Research and Evaluation of a Cyberchondria Severity Scale in a Chinese Context

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Research

Keywords: cyberchondria, severity scale, medical anxiety, Chinese health system

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Title page

A description of what the article reports

This study explores the unique nature of cyberchondria in the context of Chinese culture, identifying the risk factors for the condition and the possible negative outcomes.

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Data availability statement

Research data are not shared.

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Abstract:

Background: Cyberchondria is the unfounded anxiety that results when people look up their medical conditions online and mistakenly diagnose themselves with serious illnesses. Such internet-derived medical anxiety can manifest itself in different ways across cultures. This study explores the unique nature of cyberchondria in the context of Chinese culture, identifying the risk factors for the condition and the possible negative outcomes.

Results: An exploratory factor analysis (EFA) was used to highlight differences in the structure of the scale for Western and Chinese contexts. Through the process of the reliability and validity testing, a Chinese version of the Cyberchondria Severity Scale (C-CSS) was developed. Subsequent regression analysis indicated that three antecedents are effective predictors of cyberchondria, and that C-CSS is related to theoretically relevant outcomes.

Conclusions: This study initially demonstrated the applicability of C-CSS to assess the severity of cyberchondria among Chinese undergraduates.

Keywords: cyberchondria, severity scale, medical anxiety, Chinese health system

Introduction

With rapid improvements in internet connectivity, it is becoming increasingly common for people to access health-related information online. A 2010 poll revealed that 60% of internet users in China had searched for health-related information online and 56% of them had self-diagnosed using such information (McDaid & Park, 2010; Ding & Yang, 2015). They key attractions to using the Internet in this way are its anonymity, ease of use, efficiency, and the wealth of comprehensive information it holds. The Internet also allows people to communicate directly with others about shared medical experiences (Starcevic & Berle, 2013). Nonetheless, information obtained online is likely to be inaccurate. For example, White and Horvitz (2009) found “Amyotrophic Lateral Sclerosis” to be the most common condition returned based on online searches for “muscle twitching”, despite the fact that the incidence of this serious disease is extremely low. Research available shows that excessive searching for health-related information online can lead to increased

health anxiety. Rather than having their fears eased, users can end up being panicked into carrying out further medical information searches, resulting in a condition known as "Cyberchondria" (Norr et al., 2015). A growing set of evidence indicates that people who seek health-related information online can end up becoming anxious and distressed, and spend a substantial amount of time engaged in the activity, at the expense of working and living (Starcevic & Berle, 2013). Given the increased healthcare utilization among people with cyberchondria, it can also lead to inefficient use of medical resources, adding an unnecessary burden to the public health system (Fergus, 2014; Mathes, Norr, Allan, Albanese, & Schmidt, 2018; McElroy & Shevlin, 2014).

Cyberchondria is a general subclinical symptom characterized by excessive or repetitive seeking of health-related information online, often connected with underlying health anxiety (Fergus, 2013; Harding, Skritskaya, Doherty, & Fallon, 2008). Given the capacity of such information to exacerbate distress or anxiety, cyberchondria has been referred to as "the new frontier in illness anxiety" (Starcevic & Berle, 2013). According to models of pathological worry, cyberchondria can be described as a vicious cycle in which those who experience increased anxiety when accessing health-related information attempt to seek reassurance through further online searches (Mathes, Norr, Allan, Albanese, & Schmidt, 2018). The short-term decrease in anxiety which these searches can provide may lead sufferers to search more and more, thus maintaining a long-term negative cycle (Starcevic & Berle, 2013). Those individuals with endogenous characteristics of 'vulnerability', such as perfectionism, high levels of anxiety sensitivity (AS) and intolerance of uncertainty (IU), are more likely to be trapped in the vicious circle of increased physical health concerns and online medical information seeking (Norr, Albanese, Oglesby, Allan & Schmidt, 2015). This unique anxiety-amplifying process suggests that cyberchondria and anxiety disorders, though closely related (with both manifesting as excessive anxiety), represent distinct constructs (Starcevic, 2017).

Although existing research emphasizes an overlap between cyberchondria and other pathologies, the unique anxiety-amplifying effect of cyberchondria sets it apart (Mathe, Norr, Allan, Albanese, & Schmidt, 2018). From a cognitive-behavioral perspective, safety seeking behavior is a key feature of health anxiety. Symptoms in individuals with cyberchondria can manifest as maladaptive avoidance of medical diagnosis and excessive or repetitive seeking of health-related information online, leading to amplified anxiety and distress. Starcevic and Berle (2013) have

proposed that cyberchondria is characterized by obsessional doubt and parallel compulsions. A recent review has shown a strong correlation between cyberchondria and four obsessive-compulsive symptom dimensions, namely contamination, responsibility for harm, unacceptable thoughts, and symmetry (Norr, Oglesby, & Schmidt, 2015). Notably, individuals with cyberchondria are usually focused on having a disease, while individuals with OCD tend to focus on fears of getting a disease in the future. In addition, a related study has found a robust link between cyberchondria and problematic internet use (PIU). Both pathologies reflect a lack of control of internet use, which can lead to negative outcomes such as depression, mood distress and impairment of daily functioning (Bajcar & Babiak, 2019; Laconi, Vigouroux, Lafuente, & Chabrol, 2017).

To date, several measures have been extensively relied on to assess cyberchondria. Some studies have evaluated cyberchondria indirectly based on reports of cyberchondria-related symptoms, such as the Short Health Anxiety Inventory (SHAI) and the Positive and Negative Affect Schedule (PANAS; Fergus, 2013). Moreover, a questionnaire has been developed to assess cyberchondria directly, which includes three dimensions, namely escalation of concerns, persistence of concerns and judgment biases (Ivanova, 2014). This instrument omits some characteristics of cyberchondria, such as compulsion and reassurance seeking, and its psychometric characteristics have been inadequately reported. Semi-structured interviews have also been used to assess cyberchondria, though the questions used are not sufficiently detailed to shed light on the multidimensional structure of cyberchondria (e.g. 'Why did you choose to look up this information on the Internet?', 'How accurate do you think the health information you found online is?'; McManus, Leung, Muse, & Williams, 2014). In response, McElroy and Shevlin (2014) specified a multi-dimensional construct for cyberchondria and developed the Cyberchondria Severity Scale (CSS) to assess the severity of cyberchondria directly.

The CSS was found to be reliable in terms of internal consistency and test-retest stability (McElroy & Shevlin, 2014). The convergent and divergent validity of CSS was also supported, as demonstrated by moderate correlations with established measures of depression, anxiety and stress. Additionally, a series of studies have indicated that the CSS supports the psychometric properties of validity and reliability, based on adult samples obtained in Turkey, Germany and America (Uzun & Zencir, 2018; Barke, Bleichhardt, Rief, & Doering, 2016; Fergus, 2014). Overall, this work supports the usefulness of the CSS as a reliable and valid instrument for assessing cyberchondria in

adolescents and adults. Consistent with previous studies of CSS, Norr et al. (2015) suggested that the mistrust subscale does not assess the same construct as other factors, and should be considered distinct from CSS for several reasons. First, they found that their model of cyberchondria had superior fit when the Mistrust factor was excluded. In addition, the small correlations found between the Mistrust factor and other factors calls its inclusion in the CSS into question (Norr et al., 2015). Furthermore, according to Norr et al., (2015), a model of cyberchondria comprising a separate Mistrust factor and bifactor General Cyberchondria factor with orthogonal Compulsion, Distress, Excessiveness, and Reassurance factors provided a superior fit to the data. As suggested by Fergus (2014), the current study attempts to further illuminate the unique role these dimensions play in the development of cyberchondria. By exploring the psychometric properties and construct of CSS in China, we hope to gain insight into its nature as manifested in a Chinese context.

Although the CSS has been studied in multiple cultures, it has not yet been evaluated empirically in a Chinese sample. In fact, there are no studies of cyberchondria or widely recognized evaluation tools for cyberchondria in China. Across the country, it is estimated that about 61% of the population, approximately 854 million people, are internet users, following a period of rapid growth in online connectivity (China Internet Network Information Center, 2019). With the popularization of the Internet has come increased availability of health and medical-related information. Given the frequent occurrence of food and drug safety problems, as well as air quality problems, people in China have become increasingly worried about their health, leading to an increasing frequency of online health-related searches (Ding & Yang, 2015).

Manifestations of cyberchondria are, to some extent, determined by cultural factors associated with socialization practices. It is therefore necessary to verify the applicability of CSS in China, given the marked differences in Chinese social institutions, medical systems, beliefs and values in comparison with predominantly individualistic cultures such as the United States and Germany. Research has found that people demonstrate a higher level of conformity in collectivist societies (e.g., Norway, Japan and China) than in individualistic societies (e.g., the United States and France). One might speculate, therefore, that Chinese internet users might be more likely to believe information with high click-through rates and large amounts of thumb ups. In terms of the medical system, there are large regional differences in medical resources across China, and offline medical resources are relatively insufficient in some areas (Yan, 2014). Statistics show that the rural

population in China accounts for about 40% of the total population (Chinese National Bureau of Statistics, 2018). Given the imbalance in allocation of medical equipment between urban and rural areas, it can be inconvenient for some rural Chinese to seek medical treatment; this may make them more likely to explore health-related information online. As regards beliefs, Chinese people's attitude towards death is different from that of Britain, America and other western countries. China has a "happy life and taboo death" attitude towards dying, centered on a strong fear of death. In contrast, Christian countries hold a "living beyond death" concept which emphasizes the idea that the soul can exist independently of the body, with greater importance attached to the soul (Bai & Yin, 2014). In terms of values, Chinese people tend to be conservative. Many patients are afraid to seek medical treatment due to their prejudice against diseases (such as mental illnesses) and a desire to preserve their self-respect (Wang, 1996). Accordingly, they may adopt more covert ways to alleviate their worries about diseases. Finally, although significant associations between cyberchondria, health anxiety and intolerance of uncertainty have been established, further research is required to understand the causal relationship between these factors. A better understanding of the nature of cyberchondria could lead to the identification of effective treatments.

In summary, this study sets out several goals. First, we aim to verify the validity and reliability of the CSS in a Chinese sample. Second, we aim to test the content validity of the CSS by using the regression and calibration of antecedent and outcome variables to explore the risk factors, as well as the possible adverse effects, with the goal of increasing the adaptability of CSS to the context of China's 800 million internet users. Finally, we aim to provide a solid conceptual foundation for future studies investigating the prevalence and mitigation of cyberchondria in China.

Method

Study 1 EFA analysis

Sample 1

The first sample consisted of 385 Chinese undergraduates. These students were recruited from a university in the city of Jinan, located in Shandong Province, Eastern China. After the exclusion of the questionnaires with substantial missing information or unreliable response patterns, 380 valid responses were identified. The sample was primarily female (52.6% female) with ages ranging from

17 to 23 (M=19.55, SD=1.06). The research was conducted between May and June 2019. Informed verbal consent was obtained from all participants prior to the study.

Measure

Cyberchondria Severity Scale (CSS). The CSS is a self-report measure of the severity of cyberchondria, initially developed with United Kingdom samples (McElroy & Shevlin, 2014). This scale consists of 33 items and 5 dimensions: Compulsion (8 items), Distress (8 items), Excessiveness (8 items), Reassurance Seeking (6 items) and Mistrust of Medical Professional (3 items)（see appendix）. Each item is rated using a five-point Likert scale indicating frequency (1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Always). The whole CSS score demonstrated adequate internal consistency in previous studies (Cronbach's alpha=.94; McElroy & Shevlin, 2014).

In this study, a Chinese back translated version of the CSS was used. The following procedures were applied. First of all, each item of the English version of the scale was translated into Chinese by the researchers. Second, researchers examined each item of the translated version of the scale in terms of meaning, accuracy, wording, spelling, and grammar. Third, the Chinese version of CSS was translated back to English in order to ensure the exact meaning of each item.

Results

Reliability statistics.

The internal consistency of the whole scale was α = .91, with the consistency increasing to α= .94 given removal of 'Mistrust of Medical Professional' (including items 9, 28, 33).

EFA.

The significance of Bartlett's test of sphericity (χ^2（528）=6472.880, p< .001) and the size of the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO= .930) showed that the 33 items had adequate common variance for factor analysis (Tabachnick & Fidell,2006). EFA using principal axis factoring method was conducted to examine the internal structure of the 33-item CSS (the principal axis factoring method was applied). We rotated factors using an oblique rotation with kappa value of 4 based on our assumption that the factors would be correlated. Item selection was based on the following criteria: (1) items with loadings less than .5 on a factor were deleted, and (2) items with loadings at .5 or greater on a factor, but with cross-loadings at .32 or higher on the other factor, were deleted (Tabachnick & Fidell, 2006). To ensure minimal ambiguity among factors, the criteria for an acceptable factor were as follows: (1) the minimum eigenvalue was 1, and (2) the minimum

loading on each factor was three items (Costello & Osborne, 2005). As a result, three factors and 17 items were retained for the final version of the scale. The results of the EFA are presented in Table 1.

Insert Table 1 about here

Study 2 CFA and scale validation

Sample 2

Data in this study was collected from 221 Chinese undergraduates. These students were recruited from a university in the city of Jinan, located in Shandong Province, Eastern China. After the exclusion of questionnaires with substantial missing information or unreliable response patterns, 220 valid responses were identified. The sample was primarily female (56.8% female), with ages ranging from 16 to 22 (M=18.50, SD= .85). The research was conducted between May and June 2019. Informed verbal consent was obtained from all participants prior to the study.

Measure

Chinese Version of Cyberchondria Severity Scale (C-CSS). The 18-item Chinese version of CSS consists of 3 dimensions: Negative Effects (12 items), Excessiveness (3 items) and Reassurance Seeking (3 items). Each item is rated using a five-point Likert scale indicating frequency (1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Always). A total C-CSS score can be calculated by summing scores on relevant items. In this study, a revised Chinese version of C-CSS was used.

Short Health Anxiety Inventory (SHAI). The SHAI is a self-report measure of health anxiety initially developed by Salkovskis, Rimes, Warwick, and Clark (2002). This scale comprises of 18 items, with each item rated using a four-point Likert scale (ranging from 0 to 3); the scale has demonstrated acceptable reliability and validity in Chinese samples (Yuan, Zhang, Liu, Li, & Mao, 2015). In this study, a Chinese version of SHAI was used to assess convergent validity of the CSS.

Padua Inventory (PI). The 60-item PI was originally developed to assess the number and severity of obsessive-compulsive disorder (OCD) symptoms in clinical and non-clinical participants. Items are scored on a five-point Likert scale ranging from 0 (not at all) to 5 (very much) based on the degree of disturbance. The PI demonstrated good psychometric properties in Chinese samples (Zhong, Tan, & Kuang, 2005). In this study, a Chinese version of PI was used to assess convergent

validity of the CSS.

Results

CFA.

A confirmatory factor analysis (CFA) was performed in a structural equation modeling (SEM) framework using Mplus7.4 statistical software to confirm the overall fit and acceptability of the three-factor structure of C-CSS derived from study 1. Previous studies have suggested the removal of the 'mistrust of medical professional' subscale from the C-CSS. Consequently, the CFA was performed in a structure including three dimensions, and items were allowed to correlate with each other in each dimension. The robust maximum likelihood (MLR) estimator was used (Yuan & Bentler, 2010). There are multiple approximate fit tests that can be used to evaluate the model's fit to the data; the model specification and the parameter estimates are illustrated in Table 2. In this study, Normed Fit Index (NFI; Bentler,1990), Comparative Fit Index (CFI; Bentler, 1990), Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error Approximation (RMSEA) (Browne & Cudeck,1992) were employed to evaluate model fit. Despite widespread use of chi-square statistics in the literature, authors have criticized it due to its high sensitivity to sample size. This is because chi-square statistics tend to be conservative and detect trivial differences between hypothetical and observed models when the sample size is large (Bollen & Kenneth, 1990). For that reason, instead of chi-square statistics, the aforementioned indices were considered. We viewed χ^2/df<3, TLI> .9, CFI> .95, RMSEA< .06 (N>250) and SRMR< .11 as cut-off values representing good fit (Hu & Bentler, 1998). The model was found to fit the observed data well (χ^2/df =1.726，TLI= .937，CFI= .949，RMSEA= .058，SRMR= .050).

Second-order confirmatory factor analysis was performed. As suggested by Uzun and Zencir (2018), the model fit indices showed similar results to the first-order confirmatory factor analysis: χ^2 =225.956 (*df*=125, *p*<.001), χ^2 /df =1.808, TLI= .930, CFI= .943, RMSEA (CI) = .06 (.048, .073), SRMR= .058 (Table 2). After examining the modification indices, it was decided not to conduct any model respecification.

The overall fit index values of all models were found to be within acceptable limits. No significant difference was observed between Model 1 and 2 (S-B$\Delta\chi^2$=11.873, *p*> .05). However, CFI and TLI values of Model 2 were smaller than Model 1, indicating that Model 1 was a better fit to the data.

Insert Table 2 about here

Intercorrelations and reliability statistics.

Descriptive statistics (including means and standard deviations) and intercorrelations for the C-CSS total and three subscale scores were examined in order to investigate the construct validity of C-CSS, as shown in Table 3. The total scale demonstrated strong and positive correlations ($p < .01$) to the reassurance subscale (.624), excessiveness subscale (.683) as well as to the negative results subscale (.939). The intercorrelations for the three cyberchondria dimensions were significant. In addition, the Cronbach's alpha for the total, and that for the subscales used to evaluate the internal consistency of C-CSS, ranged from .75 to .90, thus exceeding the minimum requirement of .70 (Nunnally, 1978).

Convergent and discriminant validity.

According to the Fornell-Larcker testing system, an AVE value for each construct larger than 0.5 indicates acceptable convergent validity at the level of scale construct. If the level of AVE for each attribute is higher than the square of inter-construct correlations involving the construct, this indicates discriminant validity at the construct level (Fornell & Larcker,1981). The square root of AVE of each dimension was .66, .73, .74, thus being higher than 0.5 and also higher than the largest correlation coefficients among the dimensions (Table 3). This indicates that our constructs exhibited adequate convergent validity and discriminant validity.

Criterion-related validity.

As presented in Table 3, the total scale and subscales of C-CSS were moderately correlated with HA total score and PI total score ($p < .001$).

Insert Table 3 about here

Study 3 Antecedents and Outcomes

Anxiety sensitivity (AS) and intolerance of uncertainty (IU) are considered to be the cognitive

factors underlying anxiety disorders (McLaughlin, Stewart, & Taylor, 2007; Wright, Lebell, & Carleton, 2016). Several studies have examined the transdiagnostic vulnerability in individuals with a high level of AS, who, due to the characteristics of 'vulnerability', are at increased risk of developing cyberchondria (Dixon et al., 2018). For individuals with a high level of AS, anxiety symptoms, such as increased heart rate, are likely to be interpreted as a signal of physical illness and psychological incapacitation, which might lead to further online health-related searching. There is substantial evidence that reducing uncertainty is a core motive in searching for health-related information on the Internet (Wright, Lebell, & Carleton, 2016). In another study, comparable medium-strength correlations were found between cyberchondria and self-reported somatic complaints, suggesting the possibility that somatic complaints are one of the starting points of cyberchondria (Barke, Bleichhardt, Rief, & Doering, 2016). Hence, we reasoned that AS, intolerance of uncertainty (IU), and somatic complaints may be three antecedents of cyberchondria.

Previous studies have demonstrated that cyberchondria can be associated with a variety of psychosocial problems. As pointed out by Mathes et al. (2018), cyberchondria can contribute to impairment of one's psychosocial functioning, and is associated with increased symptoms of depression. Furthermore, problematic internet use (PIU) as a form of maladaptive behavior may also be a result of cyberchondria, given that its constructs reflect an uncontrollability of internet use. The goal of the following investigation was thus to examine whether depression, functional impairment and PIU are outcomes of cyberchondria.

Sample 3

Data in this study were collected from 199 Chinese undergraduates. These students were recruited from a university in the city of Jinan, located in Shandong Province, Eastern China. After exclusion of questionnaires with substantial missing information or unreliable response patterns, 198 valid responses were identified. The sample was primarily female (57.1% female), with ages ranging from 17 to 22 (M=18.93, SD= .79). The research was conducted between May and June 2019. Informed verbal consent was obtained from all participants prior to the study.

Measure

The Patient Health Questionnaire-15 (PHQ-15). The symptoms inquired about in the PHQ-15 include 14 of the 15 most prevalent DSM-IV somatic symptom disorders (Liu, Clark, Eaton, 1997). In determining the PHQ-15 score, each individual symptom is coded as 0, 1, or

2, and the total score ranges from 0 to 30. The application of the Chinese version of PHQ-15 in a general population has shown good reliability and validity (Lee, Ma, Tsang, 2011).

Sheehan Disability Scale (SDS). The SDS is a 3-item self-report measure that assesses mental health-related impairment in three domains: (1) work/school; (2) social life/leisure; and (3) family life/home responsibilities. Participants were asked to respond on a 10-point Likert scale ranging from 0 (no impairment) to 10 (extreme). Previous research has shown the SDS to have strong psychometrics in Chinese samples (Leu et al., 2015).

Chinese-Internet Addiction Test (CIAT). The CIAT measures internet addiction in five domains: (1) compulsion; (2) withdrawal behaviors; (3) tolerance; (4) interpersonal relationship and health; and (5) time management. Participants use a 4-point Likert scale to indicate the extent to which they experience internet addiction. The CIAT assessment has demonstrated strong psychometrics in previous studies (Chen et al., 2003).

Intolerance of Uncertainty Scale-12 (IUS-12) The IUS-27 was originally developed with French samples to assess reactions to uncertainty, ambiguous situations, and the future (Freeston et al., 1994). The IUS-12 is a short version of the 27-item IUS, which assesses prospective and inhibitory IU (Carleton, Norton, & Asmundson, 2007). IUS-12 assesses IU on a Likert scale ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me), and demonstrated good internal consistency among Chinese participants (Yang, 2013).

Anxiety Sensitivity Index-3 (ASI-3) The ASI-3 is an 18-item version of the original ASI (Maller & Reiss, 1987) intended to assess cognitive, physical and social anxiety sensitivities. The ASI-3 consists of 18 items, with each item rated using a five-point Likert scale indicating frequency (from 0 to 4). The Chinese version of ASI-3 has shown good validity and reliability in a clinical Chinese sample (Wang et al., 2014).

Beck Depression Inventory-II (BDI-II). The 21-item BDI-II is a commonly used self-report measure of the severity of depression. Each item is rated on a four-point scale (ranging from 0 to 3), reflecting the degree of depression symptoms. The BDI-II was validated in Chinese clinical and nonclinical samples, and demonstrated adequate reliability and validity (Yang et al., 2014).

Results

The relationship between C-CSS and the three antecedents is shown in Table 4. Specifically, anxiety sensitivity, patient health, and intolerance of uncertainty all had a significant influence on

negative effects, excessiveness, reassurance and total C-CSS ($p < .001$). In general, the high level of anxiety sensitivity, bad patient health, and intolerance of uncertainty can be viewed as three antecedents of cyberchondria measured by C-CSS. However, it should be noted that patient health and intolerance of uncertainty had no significant effect on reassurance ($p > .05$).

The correlations between cyberchondria and the three outcomes are provided in Table 5. Cyberchondria measured by C-CSS had significant impact on depression ($p < .001$), functional impairment ($p < .001$), and internet addiction ($p < .01$). However, reassurance exerted a nonsignificant effect on functional impairment ($p > .05$)， depression ($p > .05$) and internet addiction ($p > .05$). In sum, the new multidimensional C-CSS was related to theoretically relevant outcomes.

Insert Table 4 about here

Insert Table 5 about here

C-CSS was tested by applying it to a Chinese sample. Specifically, we carried out an investigation of the incidence of cyberchondria in China before and after the outbreak of the COVID-19 pandemic. 414 undergraduates participated in the initial analysis (56.76% female), with ages ranging from 16 to 22 (M=18.70, SD= .85). The proportions of participants living in cities, towns and rural areas were 30.43%, 38.41% and 31.16% respectively. Following the outbreak of COVID-19, we carried out the same analysis again using online questionnaires. 404 undergraduates participated (77.9% female) with ages ranging from 17 to 27 (M=20.10, SD=1.51). The proportions of participants living in cities, towns and rural areas were 34.08%, 28.36% and 37.56% respectively.

The results from the initial analysis indicated that 35.75% of participants had mild symptoms of cyberchondria (40.78% for males and 31.91% for females). For participants located in cities, towns and rural areas, the proportions with mild cyberchondria were 38.10%, 32.08% and 37.98% respectively. A total of 4.80% of participants appeared to have severe cyberchondria (5.03% of males and 4.68% of females). For participants located in cities, towns and rural areas, the proportions with severe cyberchondria were 5.56%, 2.52% and 6.98% respectively. Following the outbreak of COVID-19, we carried out the same analysis again. This time, results showed that 59.70% of participants had mild symptoms of cyberchondria (55.06% for males and 61.02% for females).

For participants located in cities, towns and rural areas, the proportions were 64.90%, 60.53% and 53.28% respectively. Furthermore, the proportion of participants demonstrating severe cyberchondria had risen to 16.67% (19.10% for males and 15.97% for females). The proportions with severe cyberchondria for participants located in cities, towns and rural areas were 19.87%, 17.54% and 12.41% respectively.

Discussion

As the first assessment tool founded on a multidimensional structure of cyberchondria, CSS has been translated into many languages, and has shown good psychometric characteristics across different cultures (McElroy & Shevlin, 2014). In this study, we translated the CSS, and evaluated its reliability and validity in Chinese samples. Due to the differences in system and culture between Chinese and foreign countries, we merged the corresponding dimensions and removed some items, finally ending up with a version featuring 18 items and 3 dimensions, which demonstrated good psychometric properties.

In study 1, the factor structure of CSS was explored in a Chinese context. The results of EFA analysis indicated that the new three-factor measurement structure was successfully obtained from the modified 18-item C-CSS. 15 items were deleted due to not being in line with the acceptable criteria, or not being suitable for the unique cultural Chinese background. First, the 'mistrust' dimension (items 9, 28, 33) was deleted for decreasing the reliability of the scale, as well as not being relevant to a Chinese social context. Considering the imperfect basic medical care (e.g., long queues) and unbalanced economic income in China, it is often more convenient for people to diagnose themselves online instead of going to hospital; this motivation to seek information online, however, is less likely to be attributed to the mistrust of medical professionals. Notably, Barke et al. (2016) suggested that a shortened version of CSS is worth taking into consideration, due to its increased response rates, as well as its good internal consistency and validity. Accordingly, 7 items (10, 11, 18, 21, 27, 30, 32) were deleted due to the low-loading (< .50).

Afterwards, results showed that 3 items (3, 4, 5) had been allocated to a different factor for various reasons, and needed to be deleted. Item 3 ('Researching symptoms or perceived medical conditions online interrupts my time spent on Facebook/Twitter/other social networks') was reallocated from 'Compulsion' to 'Excessiveness'. A possible explanation could be that people in different cultures have different attitudes towards social networks. Research has shown that online

social networks are an important way to maintain interpersonal relationships for Chinese teenagers growing up in the subculture of the Internet (Yang, 2019). Thus, it is 'excessive' for individuals' online search for health-related information to occupy more time than that spent on social networks.

The reason why item 4 (‘Researching symptoms or perceived medical conditions online leads me to consult with my GP’) was reallocated from 'reassurance' to 'excessiveness' may be that from the perspective of China's health system, family doctors are not popular. Going to the hospital is the most common way to consult doctors, which inevitably causes some problems, such as queuing and higher economic costs. In addition, the increasingly difficult doctor-patient relationship and the lack of trust in professional doctors have deterred patients from consulting doctors in recent years (Wang & Liu, 2018). Therefore, choosing to consult doctors can be regarded as an ‘excessive’ choice for Chinese people when not feeling extremely ill.

In the exploratory factor analysis results, item 5 (‘I have trouble relaxing after researching symptoms or perceived medical conditions online’) was reallocated from 'Distress', and had a cross loading between the negative effects and excessiveness dimensions, as difficulty in relaxing can be a result of ‘excessive’ searching. Moreover, since items 19 and 20 were insufficient for forming a new dimension, we deleted them. Item 19 ('When I search a symptom online, I feel the ranking of the web search results reflects how common an illness is, with more likely medical conditions appearing higher up on the results page.') reflects an upgrade of search behavior, and was excluded from the 'excessive' dimension. Under the background of the 'collectivist' orientation in China, people are accustomed to visiting higher clicked websites, so viewing websites with higher page views as more reliable is a typical way for people to engage in self-diagnosis, rather than being an ‘excessive’ behavior. Item 20 ('I think I am fine until I read about a serious condition online') was excluded from the 'distress' dimension, as it expresses changes in patients' cognition instead of negative emotions. Finally, the distress and compulsion dimensions were combined according to the results of the EFA, which is consistent with the consideration that both 'distress' and 'compulsion' reflect the negative consequences caused by cyberchondria. Specifically, ‘distress’ reflects internalizing problems, whereas 'compulsion' reflects externalizing problems. Both were combined as one dimension named ‘negative effects’.

Confirmatory factor analysis (study 2) was used to test the psychometric properties of C-CSS. Concerning the construct validity, all items loaded on the corresponding dimensions, along with

adequate concurrent and convergent validity. In addition, the scale demonstrated good criterion-related validity, which was confirmed by the strong correlation between cyberchondria and health anxiety and compulsion. Internal consistency was high for both the total scale and the subscales. These results provide support for the applicability of the 18-item C-CSS for the present Chinese sample. In sum, the results of the CFA support the measurement model, with three correlated but distinct subscales, namely negative effects, excessiveness and reassurance.

Understanding the antecedents of cyberchondria may be helpful for future studies investigating the condition. We explored the association between cyberchondria and three possible antecedents, finding that AS, IU and PH are significant predictors of cyberchondria, as measured by C-CSS. Anxiety sensitivity (AS) refers to the fear of anxiety-related sensations which is caused by the belief that these sensations could lead to harmful consequences (McNally & Reiss, 1982). A series of studies have supported the influence of both environmental factors and a genetic basis in child AS (Stassart, Dardenne & Etienne, 2014; Intrieri & Margentina, 2017). For instance, Intrieri and Margentina (2017) demonstrated that individuals with insecure attachment show higher AS. According to the integrated model (Manassis & Bradley, 1994), insecure attachment offers an environment which could promote and maintain trait anxiety over time. Notably, these findings support a widespread comorbidity between cyberchondria and anxiety disorders, which in turn suggests that effective psychological intervention could reduce anxiety sensitivity and lower the risk of anxiety disorders such as cyberchondria. From the perspective of developmental contextualism and ecological systems theory, cyberchondria should be viewed as the result of the interaction of multiple factors. In order to comprehensively understand cyberchondria, it is valuable to further explore its antecedents.

We also examined associations between cyberchondria and outcomes. While cyberchondria has been portrayed as an anxiety-amplifying effect, our findings suggest that cyberchondria can also lead to other negative outcomes. We found that those who exhibited the highest scores on C-CSS were significantly more likely to experience depression, internet addiction and functional impairment. In line with existing evidence, negative moods which accompany cyberchondria, such as depression, might aggravate anxiety and even provoke mental disorders (White & Horvitz, 2009). This relationship between cyberchondria and functional impairment provides further support for the negative impact that cyberchondria can have on individuals' normal life, potentially leading to

overuse of medical services and posing a significant public health burden (Mathes, Norr, Allan, Albanese, & Schmidt, 2018). Due to the relatively inelastic health care consumption, especially for rural dwellers, consumption inequality remains at a high level in China (Zhao & Ma, 2019). Hence, in the context of a "healthy China" strategy, equalization of medical resources is an important issue. Addressing cyberchondria is not only conducive to individuals' mental health, but also to alleviating the burden on stretched medical resources.

Limitations and Strengths

Although this study serves as a basis for future studies on cyberchondria in China, it has several limitations. First, the accuracy of the self-report data heavily depends on participant honesty, which may affect the experimental results to some extent. In addition, the cross-sectional design of this study prevents us from exploring the longitudinal stability of C-CSS subscales, and limits our ability to elucidate the strength and direction of causal relationships with other variables. Some outcomes, such as depression and problematic internet use, might plausibly act as antecedents. Furthermore, with the development of cyberchondria, the use of non-clinical samples does not allow us to draw conclusions about the relationship between C-CSS factor structure and health anxiety in clinical samples. Most cyberchondria study samples concentrate on teenagers, without understanding or distinguishing the profile of cyberchondria for other age groups (e.g., teenagers and the elderly).

In spite of these limitations, the first psychometric evaluation of the C-CSS in a large sample of Chinese undergraduates has yielded encouraging results. Our findings support the argument that cross-cultural validation is necessary when seeking to apply CSS in different cultural settings. While C-CSS can be readily employed as an instrument for assessing cyberchondria, further research is needed to provide a better understanding of cyberchondria and its measurement in China.

The current study has identified several possible negative outcomes of cyberchondria, and has emphasized the importance of timely interventions. Future longitudinal studies would be valuable in order to confirm the causal relationship between cyberchondria and these variables.

Conclusion

Our results support the three-factor structure of cyberchondria in a Chinese context. The C-CSS demonstrated high internal consistency, along with adequate concurrent and convergent validity, and the criterion-related validity of C-CSS was supported by significant correlations between cyberchondria and health anxiety and compulsion. The current study determined the

structure of C-CSS, and clarified the relationship between cyberchondria, as assessed by C-CSS, and the antecedent and outcome variables, thus laying the foundation for the application of C-CSS. Meanwhile, this study initially demonstrated the applicability of C-CSS to assess the severity of cyberchondria among Chinese undergraduates.

Declarations

Ethics approval and consent to participate

All procedures involving human participants in this study were in accordance with the ethical standards of the Academic Board of Shandong Normal University, and the 1964 Helsinki Declaration and its later amendments. Participation was voluntary and anonymous, based on written informed consent and the right to withdraw participation at any time.

Consent for publication

Not applicable

Availability of data and materials

The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Authors' contributions

YH made substantial contribution in research design, data analysis, data interpretation and drafting the article;YS made substantial contribution in conception revision of the article; XZmade substantial contribution in data collection, data analysis and interpretation; PM made substantial contribution in language revision of the article; DW made substantial contribution in research design, data analysis, data interpretation and drafting the article.

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No

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Table 1

EFA for four subscales

Factor	Items	Oblimin-rotated loadings factor			Communality
		1	2	3	
F1	Researching symptoms or perceived medical conditions online interrupts my offline work activities.	.925			.686
	Researching symptoms or perceived medical conditions online interrupts or slows my online communication (e.g. Instant Messaging, Skype).	.860			.647
	Researching symptoms or perceived medical conditions online interrupts my online leisure activities (e.g. streaming movies).	.811			.695
	Researching symptoms or perceived medical conditions online interrupts my work (e.g. writing emails, working on word documents or spreadsheets).	.794			.680
	I have trouble getting to sleep after researching symptoms or perceived medical conditions online, as the findings play on my mind.	.770			.603
	Researching symptoms or perceived medical conditions online interrupts my offline social activities (reduces time spent with friends/family).	.768			.634
	I feel more anxious or distressed after researching symptoms or perceived medical conditions online.	.766			.699
	I lose my appetite after researching symptoms or perceived medical conditions online, as my stomach feels sick.	.741			.561
	I am more easily annoyed or irritated after researching symptoms or perceived medical conditions online.	.677			.634
	Researching symptoms or perceived medical conditions online distracts me from reading news/sports/entertainment articles	.654			.550

	online.				
	Researching symptoms or perceived medical conditions online interrupts other research (e.g. for my job/college assignment/homework).	.636			.675
	I find it hard to stop worrying about symptoms or perceived medical conditions that I have researched online.	.546			.543
	I enter the same symptoms into a web search on more than one occasion.		.947		.721
F2	If I notice an unexplained bodily sensation, I will search for it on the Internet.		.920		.629
	I read different web pages about the same perceived condition.		.503		.570
	I discuss my online medical findings with my GP/health professional.			.865	.713
F3	I suggest to my GP/medical professional that I may need a diagnostic procedure that I read about online (e.g. a biopsy/ a specific blood test).			.801	.686
	Researching symptoms or perceived medical conditions online leads me to consult with other medical specialists (e.g. consultants).			.721	.665
	Sum of squares (eigenvalue)	11.458	2.942	1.977	
	variance explained (%)	34.721	8.914	5.992	49.627

Table 2

CFA of sample 2 data

model	χ^2	df	χ^2/df	SRMR	CFI	TLI	RMSEA（CI）
Model1	214.083	124	1.726	.050	.949	.937	.058（.044, .070）
Model2	225.956	125	1.808	.058	.943	.930	.061（.048, .073）

Note. Power = 1.00 for RMSEA. CFI = comparative fit index; TLI = Tacker-Lewis index; CI = confidence interval; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 3

Descriptive statistics for the Cyberchondria Severity Scale, the Short Health Anxiety Inventory and the Padua Inventory.

	1	*2*	*3*	*4*	*5*	*6*
1.C-CSS negative effects	—					
2.C-CSS excessiveness	*.486***	—				
3.C-CSS Reassurance	*.405***	*.431***	—			
4.Total C-CSS	*.939***	*.683***	*.624***	—		
5.SHAI	*.412***	*.308***	*.228***	*.428***	—	
6.PI	*.465***	*.385***	*.304***	*.498***	*.410***	—
Mean	*20.67*	*6.99*	*5.16*	*33.52*	*12.88*	*51.85*
Standard Deviation	*8.07*	*2.70*	*3.02*	*11.30*	*7.77*	*32.19*

Note. C-CSS, Chinese Version of Cyberchondria Severity Scale; SHAI, Short Health Anxiety Inventory; PI, Padua Inventory.

*p<0.05, **p<0.01

Table 4

Antecedents of cyberchondria measured by C-CSS

	Negative effects	Excessiveness	Reassurance	C-CSS
AS	.515***	.433***	.159*	.528***
PH	.282***	.325***	.138	.325***
IU	.353***	.283***	.087	.352***

Note. * $p < .05$, **$p<0.01$, *** $p < .001$. AS = Anxiety Sensitivity; PH = Patient Health; IU = Intolerance of Uncertainty; C-CSS = Chinese Version of Cyberchondria Severity Scale.

Table 5

Outcomes of cyberchondria measured by C-CSS

	Negative effects	Excessiveness	Reassurance	C-CSS
Depression	.312***	.226**	.104	.313***
FI	.376***	.224**	.125	.364***
IA	.203**	.197**	-.036	.189**

Note. * $p < .05$, **$p<0.01$, *** $p < .001$. FI = Functional Impairment; IA = Internet Addiction; C-CSS = Chinese Version of Cyberchondria Severity Scale.

Appendix: Chinese Version of Cyberchondria Severity Scale (C-CSS)

Please read the following statements and imagine how they typically apply to you. Indicate the extent to which they typically apply to you by shading in the appropriate number.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

	1	2	3	4	5
1. If I notice an unexplained bodily sensation, I will search for it on the Internet	□	□	□	□	□
2. I enter the same symptoms into a web search on more than one occasion	□	□	□	□	□
3. Researching symptoms or perceived medical conditions online interrupts other research (e.g. for my job/college assignment/homework)	□	□	□	□	□
4. I am more easily annoyed or irritated after researching symptoms or perceived medical conditions online	□	□	□	□	□
5. Researching symptoms or perceived medical conditions online interrupts my online leisure activities (e.g. streaming movies)	□	□	□	□	□
6. Researching symptoms or perceived medical conditions online interrupts my work (e.g. writing emails, working on word documents or spreadsheets)	□	□	□	□	□
7. I read different web pages about the same perceived condition	□	□	□	□	□
8. Researching symptoms or perceived medical conditions online interrupts my offline social activities (reduces time spent with friends/family)	□	□	□	□	□

9. I discuss my online medical findings with my GP/health professional	□	□	□	□	□
10. I suggest to my GP/medical professional that I may need a diagnostic procedure that I read about online (e.g. a biopsy/ a specific blood test)	□	□	□	□	□
11. Researching symptoms or perceived medical conditions online distracts me from reading news/sports/entertainment articles online	□	□	□	□	□
12. I feel more anxious or distressed after researching symptoms or perceived medical conditions online	□	□	□	□	□
13. I lose my appetite after researching symptoms or perceived medical conditions online, as my stomach feels sick	□	□	□	□	□
14. Researching symptoms or perceived medical conditions online interrupts or slows my online communication (e.g. Instant Messaging, Skype)	□	□	□	□	□
15. Researching symptoms or perceived medical conditions online interrupts my offline work activities	□	□	□	□	□
16. Researching symptoms or perceived medical conditions online leads me to consult with other medical specialists (e.g. consultants)	□	□	□	□	□
17. I find it hard stop worrying about symptoms or perceived medical conditions that I have researched online	□	□	□	□	□
18. I have trouble getting to sleep after researching symptoms or perceived medical conditions online, as the findings play on my mind	□	□	□	□	□