\alpha = .93$). Hence, the CS could potentially be a reliable and valid scale to assess cyberchondria in Turkish adult populations. Nevertheless, further studies are needed to validate its psychometric properties and to extend its use to other samples.

Short Cyberchondria Scale (SCS). Based on data from three samples, Jokić-Begić et al. (2019) devised a Short Cyberchondria Scale (SCS) with four items. Although this scale was very short, it had an acceptable reliability ($\alpha = .77$). In addition, confirmatory factor analysis revealed a clear and congruent factor structure of this new scale. Through examining the relationship between the SCS and CSS, an acceptable convergent validity of the SCS was also reported. The measurement invariance was further demonstrated across age and gender, indicating that this scale might be applied to different populations. Jokić-Begić et al. (2019) argued the SCS can capture the core elements of cyberchondria, which are excessive online health searches and escalation of health anxiety. This new short scale was adopted in recent two studies to assess individuals' level of cyberchondria during the COVID-19 pandemic (Farooq et al., 2020; Laato et al., 2020). Both studies reported a good reliability of the SCS ($\alpha = .82$ and $\alpha = .80$).

In summary, the measurements of cyberchondria have been developing in recent years. During the early stage of cyberchondria research, there was not a specific assessment tool for this new phenomenon. The notion of cyberchondria was supported by measuring the relationship between health anxiety and OHIS. Later, the CSS was first developed and adopted in a series of studies, and it demonstrated acceptable reliability and validity despite some weakness with the dimension *mistrust of medical professionals*. Further, two short versions of the CSS were proposed: CSS-15 and CSS-12. Other scales such as CS and SCS were also created to assess the level of cyberchondria in different populations and contexts. These scales have shown good psychometric properties. But since they have only been tested in a few studies, further validation studies are still needed.

Table 3.2. Measures of cyberchondria and summary of findings.

Source	Measures of cyberchondria	No. of items	Cronbach's α	Main findings
Akhtar and Fatima (2020)	CSS	33	.91	There were no significant differences in gender in terms of cyberchondria total score and its subscales.
Aulia et al. (2020)	CSS (Indonesian version)	30	.89	There was no difference of CSS scores between male and female students, but their OHIS behavior might be slightly different.
Bajcar and Babiak (2019)	CSS-PL (Polish version)	30	.95	Low self-esteem is associated with cyberchondria, and OC symptoms and health anxiety can mediate this relationship.
Barke et al. (2016)	1. CSS (German version)	33	.93	Both the German version of the CSS and its short version have good psychometric characteristics. Cyberchondria is related to health anxiety and healthcare utilization.
	2. CSS-15	15	.82	
Bati et al. (2018)	CSS-15	15	N/A	Cyberchondria and health anxiety are common among students with health problems.
Batigun et al. (2018)	CS	27	.93	CS is a valid and reliable scale to measure cyberchondria in Turkey.
Baumgartner and Hartmann (2011)	1. WI	14	.86	Health anxiety is related to an increase in OHIS. OHIS leads to a greater level of worries among anxious people.
Blackburn et al. (2019)	2. OHIS	1	N/A	
	CSS	30	N/A	Cyberchondria can mediate the relationship between IU and health anxiety among orthopedic patients.
Doherty-Torstrick et al. (2016)	1. WI	14	N/A	OHIS is positively related to greater health anxiety in highly anxious people. Long duration of OHIS is associated with functional impairment.
	2. Duration of OHIS	1	N/A	
Eastin and Guinsler (2006)	1. HAQ	21	.95	People with health anxiety seek more information online, which leads to more medical appointments based on information found online.
	2. OHIS	1	N/A	
Eichenberg and Schott (2019)	1. IAS	29	.90	Compared to healthy individuals, people with hypochondria tend to search more medical information online and perceive online health services as more reliable.
	2. Internet use (OHIS)	5	N/A	
Farooq et al. (2020)	SCS	4	.82	During COVID-19, cyberchondria and information overload are positively related to threat and coping appraisal, which further predicts self-isolation intention.
Fergus (2013)	1. SHAI	14	.92	Increased IU is related to a stronger relationship between health anxiety and OHIS.
	2. Frequency of OHIS	1	N/A	
Fergus (2014)	CSS	33	.95	The CSS is a good scale to measure cyberchondria. However, the dimension <i>mistrust of medical professionals</i> should be removed from the CSS.

Table 3.2. (Continued).

Source	Measures of cyberchondria	No. of items	Cronbach's α	Main findings
Fergus (2015)	CSS	30	.95	Physical anxiety sensitivity (AS) and inhibitory IU are positively related to the <i>distress</i> dimension of cyberchondria.
Fergus and Dolan (2014)	1. HA single item	1	N/A	Increased health anxiety is related to more Internet searches, which leads to greater Problematic Internet Use (PIU). Cyberchondria is independent but related to health anxiety, whereas it is not associated with OC symptoms after controlling health anxiety and negative affect.
	2. Frequency of OHIS	1	N/A	
Fergus and Russell (2016)	CSS	30	N/A	
Fergus and Spada (2017)	CSS	30	.95	Cyberchondria is strongly related to PIU and metacognitive beliefs.
Fergus and Spada (2018)	CSS	30	.95	Cyberchondria is positively related to beliefs about rituals, metacognitive beliefs, and stop signals.
	CSS-15	12	.88	
Gibler et al. (2019)	CSS	30	N/A	Pain catastrophizing can predict cyberchondria.
Jokić-Begić et al. (2019)	SCS	4	.77	The 4-item SCS is a satisfactory scale to measure cyberchondria. Health anxiety and anxiety sensitivity are highly related to cyberchondria.
Jungmann and Witthöft (2020)	CSS-12	12	.81	Amid the COVID-19 pandemic, cyberchondria is positively related to virus anxiety, and trait health anxiety can strengthen this relationship.
Laato et al. (2020)	SCS	4	.80	Online trust and information overload are related to cyberchondria during the COVID-19 pandemic. Females are more likely to develop cyberchondria.
Lagoe and Atkin (2015)	1. SHAI	4	.77	Neuroticism is positively related to health anxiety, which influences OHIS.
	2. OHIS	4	.86	
Makarla et al. (2019)	CSS-15	15	N/A	Cyberchondria is negatively associated with general mental health among IT professionals in India.
Marino et al. (2020)	CSS	33	.95	Italian version of the CSS has demonstrated good internal consistency. Negative metacognitive beliefs (thoughts are uncontrollable) are the most central to the dimensions of cyberchondria.
	CSS (Italian version)	32	.95	
Mathes et al. (2018)	CSS	30	.96	Cyberchondria is positively related to increased functional impairment and more healthcare utilization.
McElroy and Shevlin (2014)	CSS	33	.94	The CSS has demonstrated good internal consistency, with good concurrent and convergent validity.
McElroy et al. (2019)	CSS-12	12	.90	The CSS-12 can be a brief, reliable, and valid instrument to measure cyberchondria.

Table 3.2. (Continued).

Source	Measures of cyberchondria	No. of items	Cronbach's α	Main findings
Muse et al. (2012)	1. SHAI 2. OHIS frequency and duration	18 2	.90 N/A	People with a higher level of health anxiety seek online medical information more frequently.
Newby and McElroy (2020)	CSS	33	.96	Internet-delivered cognitive behavioral therapy for health anxiety is effective for reducing the level of cyberchondria.
Norr et al. (2015a)	CSS	30	.96	Cyberchondria is positively related to AS and inhibitory IU after controlling for health anxiety.
Norr et al. (2015b)	CSS	33	.95	The CSS can be conceptualized as containing a general cyberchondria factor that is orthogonal to its five subdimensions.
Norr et al. (2015c)	CSS	30	N/A	Cyberchondria is positively related to OC symptoms after controlling for health anxiety and negative affect.
Selvi et al. (2018)	CSS (Turkish Version)	33	.91	The Turkish version of the CSS has good psychometric properties.
Singh and Brown (2014)	1. SHAI 2. Internet usage (OHIS)	18 6	.89 N/A	Health anxiety is positively associated with frequency and different types of OHIS.
Starcevic et al. (2019)	CSS	33	.95	Cyberchondria is an independent syndrome-like phenomenon, which is strongly related to PIU and health anxiety.
Tanis et al. (2016)	1. SHAI 2. OHIS	18 1	.84 N/A	Health anxiety is positively related to OHIS, and people with high health anxiety will be less satisfied with medical consultation.
te Poel et al. (2016)	1. SHAI (Dutch Version) 2. OHIS	14 3	.85 N/A	The relationship between health anxiety and OHIS is reciprocal in a non-clinical population.
Uzun and Zencir (2018)	CSS (Turkish Version)	33	.89	The Turkish version of the CSS has shown good reliability and validity, which can be used to assess cyberchondria.

Abbreviations: AS: Anxiety sensitivity; CS: Cyberchondria scale; CSS: Cyberchondria severity scale; HAQ: Health anxiety questionnaire; IAS: Illness attitude scale; IU: Intolerance of uncertainty; OC symptoms: Obsessive-compulsive symptoms; OHIS: Online health information seeking; PIU: Problematic Internet use; SCS: Short cyberchondria scale; SHAI: Short health anxiety inventory; WI: Whiteley index.

3.3.3 Factors related to cyberchondria

In addition to validating cyberchondria-related scales, many studies have investigated various factors related to cyberchondria. For the antecedents, two studies have explored how personality traits are linked to cyberchondria. Lagoe and Atkin (2015) revealed that neuroticism is positively related to health anxiety, which may increase the frequency of health information searches on the Internet (i.e., cyberchondria). Bajcar and Babiak (2019) also found that low self-esteem is positively associated with cyberchondria, and obsessive-compulsive symptoms and health anxiety parallelly mediate this association.

Further, as health anxiety is a concept very related to cyberchondria, a group of studies examined the relationship between health anxiety and cyberchondria (Barke et al., 2016; Blackburn et al., 2019; Fergus & Russell, 2016; Fergus & Spada, 2018; Jokić-Begić et al., 2019; Mathes et al., 2018; Norr et al., 2015b; Starcevic et al., 2019). In particular, using a network analysis approach, Starcevic et al. (2019) concluded that health anxiety and problematic Internet use are the two elements most associated with cyberchondria. More importantly, four studies (Barke et al., 2016; Fergus & Russell, 2016; Mathes et al., 2018; Norr et al., 2015b) argued that although health anxiety is closely associated with cyberchondria, they have distinct features. In other words, cyberchondria should be regarded as a specific syndrome-like construct, independent from other health-related problems (Starcevic et al., 2019).

Some other psychological risk factors have been also investigated in the cyberchondria literature. First, four studies confirmed that intolerance of uncertainty (IU), a dispositional fear of the unknown, is positively associated with cyberchondria (Blackburn et al., 2019; Fergus, 2013, 2015; Norr et al., 2015a). More specifically, both Fergus (2015) and Norr et al. (2015a) showed that there is a unique relationship between the dimensions *inhibitory IU* and *distress of*

cyberchondria after controlling health anxiety. Blackburn et al. (2019) showed that IU can predict cyberchondria, which further leads to greater health anxiety. Second, three studies demonstrated anxiety sensitivity, which is the fear of sensations and behaviors due to anxiety, can confer vulnerability for cyberchondria (Fergus, 2015; Jokić-Begić et al., 2019; Norr et al., 2015a). Third, three studies (Bajcar and Babiak, 2019; Fergus, 2014; Norr et al., 2015c) reported that obsessive-compulsive symptoms, especially for contamination/washing and responsibility for harm symptoms, are positively correlated with cyberchondria. In contrast, Fergus and Russell (2016) did not find any meaningful overlaps between obsessive-compulsive symptoms and cyberchondria after controlling health anxiety and negative affect. Fourth, three studies investigated cyberchondria from a metacognitive perspective. More specifically, metacognitive beliefs (Fergus & Spada, 2017, 2018; Marino et al., 2020), beliefs about rituals (Fergus & Spada, 2017, 2018; Marino et al., 2020), and stop signals (Fergus & Spada, 2017, 2018; Marino et al., 2020) can predict cyberchondria. Among these factors, negative metacognitive beliefs (i.e., beliefs that thoughts are uncontrollable) are the most relevant to the dimensions of cyberchondria (Marino et al., 2020).

Some information-related factors can influence cyberchondria as well. For example, Laato et al. (2020) found that in the context of COVID-19 pandemic, online information trust and information overload are positively associated with cyberchondria. In addition, when new information about COVID-19 was presented at high volumes, people were not able to process such overloaded information with limited working memory (Whelan et al., 2020). This leads them to feel uncertain and anxious about the situation and to seek more relevant information for reassurance (Laato et al., 2020).

For the consequences of cyberchondria, studies have demonstrated that cyberchondria is associated with negative health outcomes including problematic Internet use (Fergus & Dolan, 2014; Fergus & Spada, 2017; Starcevic et al., 2019), general mental health problems (Makarla et al., 2019), increased healthcare utilization (Barke et al., 2016; Mathes et al., 2018), functional impairment (Mathes et al., 2018), and perceived lower quality of life (Mathes et al., 2018). In addition, cyberchondria may lead to post-search relief, such as reassurance checking with a doctor (Singh & Brown, 2014). More specifically, health anxious individuals tend to search for medical information frequently on the Internet, which may drive more medical appointments based on the information found online (Eastin & Guinsler, 2006; Eichenberg & Schott, 2019), and less satisfaction with their doctor consultation (Tanis et al., 2016). Additionally, they may change their health behavior such as doctor hopping and ordering medical product online (Eichenberg & Schott, 2019).

Moreover, Jungmann and Witthöft (2020) found that during the COVID-19 pandemic, both cyberchondria and trait health anxiety are positively related to virus anxiety. Adaptive emotion regulation and perception of being informed about the pandemic could be buffering factors for anxiety about virus in this situation. In Farooq et al.'s study (2020), excessively searching for coronavirus-related information on the Internet were found to increase perceived severity and vulnerability to the virus. Further, perceived severity can trigger intention to self-isolate whereas perceived vulnerability cannot (Farooq et al., 2020).

Taken together, previous studies have examined various antecedents and consequences of cyberchondria. However, most of them focused on psychological risk factors, and only a small portion of studies investigated how information-related factors can influence or be influenced by cyberchondria, despite the fact that cyberchondria also describes an excessive pattern of

information seeking behavior. Table 3.3 summarizes and categorizes the antecedents and consequences of cyberchondria in the existing literature.

Table 3.3. Antecedents and consequences of cyberchondria.

Antecedents	Consequences
<i>Personality traits</i> • Neuroticism (Lagoe & Atkin, 2015) • Self-esteem (Bajcar & Babiak, 2019)	<i>Psychological outcomes</i> • General mental health problems (Makarla et al., 2019) • Virus anxiety (Jungmann & Witthöft, 2020)
<i>Information factors</i> • Information overload (Laato et al., 2020) • Online information trust (Laato et al., 2020)	<i>Cognitive outcomes</i> • Less satisfaction with doctor consultation (Tanis et al., 2016) • Lower perceived quality of life (Mathes et al., 2018) • Perceived severity and vulnerability (Farooq et al., 2020)
<i>Psychological risk factors</i> • Anxiety sensitivity (Fergus, 2015; Jokić-Begić et al., 2019; Norr et al., 2015a) • Beliefs about rituals ((Fergus & Spada, 2017, 2018; Marino et al., 2020) • Health anxiety (Barke et al., 2016; Blackburn et al., 2019; Fergus & Russell, 2016; Fergus & Spada, 2018; Jokić-Begić et al., 2019; Mathes et al., 2018; Norr, Allan, et al., 2015; Vladan Starcevic et al., 2019) • Intolerance of uncertainty (Blackburn et al., 2019; Fergus, 2013, 2015; Norr, Albanese, et al., 2015) • Metacognitive beliefs (Fergus & Spada, 2017, 2018; Marino et al., 2020) • Obsessive-compulsive symptoms (Bajcar & Babiak, 2019; Fergus, 2014; Norr et al., 2015c) • Stop signals (Fergus & Spada, 2018)	<i>Behavioral outcomes</i> • Functional impairment (Mathes et al., 2018) • Health behavior changes such as doctor hopping and ordering medical product online (Eichenberg & Schott, 2019) • Increased healthcare utilization (Barke et al., 2016; Mathes et al., 2018) • More medical appointments ((Eastin & Guinsler, 2006; Eichenberg & Schott, 2019) • Problematic Internet use (Fergus & Dolan, 2014; Fergus & Spada, 2017; Starcevic et al., 2019)

3.4 Discussion

This study aimed to systematically review the current state of empirical research on cyberchondria. Key findings that emerged from this review are of importance from both theoretical and practical perspectives in addressing cyberchondria. First, the current review offered a comprehensive overview of the extant empirical studies on cyberchondria by analyzing their characteristics in regard to country, sample, and methods, among others. Second, it reviewed major assessment tools of cyberchondria that had been employed in prior work to offer useful guidance on future investigations on cyberchondria. Third, it identified the antecedents and consequences of cyberchondria in previous research, which contributes to theoretical understanding of cyberchondria. In sum, the results of this systematic review could provide an overall landscape of empirical research on cyberchondria. Based on the results, the following subsections elaborate on the gaps in the current literature and priorities for future work on cyberchondria. Implications and limitations of this review are also discussed.

3.4.1 Characteristics of the included studies

First, overall, the number of studies on cyberchondria has grown rapidly in recent years. Most of the included studies in this sample were conducted in western countries (e.g., the United States, the United Kingdom, and the Netherlands). As such, there were few studies from eastern countries such as China, Japan, and Singapore. Although the CSS was translated into several languages such as German and Turkish, more studies are warranted to investigate the phenomenon of cyberchondria in different geographical and cultural contexts. This is of particular importance given that individuals' OHIS behavior can be attributable to the availability and accessibility of health-related resources in a geographic location (Dutta, 2009),

which may exert different impacts on the development of cyberchondria. There may as well exist cultural differences in how and to what extent individuals develop cyberchondria.

Second, the majority of the examined studies relied solely on cross-sectional data to investigate cyberchondria, and their samples were mainly drawn based on convenience from the pool of university students and online crowdsourcing platforms. These limit the theoretical advancement of cyberchondria as the direction of causality cannot be established based on cross-sectional studies. Experiments and longitudinal studies are necessary in future work to examine the causal relationship between cyberchondria and its related factors. In addition, although samples from online communities have been demonstrated to provide high quality survey data in previous studies (Buhrmester et al., 2011; Fergus & Dolan, 2014; Mathes et al., 2018), and university students constitute the main group of the Internet users (McElroy & Shevlin, 2014), they may not accurately represent the whole population using the Internet for health information search. Therefore, future work should recruit participants from other age groups beyond university students. The use of random sampling designs should be encouraged. Moreover, only two papers in our sample investigated the phenomenon of cyberchondria among patients. More clinical samples should be included in future research to understand whether this group of individuals performs OHIS in a different way compared to non-clinical samples.

3.4.2 Measures of cyberchondria

Cyberchondria has been operationalized and measured in several different ways in the literature. At the early stage of cyberchondria research, there were no specific measures for cyberchondria. The notion of cyberchondria was supported through measuring its two components: OHIS and health anxiety. Health anxiety has been found to be moderately to

strongly correlated with OHIS in previous studies (McMullan et al., 2019), suggesting the presence of cyberchondria in the digital age. More importantly, te Poel et al. (2016) provided preliminary support for the reciprocal relationship between OHIS and health anxiety in their longitudinal study. That is, regardless of which element occurs first (i.e., health anxiety or OHIS), cyberchondria describes a reciprocal relationship between the two elements. This finding emphasizes the need for more empirical research to test this reciprocal relationship in the future, to serve as a foundation for advancing the current definitions of cyberchondria, many of which describes cyberchondria as an association between the two elements without specifying the direction of the relationship (Starcevic, 2017).

Moreover, the CSS was developed, and it has been considered an important measurement tool for assessing the severity of cyberchondria, given its high internal reliability and acceptable validity demonstrated in the literature. However, as the first assessment tool for measuring cyberchondria, the CSS has recently received some criticisms from other scholars. For example, Starcevic and Berle (2015) argued that the 33-item scale is too lengthy and general as some items are not necessarily related or specific to cyberchondria. Furthermore, there are some psychometric deficiencies for this multi-dimensional scale, such as the dimension of *mistrust of medical professionals* (Barke et al., 2016; Fergus, 2014; Norr et al., 2015b; Selvi et al., 2018).

To address the observed weaknesses of the CSS, two short versions of the CSS were developed, namely, the CSS-15 and CSS-12. In addition, a cultural-specific scale CS and another short scale (the SCS) were also created in the cyberchondria literature. Among these scales, the SCS and CSS-12 may be more useful and convenient for clinical and research purpose (Menon et al., 2020). In summary, work in developing the measurements of cyberchondria is still in

progress. To capture cyberchondria validly and reliably, more instrument development and verification efforts are indispensable.

3.4.3 Factors associated with cyberchondria

This review examined the factors influencing, or being influenced by, cyberchondria. For example, a variety of anxiety disorders such as intolerance of uncertainty, anxiety sensitivity, and obsessive-compulsive symptoms are linked to cyberchondria (Fergus, 2013; Norr et al., 2015a; Norr et al., 2015c). However, only a few studies have explored the role of information-related factors such as information overload in the process of cyberchondria development. Searching for health information in an online environment is not an easy task, considering the characteristics of online health information, such as complexity, ambiguity, and contradiction (Starcevic et al., 2020). Online users tend to become cyberchondriac when they fail to find relevant information or are not able to successfully process information. Therefore, future studies in this area need to further investigate how information-related factors contribute to cyberchondria.

In addition, this review underlines that limited research has explored potential moderators in these relationships. For example, health literacy can help people locate and process relevant health information from an ocean of online sources, which might further reduce the possibility of turning OHIS into cyberchondria (Korp, 2005). Future studies could therefore look into the moderating role of health literacy in weakening the effects of these antecedents on cyberchondria.

3.4.4 Research implications of this review

This review provides some implications for future research on cyberchondria. First, while previous literature has examined the role of various antecedents in explaining cyberchondria development, only a few studies have attempted to propose a unified theoretical model to organize existing results and constructs to detail the processes of how these factors lead to cyberchondria (Brown et al., 2019). Theorizing the development of cyberchondria is especially important in the context of global health emergency, where anxiety and uncertainty, to a large extent, are generated in the public. For example, informed by protection-motivation theory, Farooq et al. (2020) proposed a model outlining the effects of information overload and cyberchondria on people's perceptions and intentions during the COVID-19 pandemic. Such theory and model development efforts would help us better understand of the role of cyberchondria in risky situations. Hence, more future research could focus on the conceptualization of cyberchondria from a theoretical perspective to identify important antecedents and consequences of cyberchondria.

Second, in the current cyberchondria literature, only one experiment study found that Internet-delivered cognitive behavioral therapy for health anxiety could effectively reduce the level of cyberchondria among anxious patients (Newby & McElroy, 2020). This intervention program included treatment components about how to educate people on some possible negative effects of OHIS (e.g., worsening symptoms of health anxiety) as well as how to find neutral explanations for symptoms and avoid catastrophic thinking. Researchers could propose other appropriate treatment interventions specifically for cyberchondria and test treatment components in different populations who conduct OHIS regularly.

3.4.5 Practical implications of this review

This systematic review offers several practical implications as well. First, it summarized several assessment tools for measuring cyberchondria in the literature. From a practical perspective, medical professionals can adopt these existing measurements to assess individuals who are highly anxious after viewing medical information on the Internet. Although these measures still require further validation, they can serve as a basis for developing treatment interventions that can be tested in randomized, controlled studies (Starcevic, 2017).

Second, in this review, various factors related to cyberchondria were identified, some of which might provide insights on how to mitigate individuals' experience of cyberchondria when they seek health information online. For instance, during the COVID-19 pandemic, information overload is positively related to cyberchondria. Based on this finding, health professionals could advise people to consume manageable amounts of verified information related to COVID-19 and propose a list of reliable information sources that individuals could turn to. In summary, identifying potential antecedents of cyberchondria could provide practical insights into the development of intervention strategies to reduce the burden of cyberchondria.

3.4.6 Limitations of this review

The current systematic review is not without limitations. First, the number of identified studies that match the selection criteria is small. As such, the study does not cover all the available cyberchondria studies. The current study included only articles published in peer-reviewed journals. Future studies may consider including papers published in other venues (e.g., conference papers). Second, only articles written in English were analyzed. Further systematic reviews of cyberchondria studies that were published in other languages would provide a more

global overview of the cyberchondria literature. Nevertheless, this study synthesizes the state of the art of cyberchondria literature in English, which can contribute to the understanding of how cyberchondria has been operationalized in previous studies as well as important factors associated with cyberchondria. In addition, this study identified several research gaps, which can provide fruitful directions for future work in this new research area. Third, in light of the dearth of review studies on cyberchondria, the current review took an initial step towards providing an extensive overview of the extant literature. It would be worthwhile for future work to evaluate the validity of the methods used in cyberchondria studies, including their data collection methods, instruments, sampling designs, and statistical analyses. Moreover, meta-analytic studies are encouraged when there is a sufficient number of cyberchondria studies that share a comparable research type and variables.

3.5 Summary

This chapter presented a systematic review of existing research on cyberchondria. A comprehensive literature search was conducted in four major databases in the healthcare domain to identify cyberchondria-related articles. Based on the analysis of the 40 identified articles, key characteristics of the studies were summarized. Overall, the research on cyberchondria is in its infancy. In particular, the development and validation of cyberchondria measurements are still in progress. Further validation studies are needed in different populations and contexts. Moreover, previous studies have begun to examine various antecedents and consequences of cyberchondria. There is much room for further advancement in conceptualizing and modeling the detailed processes of cyberchondria development. To this end, the next chapter will focus on developing a theoretical model from psychology and information seeking perspectives to explicate potential

antecedents related to cyberchondria based on the existing frameworks, which have been reviewed in Chapter Two.

CHAPTER FOUR: THEORETICAL MODEL FOR CYBERCHONDRIA²

The systematic review in Chapter Three suggested that while previous research has investigated how various antecedents are associated with cyberchondria, few studies have theorized the process of cyberchondria development (Brown et al., 2019; Zheng et al., 2021). In particular, no theoretically-grounded empirical studies have taken into account the role of OHIS in this process, despite evidence that regular OHIS can turn harmful and excessive into cyberchondria (Brown et al., 2019). Notably, health information seeking has been typically examined as a safe reassurance behavior to meet users' various health information needs (Pian et al., 2020), but limited research has investigated the potential negative consequences if such needs are not satisfied. That is, most research on OHIS considers information seeking as the dependent variable while not addressing what happens after individuals seek information (Lagoe & Atkin, 2015; Yang et al., 2014). In addition, predictors of information seeking have not been incorporated as an integral part of cyberchondria research, although cyberchondria is viewed as a negative outcome of online medical research (Brown et al., 2019; Starcevic & Berle, 2013). Therefore, this chapter seeks to connect the two research areas (i.e., OHIS and cyberchondria) and develop a theoretical model to examine how some regular OHIS may diverge into the development of cyberchondria.

This chapter is organized as follows. First, it presents theories of information management as well as the hybrid model of cyberchondria in order to build an integrative model explaining the antecedents and intermediate processes of cyberchondria development.

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Second, based on the proposed theoretical model, several hypotheses are proposed, and the rationale behind each hypothesis is explicated.

4.1 Proposed Theoretical Model – Cyberchondria Development Model

4.1.1 Theories of information management

As an emerging field in health communication research, OHIS has received a good amount of scholarly attention in recent years (Wang et al., 2021). In the current study, two information management theories, namely, the theory of motivated information management (TMIM) (Afifi & Weiner, 2004) and risk information seeking and processing (RISP) model (Griffin et al., 1999), are applied to explain and predict OHIS behavior. These two theoretical models both position information seeking as an outcome and highlight uncertainty reduction as a key motive for information seeking.

The TMIM posits that people start to seek out information when they feel uncertainty discrepancy, defined as “the difference between one’s actual and desired levels of uncertainty” (So et al., 2019, p. 665). While the TMIM was originally developed in an interpersonal context, its central concepts such as anxiety, uncertainty discrepancy, and information management behaviors (e.g., information seeking) have been widely applied to health communication contexts. Similarly, the RISP model depicts how a variety of social, communicative, and psychological factors predispose individuals’ risk information seeking and processing behavior. Many of the concepts and relationships found within the RISP model are reminiscent of the TMIM (Kahlor, 2010). In particular, similar to uncertainty discrepancy, the RISP model highlights the role of information insufficiency, defined as “the size of the gap between information held and needed” in triggering active risk information seeking (Griffin et al., 2008, p. 289). According to the RISP model, information insufficiency is a direct, primary factor driving information seeking, mediating the effects of other

psychosocial factors such as affective responses (e.g., worry, anxiety) and informational subjective norms.

TMIM and RISP model converge in terms of highlighting the difference between one's current and desired levels of knowledge or uncertainty as an important motivator of information seeking. Many recent studies have employed the RISP model or TMIM to examine the effects of different antecedents on OHIS (Hovick et al., 2020; Kanter et al., 2019; J. Li & Zheng, 2020; So et al., 2019). A meta-analysis conducted by Wang et al. (2021) further showed that instrumental factors (e.g., source beliefs: belief that health information from the Internet is trustworthy and unbiased) are more important than psychological factors (e.g., affective responses) in determining individuals' OHIS. Taken together, the antecedents in the TMIM and RISP model could be used to explain why people conduct information seeking on the Internet.

4.1.2 Linking information management theories to the hybrid model of cyberchondria

Despite the insufficiencies of the current five frameworks assessed in Chapter Two, they have provided valuable conceptual foundation for research on cyberchondria, and refined frameworks could be built upon existing knowledge gained from these models. In terms of theoretical and methodological development, this thesis selects the hybrid model of cyberchondria (Brown et al., 2019) to explain why certain regular OHIS may turn into cyberchondria. There are several reasons for choosing this model in terms of theoretical development.

First, the model has potential for advancing information seeking-related theories. While other models mentioned in Chapter Two seek to explain the phenomenon of cyberchondria from a psychopathological perspective, cyberchondria is also specifically related to information seeking behavior in an online context. The hybrid model of

cyberchondria accommodates both psychological and behavioral perspectives of information seeking, and clearly explicates the difference between normal and abnormal OHIS and the process of how normal OHIS becomes abnormal. Compared to the model of cyberchondria (Starcevic & Berle, 2013), this model postulates that initially OHIS should be a safety behavior for threat evaluation and reassurance checking regardless of whether it becomes a threatening behavior at a later search stage. This argument is also in line with the propositions in the RISP model and TMIM, which argue that health information seeking behavior is a process to address information insufficiency as well as to alleviate anxiety about health threat.

Second, the model proposes that pathological OHIS consists of two parts, which are compulsive OHIS and problematic OHIS. Compulsive OHIS is excessive and repeated online health searches that is experienced as out of control while problematic OHIS is the maintenance of health anxiety due to compulsive OHIS. Hence, the two components in the model refer to the two core elements embedded in the definition of cyberchondria, that is, excessive web searches and a stable level of distress about health. Therefore, according to the hybrid model of cyberchondria, cyberchondria can be envisaged as a possible negative outcome of regular OHIS when information seekers fail to satisfy their information needs and cope with health anxiety.

Third, this model integrates factors from three cyberchondria-related models and includes other relevant factors in examining the process and outcomes of OHIS. For example, positive and negative metacognitive beliefs about OHIS are the novel elements included in the model, and this inclusion is based on Well (1999)'s metacognitive model of GAD. Additionally, it takes into account the moderating role of perceived reliability of online sources in the relationship between health anxiety and OHIS. Considering different types of factors related to OHIS can better explain the process of how OHIS becomes pathological,

that is, the development of cyberchondria. Such a theorizing approach is consistent with the TMIM and RISP model, which also include a variety of antecedents to information seeking. In fact, several factors in the hybrid model of cyberchondria share some similarities with those from the RISP model. Specifically, the factors *perception of potential health threat*, *anxiety about health*, *perceived reliability of OHR*, and *online health research* in the hybrid model of cyberchondria are consistent with the factors *perceived risk threat*, *affective response*, *source beliefs*, and *information seeking* in the RISP model, respectively, while the factors in the hybrid model of cyberchondria are more specific for the context of OHIS. Given that OHIS is a complex behavior triggered by a variety of cognitive, affective, and social factors, factors such as information insufficiency and informational subjective norms should also be considered in the process of model development.

With the above reasons, this thesis proposes that the hybrid model of cyberchondria can provide an important basis for explaining why regular OHIS becomes pathological. It should be noted that the model describes two possible outcomes of OHIS (i.e., reassuring outcome and worrying outcome) to cope with health threat. Reassuring outcome indicates that people successfully find relevant health information on the Internet, and they terminate the search process, which leads to a decrease in health anxiety. In contrast, worrying outcome can occur when people fail to find information to address their health concern, and this outcome may drive further online health searches and continuation of anxiety. This thesis focuses more on the perspective of worrying outcome, which leads to the phenomenon of cyberchondria. As such, the detailed process of how various factors contribute to regular OHIS and cyberchondria will be demonstrated in the new model whereas the reassuring outcome of OHIS will not be reflected.

Taken together, this thesis offers a theoretical model to describe cyberchondria development by integrating existing concepts and theories in information seeking and

cyberchondria (see Figure 4.1). In this model, OHIS serves an important role in bridging the process of how health concern translates into cyberchondria. In particular, the cyberchondria development first includes a set of cognitive, affective, and social factors contributing to individuals' OHIS behavior. Informed by the TMIM and RISP model (Afifi & Weiner, 2004; Griffin et al., 1999), it hypothesizes that when people experience some common symptoms (headache, fever, etc.) in their daily lives, they may perceive threat to their health. This perceived health threat would make them feel anxious about health conditions. Further, individuals with health anxiety may perceive that their current knowledge about the symptoms is not sufficient to cope with the anxiety, and they need more information to understand the symptoms (i.e., information insufficiency). In this process, individuals' OHIS behaviors can also be influenced by social motivation from others and source beliefs about the Internet. Second, this model describes how regular OHIS develops into cyberchondria. Drawing on the hybrid model of cyberchondria (Brown et al., 2019), it postulates that regular OHIS has the likelihood of turning into an excessive information seeking behavior, along with compulsion, distress, and reassurance (i.e., cyberchondria). This likelihood is contingent on negative metacognitive beliefs (e.g., uncontrollability of health-related thinking) (Fergus & Spada, 2018), which can be directly triggered by health anxiety. Put differently, when online users lose control of thinking about their health-related issues, their regular OHIS is more likely to become cyberchondriac.

Through synthesizing various concepts, the hypothesized cyberchondria development model details the process of how cyberchondria arises when individuals use the Internet for symptom-checking. This integrative model is proposed as a tentative representation of interrelations among different types of factors from existing theories. The temporal ordering of the model components is informed by the RISP model as well as the hybrid model of cyberchondria. In summary, this theoretical model aims to identify predictors of OHIS and

cyberchondria in order to guide future theory testing and refinement in the novel research area. The following subsections elaborate on the interrelations among variables in the proposed model.

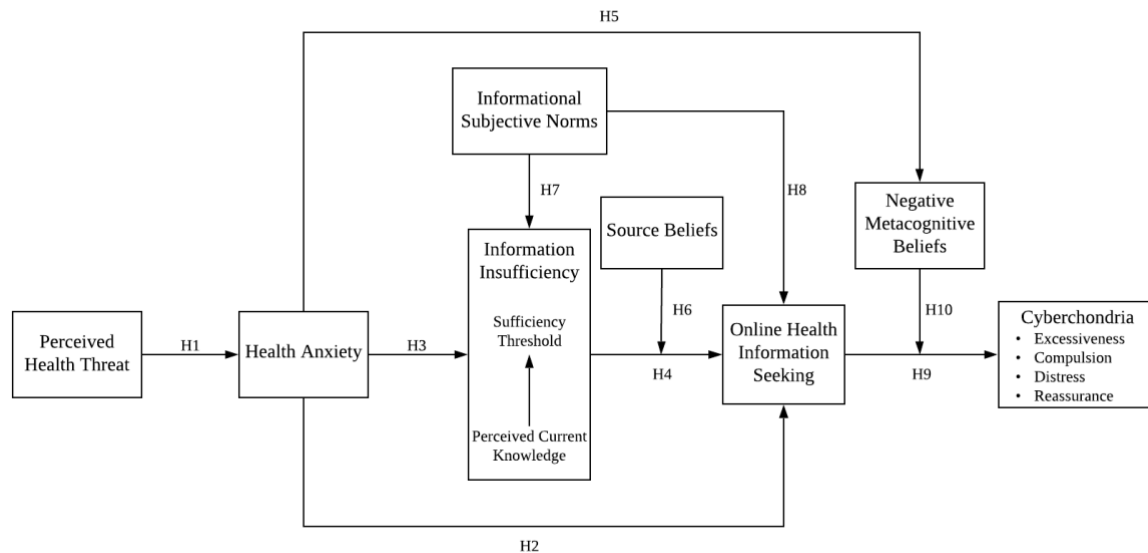


Figure 4.1. Cyberchondria development model.

4.2 Research Model and Hypotheses

4.2.1 Predictors of online health information seeking

Seeking health information starts with identifying a possible health threat. Perceived health threat is defined as people's subjective assessment of a precarious situation where their health is affected by a specific health problem (Braddock & Abramowitz, 2006). It has two dimensions: perceived susceptibility and perceived severity (Janz & Becker, 1984). Perceived susceptibility is the perceived likelihood of a person that develops a health problem.

Perceived severity indicates the perceived seriousness of a medical issue and its potential consequences. For example, an individual may experience arousal-related bodily sensations such as headache or fatigue as a result of stressful works or events. In such context, the person may perceive that the symptom is a threat to health depending on the susceptibility

and severity of the health issue. The cognitive-behavioral model of health anxiety posits that when people do not have enough ability to cope with their perceived health threat, they may develop health anxiety (Warwick & Salkovskis, 1990), which is defined as a generic worry about health conditions (Fava et al., 2017). A direct and positive association between perceived health threat and health anxiety has been found in past empirical studies (Hadjistavropoulos et al., 1998; Hovick et al., 2014). As such, this study hypothesizes that:

H1: Perceived health threat is positively related to health anxiety.

People with health anxiety may perceive their bodily symptoms as more severe than they really are and misinterpret common symptoms as evidence of a serious illness (Warwick & Salkovskis, 1990). To cope with health anxiety, people often seek reassurance from various sources such as doctors, friends, and medical brochures. With the popularity of the Internet, individuals who worry about their health start to use the Internet as a source for symptom checking (Myrick, 2017). Here, OHIS refers to a safe and normal behavior for people who are feeling anxious to obtain relevant online health information in order to reduce anxiety (Brown et al., 2019). Previous studies on cyberchondria have demonstrated that health anxiety is positively and directly linked to the duration and frequency of OHIS (Baumgartner & Hartmann, 2011; Doherty-Torstrick et al., 2016). In other words, people with health anxiety tend to spend more time and effort on online symptom checking. Thus, this study hypothesizes that:

H2: Health anxiety is positively related to OHIS.

Further, according to the RISP model and TMIM (Afifi & Weiner, 2004; Griffin et al., 1999), epistemic motivation that accounts for information insufficiency or uncertainty has a crucial role in information seeking behaviors. Information insufficiency in this study

describes a subjective gap between perceived current knowledge about a health problem and the amount of knowledge required to deal with that problem adequately (i.e., sufficiency threshold). With higher sufficiency threshold, individuals who feel anxious about their health may perceive that their current knowledge level is not sufficient to manage their risk, and thus consider that they need to obtain more knowledge through information seeking. Empirical evidence also supports that negative emotions (e.g., anxiety) are positively related to information insufficiency, which is further positively related to information seeking (Hovick et al., 2014; Kim & Kim, 2019; Li & Zheng, 2020; Yang, 2012; Yang et al., 2014). Presumably, in the context of OHIS, people with health anxiety perceive that they do not have enough knowledge about their symptoms, and such insufficiency can result in seeking some relevant health information on the Internet. Thus, this study hypothesizes that:

H3: Health anxiety is positively related to information insufficiency.

H4: Information insufficiency is positively related to OHIS.

In recent years, the Internet has become a primary source for individuals to seek health-related information (Starcevic, 2017). While the Internet allows easy and convenient access to the needed health information, it is also populated by myths and incorrect health information (Eysenbach et al., 2002). Thus, individuals are likely to have different levels of trust in online sources of health information. The concept of source beliefs in the RISP model describes a person's assessment of the quality of a particular information source. Several scholars have suggested that there might be an interaction effect between source beliefs and information insufficiency on information seeking (Griffin et al., 1999; Hovick et al., 2014). This is because people prefer to obtain information from trustworthy sources when they are in need of information about a particular issue (Yang, 2012). In the context of OHIS, individuals with more favorable source beliefs (e.g., believe that health information from

online sources is useful, trustworthy, and unbiased) (Ma & Atkin, 2017) would be more likely than individuals with less favorable source beliefs to act on their information insufficiency to check their symptoms using the Internet. Thus, this study hypothesizes that:

H5: Source beliefs positively moderate the relationship between information insufficiency and OHIS.

According to the RISP model, social motivation also serves as an important trigger for seeking health information. Informational subjective norms refer to perceived others' expectations or pressure to acquire sufficient information for a health problem. Evidence supports that informational subjective norms predict information insufficiency (Kahlor, 2010; Yang, 2012), as social expectation increases the level of threshold for sufficient information (Griffin et al., 1999). In the context of OHIS, it is possible that people suffering from illness symptoms may feel that their family members or friends expect them to be knowledgeable about the symptoms to achieve a speedy recovery. With such expectations, individuals may perceive that their current knowledge of the symptoms is insufficient (i.e., the sufficiency threshold increase). Furthermore, prior research has demonstrated a direct and positive effect of informational subjective norms on information seeking (Hovick et al., 2014; Yang et al., 2014). Expectations from others may directly drive a person to search for more information about the symptoms on the Internet. Thus, this study hypothesizes that:

H6: Informational subjective norms are positively related to information insufficiency.

H7: Informational subjective norms are positively related to OHIS.

4.2.2 Linking online health information seeking to cyberchondria

In regular OHIS, individuals may fail to find relevant information about their symptoms, or encounter threatening information on the Internet (Starcevic & Berle, 2013). Also, some may feel that the information they did find is still insufficient. These unsatisfactory search episodes may prompt some of them to conduct more and more online health searches. If unchecked, these searches may ultimately reach the point of being overly excessive and distressful. That is, conducting OHIS faces the problem that some regular searches can unfortunately become out of control, and the searcher experiences cyberchondria (Starcevic & Berle, 2013; White & Horvitz, 2009). According to the hybrid model of cyberchondria, more OHIS could mean a higher possibility of encountering the scenario in which regular searches turn extreme, and cyberchondria manifests (Brown et al., 2019). Thus, this study hypothesizes that:

H8: OHIS is positively related to cyberchondria.

The current model further proposes that the path from OHIS to cyberchondria is modified by the presence of negative metacognitive beliefs triggered by health anxiety. According to Bailey and Wells (2015), metacognitive beliefs comprise three subdimensions: (1) “beliefs about biased thinking;” (2) “beliefs that thoughts can cause illness;” and (3) “beliefs that thoughts are uncontrollable” (p. 8). “Beliefs about biased thinking” is considered as a positive metacognitive belief, whereas the latter two are considered negative metacognitive beliefs. Further, several studies have found that only one type of negative metacognitive beliefs, namely “beliefs that thoughts are uncontrollable,” is closely linked to cyberchondria (Fergus & Spada, 2018; Marino et al., 2020). Therefore, the current study focuses on the role of negative metacognitive beliefs (i.e., “beliefs that thoughts are uncontrollable”) in the process of cyberchondria development.

Negative metacognitive beliefs are also positively related to health anxiety. This proposition is supported by empirical evidence in the psychiatry literature (Bailey & Wells, 2013; Bouman & Meijer, 1999). For instance, Melli et al. (2016) found that metacognitive beliefs have a stronger association with health anxiety symptoms, compared to other dysfunctional beliefs. In particular, “beliefs that thoughts are uncontrollable” are the most central and relevant to health anxiety. Highly anxious people are not able to fully regulate their beliefs and thoughts about illness. Instead, they might worry and ruminate their illness excessively. This type of worry is challenging to bring under control (Bailey & Wells, 2015). Thus, this study hypothesizes that:

H9: Health anxiety is positively related to negative metacognitive beliefs.

Furthermore, there might be an interaction effect between OHIS and negative metacognitive beliefs on triggering cyberchondria. Kaur et al. (2011) found that negative metacognitive beliefs are a strong and direct predictor of attentional bias to health-related information. Attentional bias refers to the tendency for individuals’ perception to be influenced by their excessive thoughts of a particular issue while other possibilities are ignored (Kaur et al., 2011). This type of bias is strongly associated with addictive behavior (Field & Cox, 2008), such as cyberchondria, as it involves excessive or repeated online medical searches (Starcevic, 2017). In the context of regular OHIS, it is plausible that users who hold negative metacognitive beliefs (e.g., those who strongly believe that their thinking about their symptoms is uncontrollable) might continue to search for more health information to mitigate their information insufficiency or uncertainty (Fergus & Spada, 2017). However, in this process, they may encounter some threatening information, triggering even more excessive information seeking for reassurance. The nature of excessive seeking is associated with a greater level of emotional distress, which is a manifestation of cyberchondria

(Starcevic et al., 2019). Therefore, negative metacognitive beliefs can strengthen the possibility of turning regular OHIS into cyberchondria. In other words, when people seek medical information online, those with higher negative metacognitive beliefs are more likely to develop cyberchondria than those who do not. Thus, this study hypothesizes that:

H10: Negative metacognitive beliefs positively moderate the relationship between OHIS and cyberchondria.

4.3 Summary

This chapter sought to build a theoretical model to explicate the process of cyberchondria development. Informed by information management theories (the RISP model and TMIM) and the hybrid model of cyberchondria, this integrative cyberchondria development model aims to connect regular OHIS with cyberchondria. First, a set of cognitive, affective, and social antecedents are included to explain why people conduct OHIS. Second, based on the hybrid model of cyberchondria, cyberchondria is conceptualized as a worrying outcome of regular OHIS, and negative metacognitive beliefs may serve as a boundary condition in this process. With theory development and integration in mind, this integrative cyberchondria development model can contribute to the existing cyberchondria literature in the following ways. First, it addresses the gap that there is an absence of theoretical model that describes the relationships between factors related to cyberchondria. Second, it conceptualizes the process of how regular OHIS becomes abnormal from both psychology and information seeking perspectives, providing a guidance for further theoretical development in the area of cyberchondria. Third, it incorporates different types of factors that might contribute to OHIS, which can explicate the process of cyberchondria development from a more comprehensive perspective. Last but not least, several hypotheses are proposed based on this new model for further empirical testing. Therefore, the next chapter seeks to

test if this model is applicable and valid in explaining cyberchondria development in a sample of Chinese adults who had the experience of searching for health-related information on the Internet.

CHAPTER FIVE: STUDY TWO: MODEL TESTING³

In Chapter Four, a theoretical model—cyberchondria development model was built and several hypotheses were proposed. The model postulates how people develop cyberchondria from a theoretical perspective. Thus, the aim of this chapter is to test the proposed model empirically using a cross-sectional survey. This chapter begins with introducing the study context by explaining why this study was conducted in China, followed by describing the data collection process, measurements used in the survey, as well as data analysis procedures. Overall, results of the structural equation modelling analysis can lend support to the process of cyberchondria development as depicted in the theoretical model. Finally, this chapter ends with a discussion on theoretical and practical implications of this cross-sectional survey study. Also, several limitations that open possibilities for future research are discussed.

5.1 Study Context

This study was conducted in China for several reasons. First, the systematic review in Chapter Three showed that most of previous studies have investigated cyberchondria in western countries (e.g., the United States, the United Kingdom, etc.) whereas only two studies were conducted in an eastern country (i.e., India and Indonesia). Individuals may behave differently when searching for health information online in different geographic locations and cultures (Dutta, 2009). Thus, it would be interesting to examine if regular OHIS can become cyberchondria in other cultural contexts.

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Second, as a large country with fast economic development, the number of Internet users in China has reached 802 million, 57.7% of the population (McCarthy, 2018). In particular, about 140 million Chinese individuals are actively searching for medical information online (iResearch, 2015). As cyberchondria has become a common health burden in this digital age (Starcevic & Berle, 2013; White & Horvitz, 2009a), it would be of importance to understand this phenomenon in the Chinese context.

Third, different from other countries, Chinese Internet users have no access to Google search engine as it has been blocked by Chinese government since 2010 (Waddell, 2016). Instead, most Chinese people use the search engine Baidu. However, while millions of users rely on Baidu for obtaining health-related information, fake news and false advertising about medical products are not uncommon on Baidu (Ramzy, 2016), and the quality of health information on Baidu is often debatable (Li, 2016). In such a situation, Internet users are more likely to develop cyberchondria since they face more challenges in discerning credible and non-credible sources among a list of search results. To conclude, it would be pertinent to test the proposed cyberchondria development in China where a large number of people are conducting web health searches and the phenomenon of cyberchondria might be common as well.

5.2 Research Method

5.2.1 Participants and procedure

Upon obtaining ethical approval from the Institutional Review Board (IRB) of the university, this study recruited participants from an online panel managed by *Wenjuanxing*, a survey company in China with more than 2.6 million registered panel members (<https://www.wjx.cn/index.aspx>). Chinese healthy adults aged 21 years old or above who had experience of online health information searching were eligible to participate in this study.

The questionnaire was posted on the survey distribution platform and panel members who met the eligible criteria were randomly invited via emails and short message service. The data were collected in October 2019. Out of 1,058 invited panelists, 453 completed the survey, attaining a response rate of 42.81%. To ensure validity and reliability, the responses were further scrutinized and those who chose the same answer to all questions and those who spent less than 1/3 of the median completion time in completing the survey were eliminated ($n = 27$), resulting in an analytic sample of 426.

At the beginning of the survey, participants indicated one or more common symptoms that they had concerned most and regularly checked on the Internet (e.g., stomachache, fever, headache, etc.). Reflecting on this specified symptom, participants were asked to fill the rest of the survey questions that measured the concepts in our proposed research model.

5.2.2 Measures

In this study, all constructs were measured with items validated in the literature, with some minor modifications to suit the current research context. The English items were translated into Chinese using the forward-back process. Specifically, two research assistants who were bilingual speakers translated the items from English to Chinese. Then, another independent translator translated the Chinese items back to English to assess whether the items were consistent with the original version. After reconciling several problematic items (e.g., different Chinese characters were suggested for the similar English language words), a pretest was conducted with 20 Chinese respondents to fill out the questionnaire. This pretest aimed to solicit qualitative feedback about the clarity of items. Based on the respondents' comments, small modifications were made to ensure that the items in the survey were understandable in Chinese while preserving conceptual equivalence of the meaning with the original English version. Table 5.1 presents survey items, means, standard deviations, and

factor loadings for the constructs. Except for the items on perceived current knowledge and sufficiency threshold (10-point scales), all the constructs were measured on 5-point Likert-type scales.

Perceived health threat. Perceived health threat consists of two dimensions: susceptibility and severity. Three items derived from Champion (1999) measured susceptibility, and three items developed by Witte (1996) assessed severity. Because previous studies suggested that multiplying susceptibility and severity might introduce additional measurement error (Yang, 2012), perceived health threat was assessed as a latent construct based on the two dimensions ($M = 2.09$, $SD = .88$, $\alpha = .92$).

Health anxiety. The construct *health anxiety* was measured using Whitley Index-6 (WI-6) developed by Asmundson et al. (2008). Compared to the original WI with 14 dichotomous items (Pilowsky, 1967), this revised 6-item version with a 5-point scale addresses factorial instability of the original scale (Welch et al., 2009). The WI-6 had good reliability in the current study ($M = 2.79$, $SD = .83$, $\alpha = .85$).

Information insufficiency. The concept *information insufficiency* contains two constructs: perceived current knowledge ($M = 7.34$, $SD = 1.83$, $\alpha = .84$) and sufficiency threshold ($M = 8.46$, $SD = 1.68$, $\alpha = .83$). Both constructs were assessed with three items (Yang, 2012). Following prior RISP-related studies (Griffin et al., 2004; Pokrywczynski et al., 2019), the strategy of regressed change was employed to operationalize information insufficiency. Using multiple regression, this approach can eliminate the variance in the variable “sufficiency threshold” which is accounted for the variable “perceived current knowledge.” That means, the residual from the regression was used where sufficiency threshold was regressed on perceived current knowledge. Also, it removes the covariance accounted for by the variable “perceived current knowledge” from variables predicting the concept “information insufficiency” (i.e., health anxiety and informational subjective norms

in the analysis). Thus, the residual variance in sufficiency threshold reflects information insufficiency.

Informational subjective norms. Following prior work (Ajzen, 2002; Kahlor, 2010), three items assessed respondents' perception that their family, friends, and other important people would expect them to search for health information about their symptoms ($M = 3.49$, $SD = .86$, $\alpha = .85$).

Source beliefs. Derived from Griffin et al. (2008), four items assessed the extent to which respondents perceived the quality of online medical information. A higher value indicates a higher level of perceived quality of online health information. This scale had good equivalency reliability in the current study ($M = 2.99$, $SD = .73$, $\alpha = .82$).

Online health information seeking. OHIS was measured using three items developed by Griffin et al. (2008). Minor changes were made to suit the context of searching for common symptoms on the Internet ($M = 4.15$, $SD = .58$, $\alpha = .72$).

Negative metacognitive beliefs. To measure negative metacognitive beliefs (i.e., "beliefs that thoughts are uncontrollable"), 4 items derived from Bailey and Wells (2015) were adopted in the current study. The scale demonstrated good reliability ($M = 2.81$, $SD = .86$, $\alpha = .76$).

Cyberchondria. Cyberchondria was measured using the CSS-12 (McElroy et al., 2019). This scale has 12 items, reflecting the four dimensions of cyberchondria: excessiveness, distress, compulsion, and reassurance. McElroy et al. (2019) suggested that it is possible to view the CSS-12 as a unidimensional construct, and the 12 items can be summed up to get a total score of 12 to 60. Higher scores reflect greater severity of cyberchondria. Therefore, in the current study, the CSS-12 was treated as an observed variable with a total mean score of 42.50 ($SD = 6.01$), indicating that the participants had a

relatively high level of cyberchondria on average. The CSS-12 showed an acceptable internal consistency in this study ($\alpha = .75$).

Control variables. Demographic factors including age, gender, education, and income were measured. In addition, respondents' e-health literacy was assessed due to the diversity of the sample in the current study. On a 5-point scale, respondents indicated their ability to seek, assess, and process health information on the Internet. Eight items derived from the eHealth Literacy Scale (eHEALS) (Norman & Skinner, 2006) were used. For instance, items include "I know what health resources are available on the Internet" and "I know how to use the Internet to answer my questions about health" ($M = 3.65$, $SD = .66$, $\alpha = .87$).

5.2.3 Data analysis

Structural equation modeling (SEM) was used to test the cyberchondria development model. SEM was chosen over multiple regression models in that it analyzes all variables which contain multiple items in the model in a simultaneous way (Li & Zheng, 2020). Each of the individual items was loaded on their hypothesized latent common factors, except for the dependent variable—cyberchondria, which was entered as an observed variable in the model testing. This is because the CSS was a summed-up score to assess the level of cyberchondria that individuals would experience after OHIS (McElroy et al., 2019). Data were analyzed using the *lavaan* package in R version 3.5.1 (Rosseel, 2012).

The model fit was examined for both the measurement model and the structural model using the following fit indices: Model chi-square (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root-Mean-Square Error of Approximation (RMSEA), and Standardized Root Mean Squared Residual (SRMR). Specifically, model chi-square is an index of model adequacy, where it indicates a good model fit when p value is non-significant (Barrett, 2007). However, chi-square is sensitive to sample size, and a significant chi-square may not

represent a bad model fit. Thus, the χ^2/df ratio was also reported, and a value less than 3.0 indicates a good model fit (Kline, 2010). For CFI and TLI, the acceptable cut-off value is .90 and above (Bentler, 1990). For RMSEA, values less than .05 are considered as good fit (Browne & Cudeck, 1993). Values of SRMR below .08 indicate good fit (Hu & Bentler, 1999).

Table 5.1 Survey instrument and source.

Construct	Item	Mean	SD	Factor loading	Cronbach's α
Perceived health threat	1. "Based on my symptom, my chances of getting a serious illness are great."	2.18	1.08	.81	.92
	2. "My symptom makes it more likely that I will get a serious illness."	2.20	1.11	.81	
	3. "Based on my symptom, it is possible that I will contract a serious illness."	2.21	1.07	.84	
	4. "I believe that my symptom is severe."	2.10	0.93	.82	
	5. "I believe that my symptom is serious."	1.90	0.95	.83	
	6. "I believe that my symptom is significant."	1.94	1.02	.80	
Health anxiety	1. "I worry a lot about my health due to my symptom."	3.21	1.17	.72	.85
	2. "I am afraid of illness because of my symptom."	3.66	1.12	.70	
	3. "I often have the symptoms of very serious illnesses."	2.16	0.95	Deleted	
	4. "I find that I am bothered by many different symptoms."	2.55	1.16	.70	
	5. "Based on my symptom, I think there is something seriously wrong with my body."	2.22	1.06	.75	
	6. "Because of my symptom, I often worry about the possibility that I have got a serious illness."	2.92	1.15	.79	
Perceived current knowledge	1. "How much have you heard about your symptom?"	7.39	2.10	.70	.84
	2. "How informed are you about your symptom?"	7.22	1.97	.92	
	3. "I know a lot about my symptom at the moment."	7.40	2.23	.82	
Sufficiency threshold	1. "I need a lot of information about my symptom."	8.46	1.93	.79	.83
	2. "I need to know everything there is to know about my symptom."	8.07	2.07	.74	
	3. "I need to find out as much as possible about my symptom."	8.86	1.83	.83	
Informational subjective norms	1. "Most people who are important to me think that I should seek information about my symptom."	3.45	0.94	.75	.85
	2. "Others expect me to seek information about my symptom."	3.40	0.99	.85	
	3. "My family expects me to seek information about my symptom."	3.60	1.03	.82	
Source beliefs	1. "I find most online health information about my symptom is useful."	3.31	0.85	.80	.82
	2. "I find most online health information about my symptom is exaggerated and sensationalized (reverse-scored)."	2.61	0.98	.66	
	3. "I find most online health information about my symptom is biased (reverse-scored)."	2.95	0.93	.72	
	4. "I find most online health information about my symptom is believable."	3.12	0.88	.75	

Table 5.1 (*Continued*).

Construct	Item	Mean	SD	Factor loading	Cronbach's α
Online health information seeking	1. "I try to seek information about my symptom on the Internet."	4.01	0.71	.68	.72
	2. "When I have this symptom, I try to learn about it on the Internet."	4.31	0.68	.67	
	3. "I go out of my way to get information about this symptom on the Internet."	4.14	0.78	.68	
Negative metacognitive beliefs	1. "Dwelling on thoughts of illness is uncontrollable."	2.55	1.14	.68	.76
	2. "I have no control over thinking about my health."	2.59	1.11	.74	
	3. "Only if I have a diagnosis will I be able to stop worrying."	3.29	1.16	Deleted	
	4. "I cannot have peace of mind so long as I have physical symptoms."	2.79	1.09	.68	
Cyberchondria	1. "If I have this common symptom, I will search for it on the internet frequently."				.75
	2. "I read different web pages about this symptom."				
	3. "I enter this symptom into a web search on more than one occasion."				
	4. "I think I am fine until I read about a serious condition online."				
	5. "I feel more anxious or distressed after researching this symptom online."				
	6. "I start to panic when I read online that this symptom is found in a rare/serious condition."				
	7. "Researching my symptom online leads me to consult with my doctor."				
	8. "I suggest to my doctor that I may need a diagnostic procedure that I read about online (e.g., a biopsy/a specific blood test)."	42.50	6.01	N/A	
	9. "Researching my symptom online leads me to consult with other medical specialists (e.g., consultants)."				
	10. "Researching my symptom online distracts me from reading news/sports/entertainment articles online."				
	11. "Researching my symptom online interrupts my work (e.g., writing emails, working on word documents or spreadsheets)."				
	12. "Researching my symptom online interrupts my offline social activities (e.g., reduces time spent with friends/family)."				
Note: Following Awang (2015)'s recommendation, items with a factor loading below .6 were deleted in the model testing.					

5.3 Results

5.3.1 *Sample demographics*

A total of 426 Chinese Internet users completed the survey, and there were no missing values. The sample consisted of 39.7% males and 60.3% females. The majority of the sample were among the age range of 21 to 40 years old (84.7%). Most of the participants had a bachelor's degree (86.2%) and were employed in a company (85.7%). More than half of the participants (52.6%) had an annual income of less than 100,000 CNY (around 20,000 SGD). In terms of the preferred online source for health information seeking, Baidu search engine was used by almost all the participants (96.7%), followed by Zhihu (Chinese version of Quora; 59.4%) and WeChat (41.3%).

A common symptom refers to a deviation from normal body function, reflecting the presence of an unusual state, or of an illness, which can serve as a potential threat to individuals' health (Morrell et al., 1971). The first question in the survey asked respondents about types of common symptoms that they concerned most and had the experience of searching for such symptoms on the Internet. As shown in Figure 5.1, 59.39% of the respondents searched for headache on the Internet, followed by slight body aches (52.58%) and cough (51.64%). In addition to these symptoms, some respondents also stated that they used the Internet to search for other symptoms such as insomnia, toothache, hair loss, endocrine disorder, and the like.

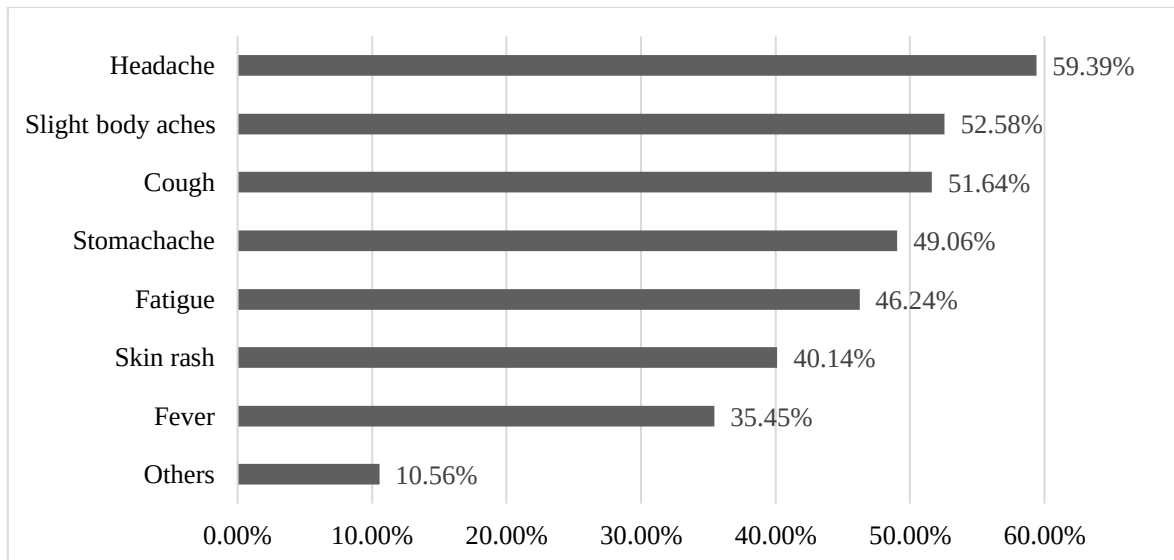


Figure 5.1. Common symptoms searched by respondents on the Internet

5.3.2 Model testing

First, the correlations between the study variables are presented in Table 5.2.

Moreover, confirmation factor analysis showed that the measurement model had a good fit:

$\chi^2/df = 2.22$, $p < .001$, CFI = .93, TLI = .92, RMSEA = .054, and SRMR = .048. Similarly,

the structural model also demonstrated a good fit to the data: $\chi^2/df = 1.88$, $p < .001$, CFI

= .92, TLI = .92, RMSEA = .045, and SRMR = .066. The full structural model explained

45% of the variance in the dependent variable cyberchondria. Figure 5.2 shows the results of

the structural model with the standardized structural coefficients.

Table 5.2 Correlations between the study variables.

	PHT	HA	PCK	ST	ISN	SB	OHIS	NMB	CSS
PHT	-								
HA	.64**	-							
PCK	.02	-.01	-						
ST	.02	.17**	.34**	-					
ISN	.08	.07	.27**	.34**	-				
SB	-.03	-.13**	.23**	.14**	.35**	-			
OHIS	-.08	.11*	.18**	.42**	.34**	.22**	-		
NMB	.51**	.61**	.04	.18**	.12*	-.11*	.09	-	
CSS	.14**	.33**	.15**	.36**	.39**	.05	.38**	.41**	-

Note: * $p < .05$, ** $p < .01$. PHT: Perceived Health Threat; HA: Health Anxiety; PCK: Perceived Current Knowledge; ST: Sufficiency Threshold; ISN: Informational Subjective Norms; SB: Source Beliefs; OHIS: Online Health Information Seeking; NMB: Negative Metacognitive Beliefs; CSS: Cyberchondria

The first hypothesis (H1) posited that perceived health threat is positively related to health anxiety. H1 was supported ($\beta = .87, p < .001$). Respondents who viewed their symptoms as a potential threat to health were likely to have health anxiety. Next, health anxiety was not directly associated with OHIS. Thus, H2 was not supported. On the other hand, after controlling for the effect of perceived current knowledge, health anxiety was weakly related to sufficiency threshold ($\beta = .11, p < .05$; H3 supported). Next, sufficiency threshold was moderately related to OHIS ($\beta = .48, p < .001$; H4 supported). Given the insignificant relationship between health anxiety and OHIS, the mediation effect was further assessed by computing Z statistics based on path estimates and standard errors of direct paths among health anxiety, sufficiency threshold, and OHIS (Baron & Kenny, 1986). The Z-score value ($Z = 2.14, p < .05$) indicated that information insufficiency mediated the effect of health anxiety on OHIS. In addition, the interaction between sufficiency threshold and source beliefs on OHIS was statistically significant, showing a positive moderated relationship ($\beta = .15, p < .05$; H5 supported).

Informational subjective norms had a positive impact on respondents' sufficiency threshold after controlling their perceived current knowledge ($\beta = .32, p < .001$). As such, H6 was supported. Also, the direct relationship between informational subjective norms and OHIS was statistically significant ($\beta = .24, p < .01$). Thus, H7 was supported. Further, OHIS was positively related to cyberchondria ($\beta = .47, p < .001$; H8 supported) after controlling for demographic factors and e-health literacy. Health anxiety exerted a strong effect on negative metacognitive beliefs ($\beta = .77, p < .001$; H9 supported). Finally, the interaction between OHIS and negative metacognitive beliefs was statistically significant, suggesting that negative metacognitive beliefs positively moderated the effect of OHIS on cyberchondria ($\beta = .41, p < .001$). Thus, H10 was supported. For the control variables, all the demographic factors (i.e., age, gender, education, and income) were not significantly related to

cyberchondria. In contrast, e-health literacy was positively related to cyberchondria ($\beta = .13$, $p < .01$).

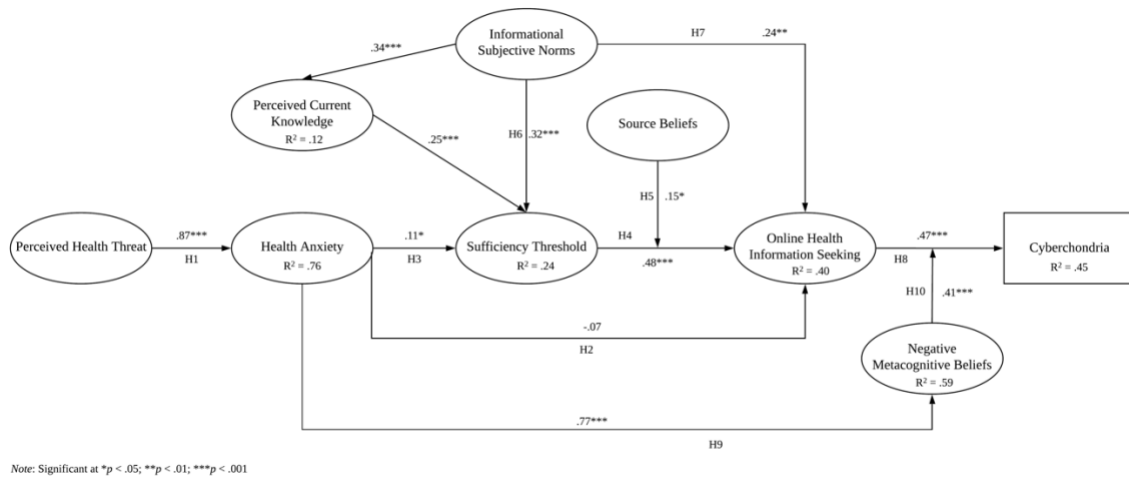


Figure 5.2. Results of the structural model.

5.4 Discussion

5.4.1 Summary of major findings

This chapter empirically assessed the cyberchondria development model proposed in Chapter Four that details the process of how online health information seekers develop cyberchondria. Understanding the potential antecedents that contribute to cyberchondria is relevant and important, as cyberchondria is a complex and an increasingly prevalent phenomenon in this digital age (Zheng et al., 2021). This is one of the earliest studies to examine cyberchondria development from a theoretically driven lens, which can offer both theoretical and practical implications for future research on this topic. Most of the predicted paths in the proposed model were statistically significant, providing evidence for the model's ability to unravel the mechanisms underlying cyberchondria development.

This study builds on prior research on OHIS and cyberchondria by offering three key contributions. First and foremost, our results showed that OHIS has a strong and positive relationship with cyberchondria. This finding suggests that while OHIS might be useful for symptom checking and decision making (Li & Zheng, 2020; Roscoe et al., 2016), it can also

lead to deleterious outcomes, such as cyberchondria (Starcevic & Berle, 2013). Regular OHIS is conceptualized as a common response to health threats, but a possible outcome can be a heightened level of distress if the search results confirm the significance of the threat (Brown et al., 2019). Furthermore, the results highlighted that negative metacognitive beliefs, which were positively associated with anxiety about symptoms, could strengthen the relationship between OHIS and cyberchondria. One interpretation could be that people who are worried about their symptoms may believe more strongly that their thoughts about health conditions are uncontrollable; they may feel the need to engage in repetitive online medical research until they address their information insufficiency (Brown et al., 2019). However, this insufficiency is difficult to be fulfilled because Internet searches can expose individuals to uncertain or ambiguous medical information, contributing to higher levels of emotional distress, especially for those holding negative metacognitive beliefs (Fergus & Spada, 2018). As such, this study has demonstrated negative metacognitive beliefs as an important boundary condition for turning OHIS into cyberchondria. It helps explain why after regular OHIS some individuals become cyberchondriac while others do not (Brown et al., 2019).

Second, this study sheds light on the role of information insufficiency in the process of cyberchondria development. Different from previous studies in cyberchondria (e.g., Baumgartner & Hartmann, 2011; Doherty-Torstrick et al., 2016; Muse et al., 2012), the current study did not find a direct link between health anxiety and OHIS. Instead, the results showed that information insufficiency fully mediates the relationship between health anxiety and OHIS. This is in line with the assumption of the RISP model, suggesting that information insufficiency is a key driver of information seeking, connecting negative emotions (e.g., health anxiety) to information seeking. In other words, health anxiety makes people exaggerate or inflate what they feel sufficient to know to adequately deal with their symptoms, which could motivate information management behaviors, such as OHIS (Griffin

et al., 1999; Li & Zheng, 2020; So et al., 2019). Therefore, this finding helps to explain the possible mechanism behind the effect of health anxiety on OHIS. The insignificant relationship between health anxiety and OHIS could be explained by the mediating role of information insufficiency. Moreover, there might be reciprocal relationships among health anxiety, information insufficiency and OHIS, and such reciprocal effects may subsequently result in cyberchondria (Brown et al., 2019; Starcevic et al., 2020). However, this argument needs to be further confirmed in future studies using longitudinal designs (Zheng et al., 2020).

Third, informational subjective norms are positively related to information insufficiency, as well as OHIS. This finding suggests that besides health anxiety, social motivation could constitute an important factor that makes individuals perceive that they need more knowledge about the symptom, and thus actively engage in conducting OHIS (Griffin et al., 1999; Yang, 2012). Also, it is possible that people in China are more highly concerned about others' expectations due to their collectivistic culture (Li & Zheng, 2020); they may search for their symptoms online because they perceive that others expect them to do so. In this situation, the duration and frequency of OHIS might increase, which serves as a basis for developing cyberchondria (Doherty-Torstrick et al., 2016). While prior studies on cyberchondria have mainly focused on psychological risk factors (Zheng et al., 2020), few have addressed social influence. The finding advances the extant literature on cyberchondria by attesting to a possible role of informational subjective norms in triggering more OHIS directly or by enlarging the gap of information insufficiency.

5.4.2 Limitations and future directions

The results of this study should be examined in the context of several limitations. First, the sample was younger and had higher education attainment than the national profile

of China, which is common to studies based on online panels managed by a survey company (Chandler & Shapiro, 2016). Yet, the sample reflects the profile of online health information seekers, who tend to be young population (e.g., Fergus & Spada, 2014; Li & Zheng, 2020). Nonetheless, to improve generalizability, the study findings should be replicated with more diverse groups of Internet users in China. Second, similar to previous studies on cyberchondria (Doherty-Torstrick et al., 2016; Mathes et al., 2018), the current research was limited by the use of cross-sectional survey design. Future studies can employ experimental designs to test the causal effects of the study variables on cyberchondria. Considering that cyberchondria is a phenomenon that develops over a period of time, longitudinal studies should be conducted to examine the effects of these antecedents over time. Finally, considering China's collectivistic culture, the process of cyberchondria development might play out differently in other cultural contexts (Barke et al., 2016). Future studies therefore can test this new hypothesized model in various countries for greater generalizability.

5.4.3 Theoretical implications

The key contribution of this study is to present and test a theoretical model that details the process of how online health information seekers develop cyberchondria, which may inform further theory development and empirical research in this new research area. Overall, this model has three advantages. First, informed by the TMIM and RISP model (Afifi & Weiner, 2004; Griffin et al., 1999), the proposed model organizes those potential cognitive, emotional, and social antecedents within a unifying theoretical model in order to predict cyberchondria, moving beyond regular OHIS in prior work. Second, the model makes a clear distinction between regular OHIS and cyberchondria while explaining the progression from one to the other (Brown et al., 2019). Third, the good model fit attests to its ability to

explicate the process of cyberchondria development from the perspectives of both social psychology and information seeking.

The proposed model yields implications for the construction of theories on cyberchondria and the way researchers understand a new health-related phenomenon in the age of the Internet. Many of the current studies in cyberchondria have focused on identifying factors associated with cyberchondria, such as health anxiety and negative metacognitive beliefs (e.g., Fergus & Spada, 2018; Starcevic et al., 2019). However, few of them have explored the *process* and mechanism behind its development from a theoretical perspective (Zheng et al., 2020). Here in this study, the results have shown how various types of drivers such as information insufficiency, informational subjective norms, and health anxiety are associated with regular OHIS, which in turn relates to cyberchondria. This approach to theory-building facilitates a synthesis of what has been investigated in the existing literature in regard to antecedents to information seeking and cyberchondria.

In summary, the cyberchondria development model is an attempt to organize existing concepts and variables into an integrative conceptual framework, with a view to identifying important areas and proposing hypotheses related to cyberchondria development. Nevertheless, it should be acknowledged that this model is tentative, and it is still far from a definitive account. As the field of cyberchondria moves forward, future studies need to test and refine this model in various contexts and populations. Such research efforts may eventually facilitate the adoption of treatment interventions within this cyberchondria development model in order to reduce the burden of cyberchondria.

5.4.4 Practical implications

Understanding the antecedents to cyberchondria also offers practical implications. First, with easy access to the Internet, individuals rely much on it for health information

searches, which sometimes help reduce their health anxiety. However, they need to be aware that, if not managed well, OHIS can turn excessive and noxious into cyberchondria. This is especially important in health crises such as COVID-19 that involve a lot of uncertainty as to what is an appropriate course of action to prevent and cure the disease. Indeed, the World Health Organization declared “infodemic” with the overwhelming amount of COVID-19 information spreading on the Internet (Xie et al., 2020). People may become more vulnerable to develop cyberchondria in a novel pandemic situation with frequent exposure to incorrect and inconsistent information on different online platforms that they rely heavily on during the lockdowns (Laato et al., 2020).

Second, for those who need more information about their symptoms, source beliefs of the Internet may strengthen their Internet usage for health information searches, but this finding should be interpreted cautiously with its small effect size ($\beta = .15, p < .05$). Excessive trust in online medical information might increase the frequency and duration of OHIS (Baumgartner & Hartmann, 2011), which provides a precondition for developing cyberchondria. Given the Internet's current advantages over other health sources (e.g., medical professionals) on availability, accessibility, speed, and lower cost, it seems unlikely that individuals will give up using the Internet for health information. Thus, health care providers, information professionals, and educators should not blanketly dismiss Internet searches and ask people not to use it for health information. Instead, they can help individuals become judicious seekers and evaluators of Internet health information (Rice & Katz, 2001).

A possible approach is to aid individuals in building discerning *source beliefs*. Information searchers are often uncertain about how best to choose appropriate information channels and sources (Chowdhury et al., 2011) and experience more problems when information from authoritative sources is scarce (Sin, 2016). To enhance the efficiency of their information search, information professionals can provide information packages that list

high-quality and customized Internet sources. In light of our findings on informational subjective norms, one could prioritize distributing these lists through trusted normative reference groups. An individual's family doctor and clinic are particularly promising channels as resources recommended by trusted ones are more likely to be valued and used (Zhang, 2014). Future research should examine whether the above approaches are feasible and effective in preventing or minimizing cyberchondria.

Third, the proposed model can inform health professionals to identify individuals who are more susceptible to cyberchondria, such as those with higher health anxiety or negative metacognitive beliefs. This study found that health anxiety positively predicts negative metacognitive beliefs, which can strengthen the relationship between OHIS and cyberchondria. Thus, it is recommended that medical professionals routinely ask clients about their OHIS behavior and their perceptions after OHIS, especially for those with negative metacognitive beliefs. In addition, interventions such as Metacognitive Therapy can be used by those with high negative metacognitive beliefs to reduce such beliefs before developing cyberchondria (Morrison et al., 2014; Wells et al., 2009).

5.5 Summary

To conclude, cyberchondria represents a state that encompasses a host of behavioral, cognitive, and affective patterns. Its development trajectory can be complex involving various factors. This study proposed an integrative theoretical model to explicate the processes of how individuals develop cyberchondria when they conduct medical information searches on the Internet. It is hoped that this model could provide a useful impetus for scholars working in this area to better understand the phenomenon of cyberchondria in this digital-connected world. The ultimate goal of treating cyberchondria is that people can successfully manage online health information without unnecessary anxiety. It requires

collaborative efforts from different stakeholders such as healthcare providers, information professionals, and health educators to revisit their approaches to facilitating OHIS and to work towards alleviating this health burden.

However, as mentioned earlier, a major limitation of this study is the use of cross-sectional survey design. As cyberchondria is a complicated phenomenon that may arise and maintain for a period of time, it is pertinent to test the evolving effects of these antecedents within the model using a longitudinal design. Therefore, the next chapter—Chapter Six will extend the findings of this chapter by conducting a longitudinal panel survey to test the evolving effects of several key variables on cyberchondria over time.

CHAPTER SIX: STUDY THREE: PANEL SURVEY

The previous chapter tested and validated the applicability of the cyberchondria development model through using a sample of 426 Chinese Internet users. While the results showed that different types of cognitive, affective, and social factors are associated with OHIS as well as cyberchondria, the cross-sectional study design was not able to investigate directional influences in this process model. According to the systematic review in Chapter Three, this is also a major limitation in the cyberchondria literature, where most empirical studies have relied on cross-sectional surveys to test the relationships between various variables and cyberchondria (Baumgartner & Hartmann, 2011; Doherty-Torstrick et al., 2016; Fergus & Dolan, 2014; Mathes et al., 2018). For health anxious individuals, cyberchondria is a syndrome-like phenomenon that has a more enduring tendency unless they stop information seeking (Brown et al., 2019; Starcevic et al., 2019). Hence, it would be important to assess how durable the predictors of cyberchondria are over time.

To address this limitation and expand research in this area, this chapter seeks to examine how various factors could contribute to the development of cyberchondria over time in the context of China, a large country where a high proportion of people conduct medical searches on the Internet (Li & Zheng, 2020). A cross-lagged panel approach was employed in this study as it is deemed reliable and appropriate for studying evolving effects in longitudinal data. By including autoregressive effects, the stability of the constructs over time are controlled, and thus cross-lagged effects can be examined (Kuiper & Ryan, 2018). A growing body of literature has used the cross-lagged approach in the context of digital technology use and health issues. For example, using a three-wave longitudinal panel, Tandoc and Goh (2021) found that more Facebook use at Wave 1 leads to a higher level of users' envy at Wave 2, which further increases depression at Wave 3. Similarly, a 2-wave

cross-lagged study conducted by Kim (2017) showed that loneliness leads to problematic use of smartphones, which increases need for social assurance, but such assurance is usually not gratified, and further drives more loneliness. Therefore, it is suitable to use such a cross-lagged approach to examine the cross-lagged effects of different antecedents to cyberchondria over time.

6.1 Selection of Study Variables

In the current study, four key variables in the cyberchondria development model are selected, namely, health anxiety, information insufficiency, online health information seeking (OHIS), and cyberchondria. The reasons for this selection are detailed as follows. First, the relationship between health anxiety and cyberchondria has been well documented in the literature (Barke et al., 2016; Fergus & Spada, 2018; Mathes et al., 2018; Starcevic et al., 2019). Through a network analysis, Starcevic et al. (2019) demonstrated that compared to other factors such as intolerance of uncertainty and OCD symptoms, health anxiety has a stronger relationship with cyberchondria. In other words, health anxiety is considered as a core element in the process of cyberchondria development. As described in Chapter Two, although the concept of cyberchondria is constructed around health anxiety, it is crucial to distinguish the two concepts. Specifically, individuals with health anxiety may convince themselves they may experience serious medical issues, and thus engage in proactive behaviors to alleviate their concerns, such as OHIS (Allen, 2017). Conversely, cyberchondria centers more on seeking for health information on the Internet in an excessive pattern, although it also involves signs of heightened anxiety or distress (McElroy et al., 2019). Put differently, cyberchondria describes a distinct, irregular form of OHIS, which is associated with other defining characteristics, such as distress, compulsion, and reassurance. Thus, it is necessary to include health anxiety as an important predictor in this longitudinal design.

Second, according to the TMIM and RISP model (Afifi & Weiner, 2004; Griffin et al., 2008), information insufficiency is an important antecedent to information seeking, mediating the roles of other psychological factors on information seeking such as negative affective response. While information insufficiency is a novel variable in the cyberchondria literature, the cross-sectional survey in the previous chapter has demonstrated its mediating role in the relationship between health anxiety and OHIS. Therefore, it would be pertinent to further assess the temporal ordering between the three concepts using a longitudinal design. Additionally, there may exist reciprocal relationships between these variables, leading to the emergence of cyberchondria (te Poel et al., 2016).

Third, OHIS provides a precondition where cyberchondria may arise. The hybrid model of cyberchondria postulates that people who conducts OHIS may become cyberchondriac when the information obtained from the Internet is not reassuring (Brown et al., 2019; Starcevic & Berle, 2013). Put differently, if online information does not address their information insufficiency, people may experience greater distress and conduct excessive seeking. As such, OHIS plays a vital role in connecting cyberchondria with potential antecedents in its development trajectory (Brown et al., 2019). While cyberchondria is a possible outcome of regular OHIS, few research has tested the directional influence of OHIS on cyberchondria. Therefore, OHIS is also included as a key antecedent in this longitudinal study.

In summary, this study includes three important antecedents to cyberchondria, namely, health anxiety, information insufficiency, and OHIS. While these antecedents have been extensively documented in the RISP-related or cyberchondria-related studies, the cross-lagged effects of the three factors on cyberchondria over time have not been investigated. A longitudinal approach can extend the cross-sectional survey design by revealing possible directional or reciprocal relationships between some key variables from the cyberchondria

development model over time. It should be noted that other factors such as informational subjective norms and negative metacognitive beliefs are not included in this study. It is not to say that such factors are unimportant in the process of cyberchondria development.

Considering the complexity of the cyberchondria development model in a cross-lagged panel design, the current study is an initial step to test the cross-lagged effects of several key variables in the model. The next section further elaborates on the theoretical bases between these concepts.

6.2 Research Hypotheses

Health anxiety describes unwarranted and excessive fear, provoked by a perceived health threat (Warwick & Salkovskis, 1990). On a daily routine, some individuals may interpret common body symptoms (e.g., headache, fever, etc.) as indicators of serious illness and suffer from anxiety. According to the RISP model (Griffin et al., 2008), people who experience negative affective response tend to perceive a subjective gap between their present knowledge about a risk and the desired knowledge required to deal with the risk, which is termed as “information insufficiency.” Extensive research has demonstrated the positive association between negative affective response (e.g., anxiety, fear) and information insufficiency (Griffin et al., 2008; Kim & Kim, 2019; Yang, 2012). For example, a recent cross-sectional survey conducted in China found that people who are anxious about COVID-19 are likely to perceive information insufficiency regarding this health crisis (Li & Zheng, 2020). Given the discussion above, the following hypothesis is proposed:

H1: Health anxiety at an earlier time point will increase information insufficiency at a later time point.

In the cyberchondria literature, health anxiety and OHIS evidently correlate. Numerous cross-sectional studies (e.g., Baumgartner & Hartmann, 2011; Doherty-Torstrick et al., 2016; Fergus, 2013; Muse et al., 2012) have revealed that health anxiety is positively related to the extent of OHIS (frequency and/or duration). However, the direction of causality between the two concepts still remains unclear. Scholars stated that people with health anxiety tend to conduct OHIS to obtain relevant knowledge, whereas the process of OHIS may trigger greater anxiety, particularly when people view threatening medical information on websites (Doherty-Torstrick et al., 2016; Starcevic & Berle, 2013). To date, only one longitudinal study has examined the relationship between health anxiety and OHIS over time. Through a four-wave longitudinal study with a representative community sample, te Poel et al. (2016) showed that for those who have a baseline level of health anxiety, there exists a reciprocal relationship between health anxiety and OHIS over time. This finding provides some preliminary support for the hypothesis that health anxiety triggers OHIS, which leads to a higher level of health anxiety. On the other hand, OHIS may reduce health anxiety if people find relevant, useful information on the Internet (Brown et al., 2019). For instance, a cohort study reported that pregnant women's health anxiety levels substantially decrease after they search for information related to obstetric disease on the Internet (Coglianese et al., 2020). As such, the effect of OHIS on health anxiety may be unclear, due to the information that people can obtain from their searches. Considering the mixed findings in the literature, this study proposes a research hypothesis and a research question as follows:

H2: Health anxiety at an earlier time point will increase OHIS at a later time point.

RQ1: How will OHIS at an earlier time point affect health anxiety at a later time point?

Based on the assumption of the RISP model and TMIM, individuals who perceive information insufficiency are likely to initiate information management behaviors such as information seeking. Several recent cross-sectional studies have empirically tested the relationship between information insufficiency and information seeking in an online context. For example, Chapter Five of this thesis reported that information insufficiency of a health issue is positively correlated with OHIS for this issue. In another study, Li and Zheng (2020) revealed that at an early stage of the COVID-19 outbreak, when people feel that they have insufficient knowledge about COVID-19, they tend to search for relevant information on the Internet.

Moreover, while the RISP model and TMIM conceptualize information insufficiency as a key motive for information seeking (Afifi & Weiner, 2004; Griffin et al., 1999), they do not address what happens after information seeking; for example, it is unclear whether the information obtained from a particular source (e.g., the Internet) can successfully address people's information insufficiency. OHIS is a purposive acquisition of health knowledge to support health-related decisions (Li & Zheng, 2020). Thus, the Internet may provide potential solutions for a health problem, and in this case, people's perceived information insufficiency would reduce. On the other hand, people may feel more uncertain or confused about a health issue after reading health information on the Internet. This is because health information from different online sources (e.g., online health communities, government health websites, etc.) might be conflicting (Baumgartner & Hartmann, 2011). In addition, certain medical terminologies can be too technical for lay people to comprehend (Chung, 2013). In this situation, they still need more knowledge to fill the subjective gap of information insufficiency. In other words, some OHIS is likely to trigger more information insufficiency. The above discussion leads to a research hypothesis and a research question as follows:

H3: Information insufficiency at an earlier time point will increase OHIS at a later time point.

RQ2: How will OHIS at an earlier time point affect information insufficiency at a later time point?

According to the models of cyberchondria, cyberchondria is envisaged as a negative outcome of regular OHIS (Brown et al., 2019; Starcevic & Berle, 2013). It describes time-consuming and excessive OHIS, emotional distress associated with OHIS, and the consequent interruption of other daily activities (Starcevic, Berle, et al., 2020). Regular OHIS in general is conceptualized as a form of threat evaluation and reassurance seeking, that is, a safety health-related behavior to reduce health anxiety as well as address information insufficiency (Brown et al., 2019). However, when the results of OHIS confirms the potential significance of the health threat, people will become more worried and anxious, thereby engaging in additional searches to manage the threat and accompanying distress (Starcevic, Berle, et al., 2020). Therefore, it seems plausible that some OHIS might turn into cyberchondria at a certain time point.

Moreover, information insufficiency may also be a potential predictor of cyberchondria. As mentioned before, individuals' perception of information insufficiency may not be addressed after initial OHIS. Consequently, they are likely to engage in more searches to obtain sufficient information. In theory, a person prone to cyberchondria may hold a view that he or she will eventually find sufficient health information to alleviate anxious feelings (Fergus & Spada, 2018). However, considering the complexity and ambiguity of online health information, individuals have difficulties to know when to stop their seeking behavior, leading to further uncertainty and emotional distress (Marino et al., 2020; Singh et al., 2016).

Finally, due to conceptual similarities, the link between health anxiety and cyberchondria has been extensively examined in prior studies (Bajcar et al., 2019; Barke et al., 2016; Fergus & Spada, 2018; Mathes et al., 2018; Starcevic et al., 2019). Scholars contend that although the two concepts are very related, they need to be studied independently (Barke et al., 2016; Fergus & Russell, 2016; Mathes et al., 2018). Health anxiety is conceptualized as an initial emotional state triggered by perceived health threat (Brown et al., 2019). In the process of regular OHIS, such anxiety may develop into a more stable, elevated level of distress, along with excessiveness, compulsion, and reassurance, which is conceptualized as cyberchondria (Fergus & Spada, 2018). In fact, health anxiety could be an important precursor to the development of cyberchondria (Starcevic et al., 2019). Given the discussion above, this study proposes the following hypotheses:

H4: (a) Health anxiety, (b) information insufficiency, and (c) OHIS at an earlier time point will increase cyberchondria at a later time point.

6.3 Research Method

To test the proposed hypotheses, this study employed a three-wave panel survey in China monthly from June 2021 to August 2021. Because cyberchondria takes several steps to develop, a three-wave panel survey is more able to explicate directional relationships beyond a single time interval, compared to two-wave cross-lagged panel designs, which only capture changes from Wave 1 to Wave 2 (Tandoc & Goh, 2021). The one-month interval between each wave was determined given that cyberchondria is a short-term phenomenon that arises in the process of OHIS. If people's health threat disappears (some ailments in daily lives), they may stop seeking information about the threat, and thus the level of cyberchondria decreases. As such, a long-time interval between the study waves might not capture the changing dynamics underlying cyberchondria development. This selection of a short-time

interval was consistent with previous longitudinal studies examining the cross-lagged effects of various antecedents to health-related behaviors (e.g., Chae, 2016; Kim & Tandoc, 2021). For instance, using a three-wave longitudinal design between February 2020 and April 2020, Kim and Tandoc (2021) revealed at an early stage of the COVID-19 pandemic, how exposure to health advisories influenced people's psychological mechanisms (e.g., normative, positive expectancy), which further affected their mask-wearing behavior.

6.3.1 Participants

Participants were recruited from an online panel with over 2.6 million registered members managed by a Chinese professional survey company, Wenjuanxing (<https://www.wjx.cn/index.aspx>). The questionnaire was published on the company's survey distribution platform, and panel members who met the eligible criteria were randomly invited via emails and short message service. Only those with prior OHIS experience and aged 21 years old or above were eligible to participate in the study. The first wave of surveys was administered in June 2021. Considering the sample attrition in longitudinal research, the company initially invited 3,452 panelists to take part in the study, and 1,271 completed the first survey, attaining a response rate of 36.82%. The same group of respondents were invited to the second survey wave in July 2021. In this wave, 816 individuals completed the survey, with a retention rate of 64.20%. This approach was repeated one month later in August 2021, contacting each individual who had completed the second survey. Finally, 654 participated in the third survey wave, with an overall retention rate of 51.50%.

Table 6.1 summarizes the demographic characteristics of the participants across the three waves. A number of tests were conducted to assess the sample characteristics. First, possible differences in the samples were tested due to the sample attrition in the three waves. That is, it aimed to check whether the final sample of 654 respondents was different to those

who participated in the first wave ($N = 1,271$), or those who participated in the first two waves ($N = 816$). In particular, the demographic characteristics of these samples were compared, in terms of their age, gender, education, annual income, Internet experience, and general health condition (see Table 6.1). The results of paired t -test showed that there were no significant demographic differences between those who participated in all waves and those who only participated in one or two waves ($p > .05$), except for a difference in participants' age between Wave 1 and Wave 3: $t(1,275) = -3.17, p = .002$, indicating that the participants in Wave 1 were younger than those in Wave 3.

Further, there were no significant differences between those who only participated in the first wave and those who stayed from Wave 1 to Wave 2, when it comes to level of health anxiety ($W_1: M = 3.25, SD = .80, N = 1,271; W_2: M = 3.19, SD = .86, N = 816; t(2,085) = 1.57, p > .05$), information insufficiency ($W_1: M = 7.28, SD = 1.46, N = 1,271; W_2: M = 7.26, SD = 1.52, N = 816; t(2,085) = .33, p > .05$), OHIS ($W_1: M = 3.54, SD = .76, N = 1,271; W_2: M = 3.59, SD = .79, N = 816; t(2,085) = -1.54, p > .05$), and cyberchondria ($W_1: M = 43.95, SD = 5.52, N = 1,271; W_2: M = 43.97, SD = 6.09, N = 816; t(2,085) = -.07, p > .05$).

Similarly, no significant differences were found between those who participated in the first two waves and those who completed the three waves across the four variables: health anxiety ($W_2: M = 3.19, SD = .86, N = 816; W_3: M = 3.21, SD = .85, N = 654; t(1,468) = -.44, p > .05$), information insufficiency ($W_2: M = 7.26, SD = 1.52, N = 816; W_3: M = 7.23, SD = 1.49, N = 654; t(1,468) = .43, p > .05$), OHIS ($W_2: M = 3.59, SD = .79, N = 816; W_3: M = 3.67, SD = .73, N = 654; t(1,468) = -1.95, p > .05$), and cyberchondria ($W_2: M = 43.97, SD = 6.09, N = 816; W_3: M = 43.99, SD = 6.18, N = 654; t(1,468) = -.06, p > .05$). In summary, the tests indicated no significant differences between panel survey attriters and stayers in terms of their demographics and study variables. Thus, this study used the sample of 654 participants for data analysis as they completed all three waves.

6.3.2 Procedure and measurements

Before data collection, the study was approved by the Institutional Review Board (IRB) of Nanyang Technological University, Singapore. Consistent with the guidelines of the IRB approval, participants were first requested to sign their informed consent. In the first survey wave, participants were asked to indicate one or more common symptoms (e.g., headache, fever, stomachache, etc.) that they concerned most and regularly checked online in daily lives. Based on the symptoms they selected, they completed a list of survey questions related to the four key measurements across the three survey waves, including health anxiety, information insufficiency, OHIS, and cyberchondria. The correlations between the four variables across the three waves are reported in Table 6.2.

Table 6.1. Sample characteristics.

Variable	Category	Wave 1 (n = 1,271)	Wave 2 (n = 816)	Wave 3 (n = 654)
Age	21 – 30	45.9%	42.2%	37.9%
	31 – 40	41.5%	44.4%	47.4%
	41 – 50	9.4%	9.8%	10.2%
	51 – 60	2.9%	3.3%	4.0%
	60+	0.2%	0.4%	0.5%
Gender	Male	46.5%	45.7%	47.1%
	Female	53.5%	54.3%	52.9%
Education	No formal school	—	—	—
	Primary school	0.1%	0.1%	0.2%
	Secondary school	1.0%	1.0%	1.1%
	High school/Junior college	6.3%	5.6%	6.1%
	Undergraduate	84.1%	84.2%	84.4%
Income	Postgraduate and above	8.5%	9.1%	8.3%
	Below 50,000 CNY	15.6%	14.2%	12.1%
	50,000 – 99,999 CNY	29.5%	28.4%	28.3%
	100,000 – 149,999 CNY	26.4%	28.6%	30.9%
	150,000 – 199,000 CNY	15.8%	16.1%	16.1%
	200,000 – 299,999 CNY	9.5%	9.6%	9.8%
OHIS experience	300,000 CNY and above	3.1%	3.2%	2.9%
	Very rare	0.6%	0.6%	0.9%
	Rare	3.1%	3.3%	2.1%
	Sometimes	38.2%	38.7%	39.9%
	Often	53.6%	53.9%	53.8%
Health condition	Very often	4.5%	3.4%	3.2%
	Poor	0.2%	0.4%	0.5%
	Fair	4.7%	4.7%	5.4%
	Good	61.4%	59.9%	59.9%
	Very good	31.2%	32.1%	31.3%
	Excellent	2.4%	2.9%	2.9%

Health anxiety. Consistent with the Study Two in this thesis, health anxiety was measured using the six items adapted from the Whitley Index-6 (WI-6) (Asmundson et al., 2008). The WI-6 was a 5-point Likert scale (1 = Strongly disagree; 5 = Strongly agree). Sample items included: “Because of my symptom, I often worry about the possibility that I have got a serious illness,” “I worry a lot about my health due to my symptom,” and “Based on my symptom, I think there is something seriously wrong with my body.” The scale was reliable in the current study ($W_1: M = 3.21, SD = .84, \alpha = .83$; $W_2: M = 3.19, SD = .88, \alpha = .85$; $W_3: M = 3.21, SD = .85, \alpha = .84$).

Information insufficiency. Following previous studies on the RISP model (Kim & Kim, 2019; Kim et al., 2020; Yang, 2012), the concept of information insufficiency was calculated by assessing perceived current knowledge and sufficiency threshold separately. First, perceived current knowledge was measured using three items: “how much have you heard about your symptom (0 = Never; 10 = A great deal),” “How informed are you about your symptom (0 = Not at all; 10 = Extremely well),” and “I know a lot about my symptom at the moment (0 = Strongly disagree; 10 = Strongly agree).” This scale was reliable in the current study ($W_1: M = 7.07, SD = 1.46, \alpha = .72$; $W_2: M = 6.99, SD = 1.46, \alpha = .75$; $W_3: M = 7.01, SD = 1.39, \alpha = .70$). Second, sufficiency threshold was measured using three items: “I need a lot of information about my symptom (0 = Strongly disagree; 10 = Strongly agree),” “I need to know everything there is to know about my symptom (0 = Strongly disagree; 10 = Strongly agree),” and “I need to find out as much as possible about my symptom (0 = Strongly disagree; 10 = Strongly agree).” This scale was reliable as well: ($W_1: M = 8.55, SD = 1.43, \alpha = .79$; $W_2: M = 8.44, SD = 1.57, \alpha = .84$; $W_3: M = 8.50, SD = 1.51, \alpha = .82$).

Furthermore, the analysis of partial variance was employed to calculate information insufficiency that contains the residual variance of sufficiency threshold accounting for the

variance of perceived current knowledge (Rosenthal, 2013). More specifically, using a linear regression model, perceived current knowledge was used to predict sufficiency threshold, and the unstandardized regression slope (B) was noted (Kim et al., 2020). Information insufficiency was calculated by subtracting perceived current knowledge $\times B$ from sufficiency threshold (W_1 : $M = 6.83$, $SD = 1.39$; W_2 : $M = 6.80$, $SD = 1.54$; W_3 : $M = 7.23$, $SD = 1.49$). This method helps to address the limitation of using a raw difference score between the two variables (e.g., sensitive to ceiling and floor effects) as well as the regressed change approach (e.g., the inflated explained variance in information insufficiency).

Online health information seeking (OHIS). To measure OHIS, participants were asked to rate how agreeable they were with the following four statements (1 = Strongly disagree; 5 = Strongly agree): “I regularly checked my symptom online to see if there was any new information,” “I actively searched for my symptom on the Internet,” “I regularly checked online sources to compare new information I found to previous website I had read,” and “I spent a lot of time searching for my symptom online.” The four items were adapted from Kim et al. (2020), and they showed a good reliability in the current study (W_1 : $M = 3.60$, $SD = .74$, $\alpha = .76$; W_2 : $M = 3.65$, $SD = .77$, $\alpha = .80$; W_3 : $M = 3.67$, $SD = .73$, $\alpha = .77$).

Cyberchondria. Consistent with the Study Two in this thesis, the CSS-12 was used to measure participants’ level of cyberchondria (1 = Strongly disagree; 5 = Strongly agree). This 12-item scale included four dimensions: excessiveness (e.g., “If I have this symptom, I will frequently search for it on the internet”), distress (e.g., “I feel more anxious or distressed after researching my symptom online”), compulsion (e.g., “Researching my symptom online distracts me from reading news/sports/entertainment articles online”), and reassurance (e.g., “Researching my symptom online leads me to consult with my doctor”). The 12 items were summed up to create a total score, ranging from 12 to 60. In the current study, the CSS-12

scale was reliable (W_1 : $M = 44.26$, $SD = 5.69$, $\alpha = .74$; W_2 : $M = 43.95$, $SD = 6.19$, $\alpha = .78$;
 W_3 : $M = 43.98$, $SD = 6.18$, $\alpha = .77$).

Table 6.2. Correlations between the study variables.

	HA_W ₁	HA_W ₂	HA_W ₃	IS_W ₁	IS_W ₂	IS_W ₃	OHIS_W ₁	OHIS_W ₂	OHIS_W ₃	CSS_W ₁	CSS_W ₂	CSS_W ₃
HA_W ₁	—											
HA_W ₂	.63***	—										
HA_W ₃	.65***	.68***	—									
IS_W ₁	.26***	.20***	.20***	—								
IS_W ₂	.23***	.28***	.24***	.55***	—							
IS_W ₃	.25***	.27***	.31***	.55***	.64***	—						
OHIS_W ₁	.22***	.23***	.13**	.32***	.32***	.33***	—					
OHIS_W ₂	.21***	.33***	.20***	.27***	.45***	.38***	.65***	—				
OHIS_W ₃	.22***	.27***	.26***	.30***	.41***	.50***	.60***	.66***	—			
CSS_W ₁	.45***	.39***	.32***	.32***	.34***	.34***	.45***	.42***	.47***	—		
CSS_W ₂	.36***	.52***	.42***	.24***	.41***	.38***	.37***	.51***	.47***	.61***	—	
CSS_W ₃	.36***	.41***	.49***	.27***	.37***	.43***	.34***	.43***	.52***	.58***	.65***	—

Note. HA: Health anxiety; IS: Information insufficiency; OHIS: Online health information seeking; CSS: Cyberchondria.

** $p < .01$, *** $p < .001$.

6.3.3 Data analysis

A cross-lagged model was adopted to test the directionality of causality and possible reciprocal effects among the study variables (Finkel, 1995). After accounting for the stability of each variable over time (i.e., autoregressive effects), the cross-lagged paths indicate the effect of one variable measured at an earlier time point on another variable measured at a later time point (Kuiper & Ryan, 2018). In addition, structural equation modelling technique with maximum likelihood estimator was employed to allow the four study variables (i.e., health anxiety, information insufficiency, OHIS and cyberchondria) to simultaneously predict one another between the survey waves. Accordingly, the structural cross-lagged model included: (a) cross-lagged paths between the four study variables, (b) stability paths of the four variables across the three waves, and (c) covariances among the residuals (error terms) of the four variables within each wave to account for reinforcement effect. Finally, consistent with previous studies on cyberchondria (e.g., Doherty-Torstrick et al., 2016; Laato et al., 2020; Tanis et al., 2016), six demographic variables, including age, gender, education level, annual income, online health search experience, and general health condition, were added as control variables in the first wave. The data analysis was conducted using the “lavaan” package in R version 3.6 (Rosseel, 2012).

6.4 Results

Overall, the cross-lagged model had a good fit to the data: $\chi^2(56) = 127.39, p < .001$; CFI = .983; TLI = .959, RMSEA = 0.044, SRMR = 0.027. The recommended cut-off values for these indices were reported in Section 5.1.3, Chapter Five (Page 90). The full model explained 44.6% of the variance in cyberchondria at Wave 3. Figure 6.1 shows the results of the cross-lagged panel analysis for the four variables.

The autoregressive effects of health anxiety, information insufficiency, OHIS and cyberchondria were all positive and statistically significant, indicating that there was a stable relationship within each construct over time: health anxiety from W_1 to W_2 : $\beta = .38, p < .01$; health anxiety from W_2 to W_3 : $\beta = .42, p < .001$; information insufficiency from W_1 to W_2 : $\beta = .44, p < .001$; information insufficiency from W_2 to W_3 : $\beta = .97, p < .001$; OHIS from W_1 to W_2 : $\beta = .84, p < .001$; OHIS from W_2 to W_3 : $\beta = .89, p < .001$; cyberchondria from W_1 to W_2 : $\beta = .52, p < .001$; cyberchondria from W_2 to W_3 : $\beta = .52, p < .001$.

In terms of the cross-lagged effects among the study variables, first, health anxiety at Wave 1 was positively associated with information insufficiency at Wave 2 ($\beta = .24, p < .01$). However, health anxiety at Wave 2 did not predict information insufficiency at Wave 3. Thus, H1 was partially supported, suggesting that health anxiety predicted information insufficiency at an earlier stage, while such a relationship did not exist at a later stage.

Second, health anxiety at Wave 1 did not increase OHIS at Wave 2. Further, health anxiety did not predict OHIS from Wave 2 to Wave 3, either. Thus, H2 was not supported. To address RQ1, the results showed that OHIS at Wave 1 did not increase or decrease health anxiety at Wave 2; however, OHIS at Wave 2 decreased health anxiety at Wave 3 ($\beta = -.21, p < .001$).

Third, information insufficiency at Wave 1 had a positive effect on OHIS at Wave 2 ($\beta = .17, p < .05$). However, information insufficiency at Wave 2 did not predict OHIS at Wave 3. As such, H3 was partially supported. To answer RQ2, the results showed that OHIS at Wave 1 increased information insufficiency at Wave 2 ($\beta = .14, p < .001$), whereas OHIS at Wave 2 did not predict information insufficiency at Wave 3. Taken together, the relationship between information insufficiency and OHIS was reciprocal at an earlier stage. However, this reciprocal relationship did not exist at a later stage.

Finally, health anxiety at Wave 1 had a positive effect on cyberchondria at Wave 2 ($\beta = .10, p < .01$). Moreover, health anxiety at Wave 2 had a positive effect on cyberchondria at Wave 3 ($\beta = .09, p < .05$), too. Thus, H4a was supported. Information insufficiency was not a predictor of cyberchondria from Wave 1 to Wave 2; however, it increased cyberchondria from Wave 2 to Wave 3 ($\beta = .09, p < .01$). Therefore, H4b was partially supported. OHIS was positively associated with cyberchondria from Wave 1 to Wave 2 ($\beta = .11, p < .01$), as well as from Wave 2 to Wave 3 ($\beta = .09, p < .05$). As such, H4c was supported.

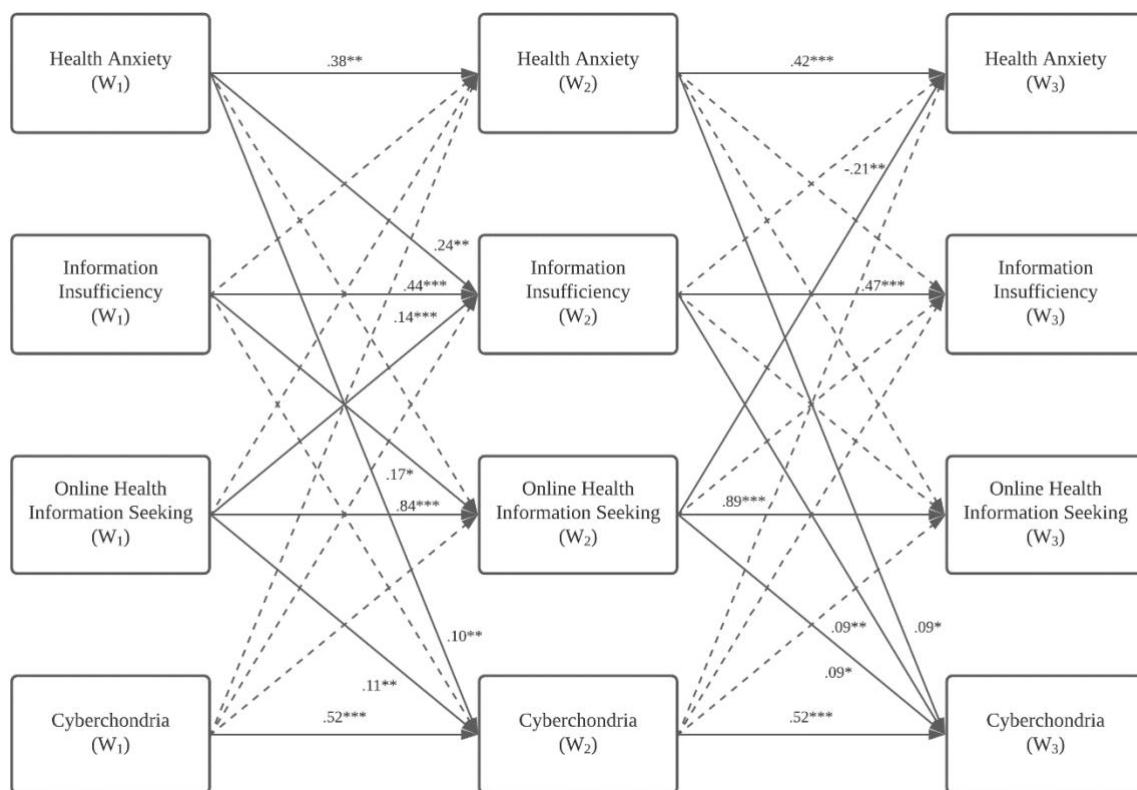


Figure 6.1. Results of cross-lagged model analysis. Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Standardized coefficients are reported. For simplicity, correlations between error terms and beta coefficients for insignificant paths are omitted. Solid lines are significant paths, while dotted lines are insignificant paths.

6.5 Discussion

6.5.1 *Summary of major findings*

This study sought to contribute to the growing literature on examining the development of cyberchondria, currently marked by some preliminary findings based on cross-sectional data. Focusing on four key variables from the cyberchondria development model, this is the first study to document how health anxiety, information insufficiency, and OHIS contribute to cyberchondria over time through a three-wave longitudinal study conducted in China.

In line with previous RISP-related studies (Kim & Kim, 2019; Li & Zheng, 2020; Yang, 2012), the cross-lagged analysis showed that health anxiety at Wave 1 predicted information insufficiency at Wave 2 after accounting for the autoregressive effects of both variables. On the other hand, information insufficiency at Wave 1 did not predict health anxiety at Wave 2. Hence, the result suggests that health anxiety is a cause of information insufficiency rather than an outcome. This result supports the proposition that people who experience negative emotions (e.g., health anxiety) about a risk tend to perceive insufficiency of their current knowledge of this risk (Griffin et al., 2008). However, this relationship did not exist at a later stage (i.e., from Wave 2 to Wave 3). It is likely that after conducting regular OHIS for a certain period, people's initial health anxiety about a medical issue heightens (Baumgartner & Hartmann, 2011). Such heightened anxiety may directly associate with cyberchondria rather than continue to increase perception of information insufficiency. In summary, in revisiting the association between health anxiety and information insufficiency, this study was able to provide evidence for the directional influence of health anxiety on information insufficiency at an initial stage.

The present study revealed a reciprocal relationship between information insufficiency and OHIS from Wave 1 to Wave 2. First, this finding suggests that people's

perception of information insufficiency regarding a health issue (e.g., common symptoms) is a key motive of information seeking, which is in line with the TMIM and RISP model (Afifi & Weiner, 2004; Griffin et al., 1999). Moreover, regular OHIS at an earlier time point increased subsequent information insufficiency as well, indicating that individuals' knowledge gap may not always be addressed with information seeking. That is, those who do not obtain relevant information may maintain or even enhance their perception of information insufficiency. This finding extends the RISP model by explaining the possibility of a bidirectional relationship between information insufficiency and information seeking. Nevertheless, such a relationship did not exist at a later stage (i.e., from Wave 2 to Wave 3). A possible explanation is that although individuals may still feel uncertain about their health issue after continuous OHIS, such uncertainty is more likely to come from the conflicting or overwhelming search results (Islam et al., 2020; Laato et al., 2020), rather than information insufficiency. Future studies could assess how perceptions of results from OHIS influence cyberchondria across time waves to verify this speculation.

Moreover, it is interesting to find that information insufficiency at Wave 1 had a positive relationship with OHIS at Wave 2, which then had a subsequent positive relationship with cyberchondria at Wave 3, while controlling for the autoregressive links of the three variables. This result is consistent with the cyberchondria development model, suggesting that people who perceive information insufficiency would conduct regular OHIS first because this is a knowledge acquisition process to address uncertainty. However, regular OHIS may turn into cyberchondria at a later stage if their uncertainty is not addressed. Therefore, the three-wave panel allows the current study to demonstrate the possible temporal ordering between information insufficiency, OHIS as well as cyberchondria.

The results showed that OHIS at Wave 2 decreased health anxiety at Wave 3, while OHIS at Wave 2 increased cyberchondria at Wave 3. The two findings are consistent with the

hybrid model of cyberchondria (Brown et al., 2019), suggesting that regular OHIS has two possible outcomes to cope with health threat, namely, reassuring outcome and worrying outcome. The former indicates that people successfully find relevant health information on the Internet, and they terminate their seeking process, which leads to a decrease in health anxiety. The latter describes that people fail to find information to address health concern, which drive further online health searches and continuation of anxiety. Therefore, the present study is the first to empirically validate the possible outcomes of OHIS at a later stage.

Putting the path analysis results together, the three antecedents (i.e., health anxiety, information insufficiency, and OHIS) were directly and positively related to cyberchondria across the waves, except that information insufficiency at Wave 1 did not predict cyberchondria at Wave 2. First, consistent with the existing studies on cyberchondria (Fergus & Spada, 2018; Mathes et al., 2018; Starcevic et al., 2019), health anxiety and cyberchondria are closely related. The current study further suggests that those who are anxious about health issues are more likely to develop cyberchondria at any stage of information seeking. Second, at an initial stage, those with information insufficiency tend to conduct regular information seeking for knowledge acquisition in order to alleviate health concerns (Li & Zheng, 2020). In this context, they may not suffer from cyberchondria. However, at a later stage, when people do not still obtain the knowledge they need, they become more uncertain and anxious, thereby increasing the possibility of developing cyberchondria. Finally, based on the hybrid model of cyberchondria (Brown et al., 2019), OHIS provides a precondition where cyberchondria arises. Accordingly, the current study showed that the positive association between OHIS and cyberchondria was stable across time. In summary, the results add new knowledge to the existing literature by showing the associations among health anxiety, information insufficiency, OHIS, and cyberchondria across different time points. The cross-

lagged effects among these study variables indicate that the development trajectory of cyberchondria is complex and dynamic.

6.5.2 Limitations and future directions

This study has a few limitations that open possibilities for future research. First, considering the complexity of the cyberchondria development model in a cross-lagged panel design, this study only focused on the links among health anxiety, information insufficiency, OHIS, and cyberchondria. However, other important factors from the model may be at play, and the development of cyberchondria is also influenced by such factors as informational subjective norms, negative metacognitive beliefs, among others. Hence, future studies should examine how these factors predict cyberchondria over time.

Second, although this study used a longitudinal panel design to establish temporal ordering of the study variables, the survey method is largely dependent on respondents' willingness and accuracy in reporting their perceptions and behaviors. Future research in this area can adopt other research methods such as qualitative approaches and field experiments to offer comprehensive perspectives regarding how information seekers develop cyberchondria. For example, OHIS can be measured through monitoring actual time spent on using the Internet to search for a particular health issue (So et al., 2019).

Third, compared to the national profile of China, the sample of this study was younger and more educated, which is typical of studies that collected survey data using online panels. Nonetheless, the sample matches the characteristics of online information seekers, who are mostly younger generations (Fergus & Dolan, 2014; Li & Zheng, 2020). Moreover, this longitudinal study was conducted between June and August 2021, when the COVID-19 pandemic outbreak in most parts of the world. Although the pandemic was well-controlled in China during that period, people might feel worried about the situation when they read

COVID-19 news from other countries. Future studies can replicate the current study through recruiting more diverse samples with general OHIS experience when there is no pandemic.

Fourth, since cyberchondria is a short-term phenomenon that may develop in the process of OHIS (Brown et al., 2019; Vismara et al., 2020), this study implemented one-month interval between each time point. However, some of these antecedents may be more or less salient in the long term. Future research therefore should revisit the current results and test them using longer time lags.

Finally, this study was conducted in the specific context of China, a large country with a high rate of Internet penetration. In addition, Chinese Internet users mainly rely on the search engine Baidu to obtain health information (Li, 2016). As such, the findings may not be generalizable to other countries where Google is the most popular search engine among online information seekers. Future studies should test the cross-lagged links between cyberchondria and other factors in other cultural contexts.

6.5.3 Theoretical implications

This study can contribute to research on cyberchondria in several ways. Most notably, it is the first study to theoretically develop and empirically test a set of associations that explicate the process of cyberchondria development over time. Most previous studies examining cyberchondria has focused on a one-time snapshot (Fergus & Dolan, 2014; Marino et al., 2020; Starcevic et al., 2019) instead of how factors contribute to cyberchondria over time. In these cross-sectional studies, Internet users may or may not experience cyberchondria at an initial stage of OHIS since they still need information to address their information insufficiency and health anxiety (Starcevic, Berle, et al., 2020). Therefore, a longitudinal study involving multiple testing sessions is expected to represent a more valid modeling of actual cyberchondria development trajectory. In addition, although the current

study only focused the four key variables in the cyberchondria development model, the findings advance the conclusions in Chapter Five by providing the cross-lagged effects of health anxiety, information insufficiency, and regular OHIS on cyberchondria across time. This study also reveals some unidirectional or reciprocal relationships between the antecedents at an early stage. Finally, the study highlights the need for the adoption of longitudinal approaches in cyberchondria research, thereby providing methodological implications for designing future research in this area.

6.5.4 Practical implications

Findings of this study offer some practical implications as well. First, while regular OHIS can be a process of knowledge acquisition to address information insufficiency at an initial stage, health professionals should educate information seekers on learning to manage uncertainty if information insufficiency is not addressed. Internet users should avoid futile online searches and turn to other sources (e.g., physicians) for help given that they still have medical concerns after regular OHIS (Starcevic, Schimmenti, et al., 2020). Second, since cyberchondria is more likely to arise after a long period of OHIS, it is necessary to encourage efficient self-control strategies when searching for medical information online such as limiting the duration of OHIS and the number of links clicked. Third, some Internet users may have unrealistic expectations of search results whereas the Internet is not always designed to provide reassurance. Health educators need to improve the public understanding of what online sources can do for individuals with health anxiety and highlight the fact that online health research may create unnecessary emotional distress at certain time point.

6.6 Summary

In summary, this chapter has reported a 3-wave longitudinal study examining how health anxiety, information insufficiency, and OHIS contribute to cyberchondria over time. Building upon the conclusions in Chapter Five, results of the current study further reveal the complex and dynamic processes underlying cyberchondria development, which contribute to the literature by helping to understand the rise of cyberchondria in the process of conducting OHIS. As the last chapter of this thesis, Chapter Seven will summarize the key findings of previous chapters, highlight several research and practical contributions of this thesis, and propose future directions for cyberchondria research.

CHAPTER SEVEN: THESIS CONCLUSION

7.1 Summary of Chapters

Considering several research gaps in the cyberchondria literature, the main purpose of this thesis was to address an overarching research question: “how do individuals develop cyberchondria when they search for health-related information on the Internet?” To do so, in Chapter Two, the thesis first reviewed the definitions of cyberchondria within and outside of academia and delineated conceptual differences between the terms “cyberchondria,” “health anxiety,” and “hypochondriasis.” Next, the chapter conceptualized cyberchondria as a multidimensional phenomenon and defined it as a state in which an individual exhibits a set of behavioral, cognitive, and affective patterns; these patterns include excessive online health information searching, along with compulsion, distress, and reassurance. Such a conceptualizing approach is consistent with the view from existing scholarship that cyberchondria is multidimensional in nature (McElroy et al., 2019; Vismara et al., 2020). Finally, the chapter surveyed existing theoretical frameworks used to explain cyberchondria and highlighted the strengths and weaknesses of these frameworks. Overall, although these frameworks provide different theoretical perspectives for understanding cyberchondria, gaps and insufficiencies still remain for developing a comprehensive, specific model that explain the mechanisms underlying cyberchondria development.

As the first study of this thesis, Chapter Three conducted a systematic review to provide an empirical landscape of cyberchondria research. This review included a sample of 40 publications, based on a thorough literature search and systematic filtering process. First, in terms of study characteristics, this review found that despite the growing number of studies in cyberchondria research, most studies were conducted in Western countries. These studies mainly relied on cross-sectional survey data collected from online crowdsourcing platforms

or university students. Additionally, different ways of measuring cyberchondria were summarized, and the CSS was the most prominent assessment tool in the literature. Finally, while a wide range of antecedents and consequences of cyberchondria were identified in previous studies, few have integrated these factors within a theoretical framework. Therefore, this review highlighted several research gaps in the cyberchondria literature that open possibilities for future research.

Given that few cyberchondria-related studies are theoretically driven, Chapter Four proposed an integrative theoretical model (i.e., cyberchondria development model) to explicate the antecedents and intermediate processes underlying cyberchondria development. Informed by information management theories (the RISP model and TMIM) and the hybrid model of cyberchondria (Afifi & Weiner, 2004; Brown et al., 2019; Griffin et al., 2008), this model proposes that when people perceive health threats of common symptoms, they may develop health anxiety; such anxiety drives OHIS through the perception of information insufficiency. In this process, positive source beliefs strengthen the association between information insufficiency and OHIS. Further, negative metacognitive beliefs serve as a boundary condition for how regular OHIS results in cyberchondria. By conceptualizing the mechanisms and intermediates underlying cyberchondria development, this comprehensive model offers insights on future theory building and testing in this new research area.

To empirically test the cyberchondria development model, Chapter Five reported a cross-sectional survey study with a sample of 426 Internet users in China, which is the second study of this thesis. Most of the predicted paths in the proposed model were statistically significant, lending support to the model's ability to explain how online health information seekers get cyberchondriac. Overall, the results of this study revealed that different types of factors (i.e., cognitive, affective, and social) may contribute to regular OHIS, which further turns into cyberchondria. Specifically, the study highlighted the relationship between health

anxiety and regular OHIS is mediated by perceived information insufficiency. More importantly, negative metacognitive beliefs positively moderate the effect of regular OHIS on cyberchondria.

Last but not least, as the third study of this thesis, Chapter Six sought to explore the cross-lagged effects of several key variables (i.e., health anxiety, information insufficiency, and regular OHIS) on cyberchondria from the cyberchondria development model over time. A three-wave longitudinal panel survey was conducted in China ($N = 1,271$, W1 in June 2021; $N = 816$, W2 in July 2021; $N = 654$, W3 in August 2021). Results showed that (a) health anxiety at Wave 1 had a cross-lagged effect on information insufficiency at Wave 2; (b) there was a reciprocal relationship between information insufficiency and OHIS from Wave 1 to Wave 2; (c) information insufficiency at Wave 1 increased OHIS at Wave 2, which further predicted cyberchondria at Wave 3; (d) OHIS at Wave 2 decreased health anxiety at Wave 3, while OHIS at Wave 2 increased cyberchondria at Wave 3; and (e) the three antecedents (i.e., health anxiety, information insufficiency, and OHIS) were directly and positively related to cyberchondria across the waves, except that information insufficiency at Wave 1 did not predict cyberchondria at Wave 2. In summary, this study further revealed the complex and dynamic processes underlying the development of cyberchondria.

7.2 Research Contributions of Thesis

Taken together, this thesis project has contributed to research on cyberchondria by providing an empirical landscape of cyberchondria research as well as theorizing the process of cyberchondria development. More specifically, three important research contributions could be extracted from the three studies collectively. First, the systematic review in this thesis has addressed the fragmented nature of cyberchondria research, by summarizing the key study characteristics of 40 empirical studies in this area. As Chapter One mentioned, one

of the main gaps in the cyberchondria literature is a lack of systematic knowledge regarding the current state of cyberchondria research, especially regarding how cyberchondria has been measured and what factors are associated with cyberchondria. Thus, this thesis reported several measurements of cyberchondria in the current literature, such as the CSS, highlighting the multidimensional nature of cyberchondria. Development of new instruments for assessing cyberchondria could give a significant impetus to research activity and scholarly work in this nascent field (Starcevic, Berle, et al., 2020). Furthermore, this thesis identified a list of factors related to cyberchondria (see Table 3.3). This list may help scholars to understand key antecedents to cyberchondria as well as explore other potential antecedents in future research. More importantly, the review highlighted the need for understanding cyberchondria from a theoretically driven approach because cyberchondria is a complex phenomenon and such complexity may not be adequately captured by testing the correlations between some factors and cyberchondria.

The second contribution of this thesis is developing an integrative theoretical model to explicate how cyberchondria arises in the process of seeking health information on the Internet. While a significant body of studies have examined factors related to cyberchondria (Baumgartner & Hartmann, 2011; Fergus & Dolan, 2014; Mathes et al., 2018; McElroy et al., 2019; Starcevic et al., 2019), few have explored the process of cyberchondria development. The cyberchondria development model accounts for different types of antecedents to regular OHIS and cyberchondria. For example, the roles of perceptions of information insufficiency and informational subjective norms have not been examined in the existing cyberchondria literature. Also, the model highlights the role of negative metacognitive beliefs when regular OHIS turns into cyberchondria. Nevertheless, it is important to note that health anxiety was not positively associated with OHIS in both studies, which is inconsistent with many previous cyberchondria-related studies (e.g., Baumgartner & Hartmann, 2011; Doherty-Torstrick et al.,

2016; Muse et al., 2012). This insignificant relationship may be explained by the full mediating role of information insufficiency. Future research in this area could revisit this relationship by taking potential underlying mechanisms into account in order to make a better sense of how health anxiety links to information seeking.

Overall, this model building approach provides new insights on the future development of theories or theoretical frameworks in cyberchondria research. Notably, researchers have argued that cyberchondria is more likely to develop during public health crises, such as the COVID-19 pandemic, due to the uncertainty and anxiety induced by the virus and the unlimited amount of constantly updated, unverified information on the Internet (Starcevic et al., 2020). It could be instructive to test the cyberchondria development model in the context of the COVID-19 pandemic. This would help further make sense of how cyberchondria arises during public health crises and inform evidence-based strategies for prevention of cyberchondria.

The third key contribution is the adoption of longitudinal panel approach in theory testing for several key variables drawn from the cyberchondria development model. As highlighted in Chapter One, one major research gap in cyberchondria research is the heavy use of cross-sectional designs to test the associations between cyberchondria and its associated factors. To address this gap, this thesis conducted a three-wave panel study to examine how factors contribute to cyberchondria over time. Compared to previous studies in the literature as well as Chapter Five, the findings further explicated the complex relationships between the study variables across time waves. Also, considering the complexity of cyberchondria, this thesis poses methodological implications for investigating this phenomenon in future studies, by highlighting the need for longitudinal approaches.

7.3 Practical Contributions of Thesis

In addition to theoretical contributions, the findings of this thesis result in several significant and meaningful impact in practice as well. Overall, prevention of cyberchondria does not mean that people should avoid using the Internet as a source for obtaining medical information. Instead, it is crucial for various stakeholders such as medical staff, information professionals, and health educators to revisit their approaches to alleviating the features of cyberchondria (e.g., excessiveness, distress, etc.). First, as suggested by the systematic review in Chapter Three, medical professionals should use appropriate, effective measurement tools for assessing people's level of cyberchondria. Although the development of cyberchondria measures is still in progress, the current assessment tools (e.g., the CSS-12) can be adopted in practice to help physicians effectively identify those who experience a heightened level of emotional distress after excessively searching for medical information online.

Second, based on the findings in Chapter Five, various types of factors (e.g., source beliefs, negative metacognitive beliefs) play a role in the process of cyberchondria development. For example, it is important to ensure that the information is obtained from credible, trustworthy, and reputable sources. Guidelines for OHIS can be provided to Internet users so that they can effectively locate accurate and high-quality online sources and distinguish between reliable and unreliable ones (Starcevic, Schimmenti, et al., 2020). Such guidelines are usually published by government agencies or health institutions, using non-technical, simple language to assist information seekers with different educational backgrounds. Additionally, in the process of assessing cyberchondria, medical professionals should ascertain whether online information seekers have any significant associated psychopathology such as negative metacognitive beliefs (Lenzo et al., 2020). Using appropriate treatment approaches (e.g., Internet-delivered cognitive behavior therapy) for such psychopathology may reduce the features of cyberchondria (Marino et al., 2020).

Third, the longitudinal study in Chapter Six revealed that at a later stage, regular OHIS may either decrease health anxiety or increase cyberchondria. When the outcome of OHIS causes emotional distress, especially in the presence of common symptoms, the viable approach could be stopping further OHIS (Fergus & Spada, 2018; Starcevic, Berle, et al., 2020). This is because excessive OHIS for further explanation and reassurance may result in an interaction between a person and online sources in which the person tends to feel unsupported, alone, and confused, and thus is likely to become more anxious in the seeking process. If people's information insufficiency is not fulfilled via OHIS at an initial stage, such knowledge needs can be managed via consultation with a physician, which can clarify some misunderstanding or concerns due to OHIS.

7.4 Directions for Future Research

Based on the findings of this thesis, a few key areas can be further explored in future research. First, this thesis conceptualized cyberchondria as a multidimensional construct. While such conceptualization is line with previous studies that define cyberchondria as a syndrome-like entity (McElroy et al., 2019; Starcevic et al., 2019), further investigation on the structure of the cyberchondria construct is needed. For example, a confirmatory factor analysis can be conducted to examine the interrelationships between the dimensions of cyberchondria and identify which dimension is more central to cyberchondria. Also, it is interesting to examine whether the construct of cyberchondria only includes the four subdimensions (i.e., excessiveness, distress, reassurance, and compulsion) or it may contain other unknown affective or behavioral patterns.

Second, in terms of theoretical modelling, there is certainly more room for improvement in the current cyberchondria development model. While the current model links predictors of OHIS to cyberchondria, the process of how regular OHIS becomes

cyberchondria can be further investigated from a theoretical perspective. For example, Starcevic, Schimmenti, et al. (2020) proposed several components that may maintain the level of cyberchondria after regular OHIS, including difficulties in coping with uncertainty, difficulties in coping with information overload, questionable trustworthiness of online information, and ineffective online reassurance seeking. When theorizing the process of cyberchondria development, these components can be considered. In addition, scholars may want to figure out how to operationalize these concepts for empirical testing.

Third, scholars may revisit the findings of this thesis. For example, as mentioned above, the two empirical studies concluded that the direct relationship between health anxiety and OHIS was insignificant, and information insufficiency fully mediated the relationship. This insignificant relationship warrants more empirical investigations in the future research since health anxiety is a core element in the process of cyberchondria development (Starcevic et al., 2019). Regarding the research context, the studies in this thesis were conducted in China, where a large proportion of Internet users rely on Baidu search engine to search for health information. Additionally, the participants in the two empirical studies were recruited from an online survey panel, and they had similar demographic characteristics. They tended to be young (around 85% of the participants were between 21 and 40 years old), well-educated (around 85% had a bachelor's degree), digitally capable (more than half of the participants often used the Internet for health research), and healthy (more than 90% of them reported "good" or "very good" health conditions). Hence, future studies may replicate these studies in other cultural contexts with more diverse populations to examine whether the findings are still consistent. In addition to the current findings, future research should further test the roles of other key factors in the process of cyberchondria development over time, such as informational subjective norms and negative metacognitive beliefs.

Finally, treatment approaches to cyberchondria can be designed based on the findings of this thesis. This requires a good understanding of the process of cyberchondria development. In other words, specific aspects of cyberchondria and some key factors that may maintain cyberchondria should be targeted in order to propose treatment interventions. In doing so, it is important to understand (a) main motivations for conducting OHIS (e.g., anxiety about a symptom, information insufficiency), (b) purpose of OHIS (e.g., seeking reassurance or addressing information insufficiency about the illness), and (c) factors that strengthens the effect of regular OHIS on cyberchondria such as negative metacognitive beliefs. Considering these aspects in treatment interventions would make regular OHIS empowering, rather than overwhelming or distressing.

7.5 Concluding Remarks

As reflected in the growing number of publications, cyberchondria has received attention from scholars in recent years, while this area has been plagued by several theoretical and methodological challenges. Overall, this thesis has addressed some important research gaps in the cyberchondria literature—through conceptualizing the phenomenon, systematically reviewing the empirical landscape, developing an integrative theoretical model to explicate the process of cyberchondria development, as well as validating the proposed model using both cross-sectional and longitudinal designs.

It is hoped that the findings of this thesis can contribute to a more nuanced understanding of what cyberchondria is and how it arises and maintains in the process of OHIS. Research on cyberchondria is still in its infancy stage, and the area is fertile and has much potential for further development in terms of theoretical understanding. This thesis could provide useful suggestions in explaining how Chinese Internet users get cyberchondria when they seek health information on the Internet as well as advancing cyberchondria

research theoretically and practically. More research is needed to further explore this area based on the findings of this thesis. For example, future studies can test and validate the theoretical model and propose evidence-based management approaches. Such studies should recruit participants with diverse backgrounds, not only those from online panels, but also clinical samples, to make the findings more generalizable and valid.

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