Online risky behavior and sleep quality among Chinese college students: The chain mediating role of rumination and anxiety

Wen-Fu Qiu[1] · Jian-Ping Ma[2] · Zhen-Yu Xie[1] · Xiao-Tong Xie[1] · Cong-Xing Wang[1] · Yi-Duo Ye[1]

Abstract

This study explored the chain mediating effects of rumination and anxiety in the relationship between online risky behavior and sleep quality among Chinese college students. A sample of 1039 Chinese college students (Mage = 19.49, SD = 1.14, 53.32% males) were investigated with Online Risky Behavior Scale (ORBS), Pittsburgh Sleep Quality Index scale (PSQI), Ruminative Responses Scale (RRS) and Self-rating Anxiety Scale (SAS). The results showed that: (1) There is a significant positive correlation among online risky behavior, sleep quality, rumination and anxiety, and (2) Online risky behavior could not directly affect sleep quality, but it can affect sleep quality through the mediation of rumination and anxiety. The chain mediating effects includes three paths: The mediating role of rumination, the mediating role of anxiety, and the chain mediating role of rumination and anxiety after controlling for gender, grade, major, and network usage time. These findings contribute to a deeper understanding of how online risky behavior affects sleep quality and provide important practical guidance for improving sleep quality.

Keywords Online risky behavior · Sleep quality · Mediating effect · Rumination · Anxiety

Introduction

According to the 47th China Statistical Report on Internet Development (2021), as of December 2020, the number of Chinese Internet users was 989 million, while that of mobile Internet users was 986 million, and the proportion of Internet users using mobile phones to surf the Internet reached 99.7%. 38.3% of netizens reported that they had encountered network security problems while surfing the Internet in the past six months, of which 21.9% had experienced personal information disclosure, 16.5% had experienced network fraud, 10.8% had encountered viruses or Trojans in devices, and 8.2% had experienced account or password theft. It can be seen that Chinese netizens still face greater risks and hidden dangers in their online life. Contemporary college students are the "indigenous people" of the Internet,

Using Internet has become an indispensable part of college students' daily life.

Online Risky Behavior (ORB) refers to the behaviors and activities with potential adverse consequences that occur in Internet life (Choi & Lee, 2017; Qiu, 2018). It manifests itself in exposing a lot of private life on social networking sites, downloading free movies or games on websites of unknown sources, clicking on a link to an unknown website, opening any email attachment, and so on. In recent years, the network security problems such as computer virus infection, personal data theft or leakage are deteriorating, and the reckless Internet behavior of network users often aggravates the network security problems (Chou & Sun, 2017).

Relationship Between Online Risky Behavior and Sleep Quality of College Students

As we all know, it is an indispensable basis for maintaining health to have a good sleep, which is one of the necessary conditions for normal physiological and psychological functioning of individuals, while chronic poor sleep quality can lead to serious physical and mental health problems (Altchuler, 2009; Urponen et al., 1991). However, people's sleep quality is inevitably affected by cybersecurity issues.

✉ Yi-Duo Ye
yeyiduo@163.com

1 Fujian Normal University, Fuzhou, China

2 Department of Psychology, Shandong Normal University, Jinan, China

Poor sleep quality is one of the most important health problems of college students. Sleep problems occur frequently in college students. For instance, staying up late, insomnia, too many times of awakening at night, too long awakening time at night, and so on. Insufficient sleep duration among college students has become a major international health concern. Research has showed that 27% of college students in the southeastern United States are at least at risk of one sleep disorder, and the common sleep problems of college students are sleep deprivation and daytime sleepiness caused by sleep deprivation (Gaultney, 2010). Back in 2001, a study showed that Only 11% of college students have good sleep quality, more than 73% of college students occasionally have sleep problems, and more than 15% of college students reported poor sleep quality (Buboltz et al., 2001). According to the Chinese National Mental Health Development Report (2019–2020), 43.8% of college students identified they didn't get enough sleep in recent days, 7.9% identified they didn't get enough sleep more than half the time, and 4.4% identified they didn't get enough sleep almost every day (Fu & Zhang, 2021). Another study about college students' sleep quality in Wuhan, China, showed that 17.84% of college students had sleep disorders (Wang, 2012). The above findings show the prevalence of sleep problems among Chinese college students.

There are a few studies that have examined the relationship between online risky behavior and sleep quality. Generally speaking, both problematic and addictive social networking behaviors are considered to be a type of online risky behavior (Qiu, 2018), and they are closely related to sleep problems such as reduced sleep time, sleep quality and insomnia (Lam, 2014). Of which Problematic social network users reported more sleep problems than Non-problematic users (King et al., 2014). From the perspective of the use of social networks, college students with more serious social network addiction and longer social network use and graduate students with more obvious passive social network use have worse sleep quality (Andreassen et al., 2012; Hussain & Griffiths, 2019; Yang et al., 2018). Woods and Scott's (2016) study indicated that the individuals who used social media at night had worse sleep quality. A study on the relationship between the use of Facebook, a well-known social software in the United States, and sleep quality of college students found that, after controlling age and sex, the incidence of poor sleep quality of college students with Facebook used dependence was still 1.3 times higher than that of non-dependent college students (Wolniczak et al., 2013). Alsulami et al. (2019) found that College students with poor sleep quality use electronic devices (including social networks) for longer on average than those with better sleep quality, and Those people reported that they spend an average of 64.38 min online on social networks before falling asleep. From the perspective of online games, playing online games is associated with longer sleep latency and shorter REM sleep (Higuchi et al., 2010). That is, the longer you play online games, the less likely you are to fall asleep. Akçay and Akçay (2020) found that as levels of game addiction increased, individuals experienced decreased sleep quality, increased severity of daytime sleepiness, and delayed waking times. The above reflects the impact of Problematic internet use (PIU)on sleep quality. Both severe online gaming disorder and social media addiction can lead to worse sleep quality (Wong et al., 2020).

To our knowledge, although most empirical studies on this topic have considered the effects of PIU on sleep disturbance, the direct relationship between online risky behavior and college students' sleep quality has been infrequently tested. Based on this, this study will first investigate the relationship between online risky behaviors and sleep quality among college students.

The Mediating Role of Rumination

Rumination (this article refers to repetitive negative thinking), which is one of the crucial factors of sleep disturbance (Pillai & Drake, 2015), refers to a psychological phenomenon in which individuals think repeatedly or frequently about the causes and potential consequences of negative life events after they encounter negative life events (Nolen-Hoeksema, 1991). It is a kind of negative reaction style and personality characteristics (Nolen-Hoeksema, 1991). According to the sleep-interfering processes theory, sleep problems are caused by cognitive arousal. When the brain is very active during sleep to think, worry, plan, analyze and solve problems, people will have difficulty controlling their thoughts and they will have sleep problems (Lundh, & Broman, 2000). Rumination is a significant interfering factor in sleep quality. A large number of previous studies have confirmed the positive relationship between rumination and sleep quality (Bertelson & Monroe, 1979; Kales et al., 1983). The cognitive model of maintaining insomnia, proposed by Harvey (2002), suggests that intrusive thoughts that occur at bedtime can prevent individuals from falling asleep normally. Ruminative thinking, a typical intrusive thought, triggers physiological hyperarousal and emotional distress, which can lead to sleep problems and true sleep deprivation (Harvey, 2002). Some other studies found that, after control of depression, anxiety and anger, there is still a significant positive correlation between ruminant thinking and sleep quality (Jeffrey et al., 2009; Shen, 2019; Thomsen et al., 2003). That is to say, the more obvious ruminant thinking, the worse the sleep quality of college students.

In recent years, there has been an increasing number of studies exploring the relationship between PIU and rumination. Jin et al. (2018) found that there is a significant positive correlation between college students' cyber aggressive

behavior and ruminant thinking. Teenagers in the environment of cyber violence will repeatedly think about the scene of being bullied, and then appear ruminant thinking (Feinstein et al., 2014). Both problematic smartphone use and problematic Facebook use were significantly and positively correlated with ruminative thinking (Dempsey et al., 2019; Elhai et al., 2018, 2020; Wang et al., 2020). That is, the higher the frequency of smartphone and Facebook software use, the more likely individuals are to ruminant thinking. Feinstein et al. (2013) found that negative social comparisons on Facebook can predict the enhancement of ruminating emotion.

It is clear from the above that online risky behaviors such as cyber-attack and internet addiction have a positive effect on rumination, and rumination is a critical factor affecting sleep quality. Therefore, it is speculated that rumination may be a mediator in the relationship between online risky behavior and sleep quality. On the basis of this, this study will explore the mediating role of rumination in the relationship between online risky behavior and sleep quality among college students.

The Mediating Role of Anxiety

In addition to rumination,anxiety is also an important factor affecting sleep quality. Therefore, in this study, the effect of anxiety will also be considered, because anxiety is not only the other significant factor for college students' sleep disorders, but also highly related with online behavior. Anxiety refers to the emotional state elicited by signals of impending punishment. Qiu et al. (2017) found that there is a significant positive correlation between college students' social media use intensity and anxiety. Kim and Davis (2009) found that the higher the degree of problematic Internet use, the more serious the anxiety. As the line between online and offline communication tends to blur, social media situations can also induce social anxiety (Theresa & Lee, 2014). college students' problematic Internet use can significantly predict social anxiety (Wang et al., 2017). Medical students with severe Internet addiction will show higher social anxiety (Bengü and Ahmet, 2018). Ariel et al. (2020) found that 24% of people miss important moments in their lives due to browsing and sharing on social media, causing individuals to experience more anxiety (Duvenage et al., 2020; Frison et al., 2016). A meta-analysis showed that individuals with higher levels of social media use tend to be accompanied by higher levels of miss anxiety (Zhang et al., 2021). Another study have found that being bullied on the Internet can also lead to a significant increase in anxiety levels (Kowalski et al., 2014).

Furthermore, anxiety is a key determinant of poor sleep quality among college students (Stewart et al., 2011. Based on the cognitive model of Sleep Disturbance, Worry, as an important cognitive component of anxiety, is a potential underlying cause of sleep-related difficulties (Harvey, 2002). Adults' worries about the next working day are related to a decline in sleep quality (Kecklund & Akerstedt, 2004). Brown et al. (2002) found that there is a significant positive correlation between anxiety level and sleep quality. Ulrich et al. (2021) found that college and university students with moderate-to-severe anxiety were more likely to report poor sleep quality than those with less anxiety during the COVID-19 pandemic. That is, the higher the anxiety level, the more likely to have problems with sleep quality. Some other studies have indicated that excessive uncontrollable anxiety before falling asleep is a common complaint of insomniacs (Allison & Emmeline, 2003), even after controlling depression, both state anxiety and trait anxiety are associated with increased arousal after sleep onset (Spira et al., 2008). In addition, social anxiety is related to insomnia (Buckner et al., 2010), individuals who are emotionally involved in social networking sites will increase their anxiety, thus affecting their sleep quality (Doane et al., 2015).

In summary, online risky behavior has a positive effect on anxiety, and anxiety is an important factor affecting sleep quality. Therefore, the relationship between online risky behavior and sleep quality among college students may be mediated by anxiety. Accordingly, this study will explore the mediating role of anxiety in the relationship between online risky behavior and sleep quality among college students.

The Chain Mediating Effect of Rumination and Anxiety

A large number of historical studies have showed that rumination can significantly increase anxiety (Harrington & Blankenship, 2002; Fresco et al., 2002; Hsu et al., 2015; Xuan, 2017). Nolen-Hoeksema (2000) found that rumination can predict anxiety symptoms. The higher the tendency of ruminating thinking, the more obvious anxiety is (Roelofs et al., 2009). In the study of Facebook use, Shaw et al. (2015) et al. found that ruminative thinking was a potential mechanism for triggering anxiety, and that passive use of Facebook triggered more ruminative thinking, which in turn exacerbated anxiety Similarly, college students with higher tendency of ruminating thinking are more likely to have negative emotions such as anxiety (Gan et al., 2017). Some studies have confirmed that rumination is not only a susceptibility factor for anxiety and depression (Michl et al., 2013; Raes, 2010), but also an important factor in triggering and reinforcing psychological pain and suicidal ideation (Morrison and O'Connor, 2005; Miranda et al., 2013). In summary, we can conclude that people with higher rumination are more prone to have anxiety, which may trigger insomnia.

Although some studies have revealed the effects of rumination and anxiety on sleep quality, few studies have

explored the mediating effect of rumination and anxiety in impacting sleep quality. The above evidence provided an empirical basis for investigating the chain mediating effect of rumination and anxiety. Therefore, this study will not only explore the direct correlation between online risky behavior and college students' sleep quality, but also explore the mechanism of the effect of online risky behavior on college students' sleep quality. Based on previous research in this area, this study puts forward the hypothesis that (1) there is a significant correlation between online risky behavior and sleep quality and (2) rumination plays a mediating role between online risky behavior and sleep quality and (3) anxiety plays a mediating role between online risky behavior and sleep quality and (4) rumination and anxiety play a chain mediating role between online risky behavior and sleep quality. The hypothetical model of the study is shown in Fig. 1. This study aims to answer the question of how online risky behaviors affects the quality of sleep among college students. It is significant to deeply explore the joint role of rumination and anxiety between online risky behaviors and sleep quality among college students. It is beneficial to deepen the research in the field of cyber behavior and sleep. It can also be a valuable contribution for later researchers.

Methods

Participants

The participants in this research, all of whom had Internet usage experience, were recruited by a cluster sampling from three universities in Fuzhou, the capital city of Fujian province in China. Participants completed their questionnaires in class; and the surveys were administered by their professional teachers. The researcher and procedures obtained ethical approval from the Ethics Committee of Fujian Normal University. A total of 1100 questionnaires were sent out, and 1039 valid questionnaires were obtained after recovery, with an effective recovery rate of 94.45%. In total, there were 554 males and 485 females. There were 488 participants from

Freshman, 228 from Sophomore, and 323 from Junior. There were 480 participants from liberal arts, 293 from science, 257 from engineering, and 9 from arts and agriculture. All participants were informed of the purpose of the study after which they provided their informed consent. The researcher obtained ethical approval from the Ethics Committee of Fujian Normal University.
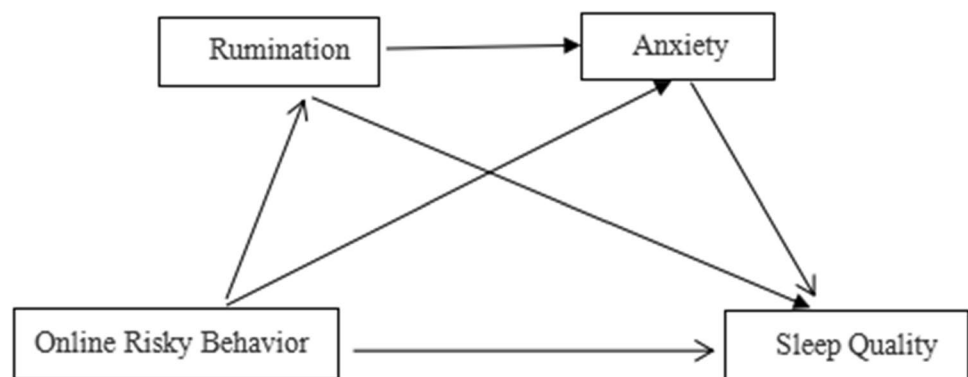
Measures

Online Risky Behavior Scale (ORBS)

The online risky behavior was measured by the Online Risky Behavior Scale of college students compiled by Qiu (2018), which is used to describe the activities and use behavior of college students in online life. The scale, which consists of 24 items, includes five sub-scales: entertainment risk, social risk, transaction risk, contact risk and management risk. Items are rated on a 5-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree). The higher the score, the higher the online risky behavior index of college students. In this study, the total Cronbach's alphas of the scale was 0.90, the Cronbach's alphas of the subscales were as follows: entertainment risk (0.93); social risk (0.87); transaction risk (0.80); contact risk (0.85); management risk (0.67).

Ruminative Responses Scale (RRS)

Rumination was measured by the Ruminative Responses Scale (RRS; Nolen-Hoeksema et al., 2008). This tool,which includes 22 items, consists of three sub-scales: Symptom Rumination, Brooding and Reflective Pondering. Items are rated on a 4-point Likert scale ranging from 1(almost never) to 4 (almost always). The higher the total score, the higher the individual's rumination level. In the current study, the Chinese version of the RRS was used (Han & Yang, 2009), the total Cronbach's alphas of the scale was 0.953, and the Cronbach's alphas of the subscales were as follows: Symptom Rumination (0.89); Brooding (0.91); Reflective Pondering (0.82).

Fig. 1 The hypothetical chain mediating effect model of rumination and anxiety between online risky behavior and sleep quality among college students

Self-rating Anxiety Scale (SAS)

Anxiety was measured by the Self-rating Anxiety Scale (SAS), compiled by Chinese professor Zung (1971). The *SAS* consists of 20 items which are rated on a 4-point Likert scale ranging from 1 (No or little time) to 4 (Most or all of the time). The higher the score, the higher the frequency of anxiety symptoms. In this study, the Cronbach α coefficient of the scale was 0.778.

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was measured by the widely-used Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989; Liu and Tang, 1996). The PSQI is used to measure an individual's sleep disturbances for the previous month. It includes seven subscales: Subjective Sleep Quality, Sleep Latency, Sleep Duration, Habitual Sleep Efficiency, Sleep Disturbance, Used Sleep Medicine, and Daytime Dysfunction. This tool has 18 items in total, which rated on a 4-point Likert scale between 0 and 3, with higher scores indicating poorer levels of sleep quality. The total score is the sum of the subjects' scores for each item, and the higher the total score, the worse the sleep quality of the subjects. This study used the Chinese version of the PSQI was revised by Liu and Tang (1996). In this study, the Cronbach's alpha coefficient for the PSQI was 0.808.

Statistical Analysis

The statistical analysis was conducted using SPSS24.0, and the chain mediation tests with Bootstrap analysis were performed using Hayes' (2013) PROCESS macro program.

Common Method Biases Test

The data in this study were all obtained from the subjects' self-reports, and the results may have a significant biases. In order to ensure the scientific accuracy of the findings, harman's single factor test was performed to test for possible common methodological biases before data analysis (Zhou & long, 2004). All items of the questionnaire were integrated for exploratory factor analysis. The results showed that there were 14 factors with characteristic roots greater than 1, and the first common factor interpretation rate was 21.54%, which was much less than 40%. Therefore, there is no significant common methodological biases in this study (Xiong et al., 2012).

Results

Descriptive Statistics and Related Analysis

There is a list of the average, standard deviation and Pearson correlation matrix of each variable in Table 1. The analysis shows that there is a significant positive correlation between online risky behavior and rumination, anxiety, and sleep quality; rumination, anxiety, and sleep quality are all positively associated; Anxiety is positively associated with Sleep quality. The relationship between variables supports the subsequent testing of the hypotheses.

Notes. $***p < 0.001$, $**p < 0.01$, $*p < 0.05$, Same below.

Mediating Effect Test

The results of the above correlation analysis fit the statistical requirements for further tests of mediating effects on rumination and anxiety (Wen & Ye, 2014). Firstly, all the variables were standardized in this study. Then, online risky behavior was used as the independent variable; sleep quality as the dependent variable; rumination and anxiety as mediating variables; gender, grade, major, and time spent using the Internet as covariates. The test for mediating effects was conducted using the SPSS macro program developed by Hayes (2013) (http://www.afhayes.com), which allows for integration tests of the chained mediator model (Liao et al., 2014).

Multiple hierarchical regression analysis was performed according to model 6 of the Process program dedicated to chain mediated model testing. After gender, grade, major, and network usage time were controlled, the results of the regression analysis showed (see Table 2):online risky behaviors did not significantly predict sleep quality ($\beta = -0.01$, $p > 0.05$); online risky behaviors could significantly positively predict both rumination ($\beta = 0.22$, $p < 0.001$) and anxiety ($\beta = 0.15$, $p < 0.001$); rumination could significantly positively predict both anxiety ($\beta = 0.44$, $p < 0.001$) and sleep quality ($\beta = 0.31$, $p < 0.001$); anxiety could significantly positively predict sleep quality ($\beta = 0.42$, $p < 0.001$).

Table 1 Descriptive statistics of various variables and associations between the variables ($n = 1039$)

Variables	$M \pm SD$	1	2	3	4
1 Online risky behavior	53.62 ± 12.98	1			
2 Rumination	42.25 ± 11.30	0.21[***]	1		
3 Anxiety	41.95 ± 8.37	0.27[***]	0.477[***]	1	
4 Sleep quality	7.69 ± 6.21	0.18[***]	0.517[***]	0.587[***]	1

Table 2 Regression analysis of the relationship between variables

Regression equation		Overall fit index			Significance of regression coefficients	
Result Variables	Predictive variables	R	R^2	F	β	t
Sleep quality	Gender	0.27	0.07	15.70***	0.03	1.01
	Grade				0.21	6.17***
	Major				0.02	0.50
	Network usage time				-0.02	-0.65
	Online risky behavior				0.16	5.26***
Rumination	Gender	0.26	0.07	14.88***	0.11	3.27**
	Grade				0.04	1.20
	Major				-0.07	-1.91
	Network usage time				-0.01	0.47
	Online risky behavior				0.22	7.26***
Anxiety	Gender	0.53	0.29	68.72***	-0.07	-2.32*
	Grade				0.16	5.45***
	Major				0.13	4.15***
	Network usage time				-0.06	-2.19*
	Online risky behavior				0.15	5.62***
	Rumination				0.44	16.18***
Sleep quality	Gender	0.65	0.42	108.70***	0.01	0.31
	Grade				0.12	4.48***
	Major				-0.00	-0.09
	Network usage time				0.01	0.49
	Online risky behavior				-0.01	-0.56
	rumination				0.31	11.39***
	Anxiety				0.42	14.94**

In the test for mediating effects, the Bootstrap method was used to calculate 95% confidence intervals for each of the 5000 repeated draws. The results of the mediation effect size analysis (see Table 3, Fig. 2) showed that rumination and anxiety mediated significantly between online risky behavior and sleep quality, with a total standardized mediation effect value of 0.17, and three significant mediating chains were identified in this study: firstly, mediating effect 1 generated by the path of "Online risky behavior → rumination → sleep quality", whose confidence interval does not contain a 0 value, indicating that rumination plays a significant mediating role between Online risky behavior and sleep quality, with a mediating effect value of 0.07; Secondly,

mediating effect 2 generated by the path of "Online risky behavior → anxiety → sleep quality", whose confidence interval does not contain a 0 value, indicating that anxiety plays a significant mediating role between Online risky behavior and sleep quality, with a mediating effect value of 0.06; Thirdly, the mediating effect 3 generated by the path of "Online risky behavior → rumination → anxiety → sleep quality", with a confidence interval that does not contain a 0 value, indicating that rumination and anxiety play a significant chain mediating role between online risky behavior and sleep quality, which means sleep quality can be influenced by online risky behavior through rumination first and then via anxiety, with the mediating effect value at 0.04. Since

Table 3 Mediating Effect Analysis of the Chain mediating Model

Path	Mediating Effect Value	Standard error	Lower limit of 95% CI	upper limit of 95%CI
Path1 Online risky behavior → rumination → sleep quality	0.07	0.01	0.04	0.10
Path2 Online risky behavior → anxiety → sleep quality	0.06	0.02	0.03	0.09
Path3 Online risky behavior → rumination → anxiety → sleep quality	0.04	0.01	0.02	0.06

none of the direct effects of the above mediating chains were significant, they were all fully mediated. That is, online risky behavior affects sleep quality exclusively through rumination and anxiety (Fig. 2).

Discussion

### The Relationship Between Online Risky Behavior and Sleep Quality

Previous studies mostly focused on the impact of social network use and online game addiction on college Students' sleep quality, and found that individuals with higher intensity of social network use and more serious online game addiction showed more sleep disorders. Previous studies have showed that there are at least three reasons to explain the impact of Internet use on sleep. Firstly, the use of Internet media deprives sleep and takes up sleep time; Secondly, the use of Internet media increases the individual's awakening state, leading to difficulty in falling asleep; Thirdly, the strong light exposure of Internet media will delay the circadian rhythm and cause irregular sleep habits (Cain and Gradisar, 2010; Chen & Gau, 2016). This study explored the relationship between online risky behavior and sleep quality of college students. The results showed that there was a significant positive correlation between online risky behavior and sleep quality, which verified hypothesis 1. But in this study the relationship between online risky behaviour and sleep quality is very low. By the subsequent multiple hierarchical regression analysis, it was found that online risky behaviors could not directly predict sleep quality among college students. The reasons can be explained by the theory of planned behavior. According to the theory of planned behavior, all of people's behaviors are planned, which means that individuals consider the potential consequences of their activities before deciding to act. People's decision making process includes an assessment of relevant factors such as their attitudes, subjective norms, and perceptual behavioral control, and the assessment of these factors together determine their intention to engage in behavior, which is a prerequisite for behavior to occur (Fishbein & Ajzen, 1975). That is to say, engaging in online risky activities can be made through individual rational choice, therefore does not have a significant impact on sleep.

The Chain Mediating Effect of Rumination and Anxiety

This study found that rumination plays a mediating role between online risky behavior and sleep quality, which verifies hypothesis 2. This is consistent with previous studies on the influence of problematic Internet use on rumination (elhai et al., 2018; Elhai et al., 2020; Dempsey et al., 2019; Wong et al., 2020), rumination affects sleep quality (Shen, 2019; Thomsen et al., 2003). In this study, three variables were taken into consideration at the same time, which revealed that online risky behavior is an important factor to increase rumination, and rumination is an important factor to affect sleep quality. This may be because college students with high frequency of online risky behaviors will feel more negative intrusive thinking, which makes them more likely to treat themselves with a self reproach and regret attitude when they touch various network risks, thus affecting the quality of sleep. This study also found that anxiety plays a mediating role between online risky behavior and sleep quality, which verifies hypothesis 3. This is consistent with the research results of problematic Internet use causing anxiety (Kim & Davis, 2009), and anxiety affecting sleep quality (Stewart et al., 2011). This study also explored the relationship between these three variables, and confirmed that online risky behavior is an important factor causing anxiety, and anxiety is an important factor affecting college students' sleep quality. The possible reason is that college students' online risky behavior may increase their worry and tension about the future safe life, such as fear of personal privacy

Fig. 2 Model diagram of the effect of online risky behavior on sleep quality
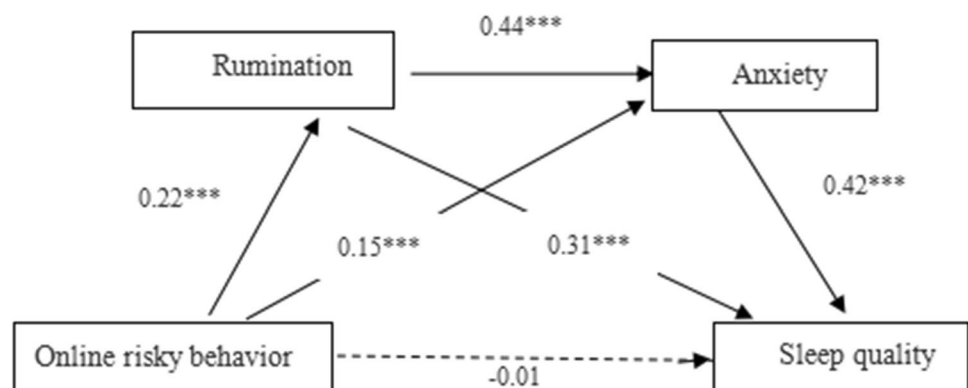
leakage, fear of being bullied by the network, and then affect the sleep quality of college students. According to cyber-routine activities theory (Cyber-RAT),Some risky online behaviors or daily online habits of an individual can increase his/her likelihood of being victimized (Choi & Lee, 2017). Therefore, when individuals realize that they will be exposed to risks such as private information leakage, cyber-attacks, or cyber-fraud, they may have negative perceptions and anxiety, which may lead to insomnia.

In addition, the findings further revealed that rumination and anxiety mediated the chain between online risky behavior and sleep quality, and Hypothesis 4 holds. This is consistent with previous findings that ruminant thinking significantly increases anxiety and that individuals with a high propensity for ruminant thinking also have more pronounced anxiety (Harrington & Blankenship, 2002; Fresco et al., 2002; Hsu et al., 2015; Roelofs et al., 2009; Xuan, 2017). The response style theory suggests that rumination reinforces negative thinking tendencies, reduces problem solving abilities, and decreases social support resources, thus further prolonging and exacerbating negative emotional experiences and reinforcing the negative effects of negative factors (Nolen-Hoeksema, 1991; Nolen-Hoeksema et al., 2008). This study showed that the more college students with online risky behaviors, the more they will repeatedly dwell on their online risk-taking behaviors, making anxiety more pronounced and thus affecting sleep quality. From the hot system/cold system model of information processing (Li et al., 2015; Metcalfe & Mischel, 1999), rumination is a self-immersive perspective of self-concentration, which makes individuals focus on details and feelings and activates the hot system more, increasing individual anxiety and thus exacerbating the impact on sleep quality.

In this study, it was found that online risky behaviors affect college students' sleep quality exclusively through the chain mediating effects of rumination and anxiety. Online risky behavior is not a direct predictor of sleep quality among college students. This suggests that among the behavioral, cognitive and emotional factors that influence sleep quality, cognition and emotion may be the more important influences. That is, cognition and emotion are both the important and most direct generators of sleep quality. In summary, when examining the effects of online risky behaviors on sleep quality, both cognitive and emotional factors should be integrated, and not only the separate roles of cognition and emotion should be emphasized, but also the dual system architecture of both cognitive and emotional processing characteristics. According to this study we know that, as a negative lifestyle, online risky behaviors have different degrees of influence on college students' ruminative thinking, anxiety, and sleep quality. This suggests to us that, for college students, effective control of their online risky behaviors, cultivation of positive and optimistic thinking

patterns, and learning to adjust to anxiety may all contribute to improving sleep quality.

This study investigated the factors influencing the sleep quality of college students from the perspective of cybersecurity, and analyzed in depth the pathways and conditions of the influence, based on which we can provide empirical support and practical inspiration for protecting and promoting the sleep quality of college students. This result expands the previous research on online behavior and individual psychosocial adaptation, and to a certain extent enriches the research horizon in the field of online risky behavior and sleep.However, there are some insufficiencies in this study. Future research can be improved and expanded from the following three aspects. First of all, this study was a cross-sectional design, and the causal relationship between the variables could not be determined. Therefore, experimental methods can be used in future studies to increase the persuasion of the conclusions. Secondly, this study selected college students as the object of study, and future research can be extended to other age groups to explore the impact of online risky behaviors on sleep quality in different age groups. Finally, this study mainly focused on the effect of online risky behaviors on sleep quality among Chinese college students. Future research can explore the impact of online risky behaviors on sleep quality among college students from different cultures and countries.

Conclusion

(1) Online risky behaviors are significantly and positively associated with sleep quality in college students, but could not directly predict sleep quality.

(2) Rumination and anxiety mediated the association between online risky behaviors and sleep quality, and the mediating effect consisted of three pathways: a separate mediating effect of rumination, a separate mediating effect of anxiety, and a chain mediating effect of rumination-anxiety.

Declarations

Ethical Approval This project was approved by the Ethics Committee of Fujian Normal University.

Informed Consent All participants were informed of the purpose of the study after which they provided their informed consent.

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

References

Akçay, D., & Akçay, B. D. (2020). The effect of computer game playing habits of university students on their sleep states. *Perspectives in Psychiatric Care, 56*(4), 820–826. https://doi.org/10.1111/PPC.12497

Allison, G. H., & Emmeline, G. (2003). Catastrophic worry in primary insomnia. *Journal of Behavior Therapy and Experimental Psychiatry, 34*(1), 11–23. https://doi.org/10.1016/S0005-7916(03)00003-X

Alsulami, A., Bakhsh, D., Baik, M., Merdad, M., & Aboalfaraj, N. (2019). Assessment of sleep quality and its relationship to social media use among medical students. *Medical Science Educator, 29*(1), 157–161. https://doi.org/10.1007/s40670-018-00650-9

Altchuler, S. I. (2009). Sleep and quality of life in clinical medicine. *Mayo Clinic Proceedings, 84*(8), 758–760. https://doi.org/10.1016/S0025-6196(11)60532-6

Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports, 110*(2), 501–517. https://doi.org/10.2466/02.09.18.PR0.110.2.501-517

Ariel, S., Jaime, E. S., César, G. E., Galen, E. S., Brian, A. P., & Sophia, C. (2020). Emotional support from social media and face-to-face relationships: Associations with depression risk among young adults. *Journal of Affective Disorders, 260*, 38–44. https://doi.org/10.1016/j.jad.2019.08.092

Bertelson, A. D., & Monroe, L. J. (1979). Personality patterns of adolescent poor and good sleepers. *Journal of Abnormal Child Psychology, 7*(2), 191–197. https://doi.org/10.1007/BF00918899

Bengü, Y., & Ahmet, Ü. (2018). The relationship between internet addiction, social anxiety, impulsivity, self-esteem, and depression in a sample of Turkish undergraduate medical students. *Psychiatry Research, 267*, 313–318. https://doi.org/10.1016/j.psychres.2018.06.033

Brown, F. C., Buboltz, W. C., & Soper, B. (2002). Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in University Students. *Behavioral Medicine, 28*(1), 33–38. https://doi.org/10.1080/08964280209596396

Buboltz, W. C., Brown, F., & Soper, B. (2001). Sleep habits and patterns of college students: A preliminary study. *Journal of American College Health, 50*(3), 131–135. https://doi.org/10.1080/07448480109596017

Buckner, J. D., Bernert, R. A., Cromer, K. R., Joiner, T. E., & Schmidt, N. B. (2010). Social anxiety and insomnia: The mediating role of depressive symptoms. *Depression & Anxiety, 25*(2), 124–130. https://doi.org/10.1002/da.20282

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193–213.

Cain, N., & Gradisar, M. (2010). Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Medicine, 11*(8), 735–742. https://doi.org/10.1016/j.sleep.2010.02.006

Chen, Y. L., & Gau, S. S. F. (2016). Sleep problems and internet addiction among children and adolescents: A longitudinal study. *Journal of Sleep Research, 25*(4), 458–465. https://doi.org/10.1111/jsr.12388

China Internet Network Information Center. (2021). *The 47th China Statistical Report on Internet Development.* Retrieved May 20, 2021, from http://www.cac.gov.cn/2021-02/03/c_1613923423079314.htm,2021-02-03

Choi, K., & Lee, J. R. (2017). Theoretical analysis of cyber-interpersonal violence victimization and offending using cyber-routine activities theory. *Computers in Human Behavior, 73*, 394–402. https://doi.org/10.1016/j.chb.2017.03.061

Chou, H., & Sun, J. C. (2017). The moderating roles of gender and social norms on the relationship between protection motivation and risky online behavior among in-service teachers. *Computers & Education, 112*, 83–96. https://doi.org/10.1016/j.compedu.2017.05.003

Dempsey, A., O'Brien, K., Tiamiyu, M., & Elhai, J. D. (2019). Fear of missing out (fomo) and rumination mediate relations between social anxiety and problematic facebook use. *Addictive Behaviors Reports, 9*, 100150. https://doi.org/10.1016/j.abrep.2018.100150

Doane, L. D., Gress-Smith, J. L., & Breitenstein, R. S. (2015). Multi-method assessments of sleep over the transition to college and the associations with depression and anxiety symptoms. *Journal of Youth and Adolescence, 44*(2), 389–404. https://doi.org/10.1007/s10964-014-0150-7

Duvenage, M., Correia, H., Uink, B. N., Barber, B. L., & Modecki, K. L. (2020). Technology can sting when reality bites: Adolescents' frequent online coping is ineffective with momentary stress. *Computers in Human Behavior, 102*, 248–259. https://doi.org/10.1016/j.chb.2019.08.024

Elhai, J. D., Tiamiyu, M., Weeks, J., & Cheung, C. (2018). Depression and social anxiety in relation to problematic smartphone use: the prominent role of rumination. *Internet Research: Electronic Networking Applications and Policy, 28*(2), 315–332. https://doi.org/10.1108/IntR-01-2017-0019

Elhai, J. D., Yang, H., Dempsey, A. E., & Montag, C. (2020). Rumination and negative smartphone use expectancies are associated with greater levels of problematic smartphone use: A latent class analysis. *Psychiatry Research, 285*, 112845. https://doi.org/10.1016/j.psychres.2020.112845

Feinstein, B. A., Hershenberg, R., Bhatia, V., Latack, J. A., Meuwly, N., & Davila, J. (2013). Negative social comparison on facebook and depressive symptoms. *Psychology of Popular Media Culture, 2*(3), 161–170. https://doi.org/10.1037/a0033111

Feinstein, B. A., Bhatia, V., & Davila, J. (2014). Rumination mediates the association between cyber-victimization and depressive symptoms. *Journal of Interpersonal Violence, 29*(9), 1732–1746. https://doi.org/10.1177/0886260513511534

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behaviour: An introduction to theory and research. *Philosophy & Rhetoric, 41*(4), 842–844.

Fresco, D. M., Frankel, A. N., Mennin, D. S., Turk, C. L., & Heimberg, R. G. (2002). Distinct and overlapping features of rumination and worry: The relationship of cognitive production to negative affective states. *Cognitive Therapy & Research, 26*(2), 179–188. https://doi.org/10.1023/A:1014517718949

Frison, Eline, Eggermont, Steven, & Beyens, & Ine. (2016). "I don't want to miss a thing": Adolescents' fear of missing out and its relationship to adolescents' social needs, Facebook use, and Facebook related stress. *Computers in Human Behavior, 64*, 1–8. https://doi.org/10.1016/j.chb.2016.05.083

Fu, XL., & Zhang, K. (Eds). (2021). *Chinese National Mental Health Development Report (2019–2020)*. Social Sciences Scademic Press

Gan, X. R., Hu, W., & Tang, H. (2017). Influence of College Students' Rumination on Anxiety and Depression. *Journal of Gannan Medical University, 37*(5), 688–691.

Gaultney, J. F. (2010). The prevalence of sleep disorders in college students: Impact on academic performance. *Journal of American College Health, 59*(2), 91–97. https://doi.org/10.1080/07448481.2010.483708

Han, X., & Yang, H. F. (2009). Chinese version of Nolen-Hoeksema ruminative responses scale (RRS) used in 912 college students: Reliability and validity. *Chinese Journal of Clinical Psychology, 17*(5), 550–551.

Harrington, J. A., & Blankenship, V. (2002). Ruminative Thoughts and Their Relation to Depression and Anxiety. *Journal of Applied Social Psychology, 32*(3), 465–485. https://doi.org/10.1111/j.1559-1816.2002.tb00225.x

Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research & Therapy, 40*(8), 869–893.

Hayes, A. F. (2013). *An introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. The Guilford Press.

Higuchi, S., Motohashi, Y., Liu, Y., & Maeda, A. (2010). Effects of playing a computer game using a bright display on presleep physiological variables, sleep latency, slow wave sleep and REM sleep. *Journal of Sleep Research, 14*(3), 267–273. https://doi.org/10.1111/j.1365-2869.2005.00463.x

Hsu, K. J., Beard, C., Rifkin, L., Dillon, D. G., & Björgvinsson, T. (2015). Transdiagnostic mechanisms in depression and anxiety: The role of rumination and attentional control. *Journal of Affective Disorders, 188*, 22–27. https://doi.org/10.1016/j.jad.2015.08.008

Hussain, Z., & Griffiths, M. D. (2019). The Associations between Problematic Social Networking Site Use and Sleep Quality, Attention-Deficit Hyperactivity Disorder, Depression, Anxiety and Stress. *International Journal of Mental Health and Addiction, 19*(3), 686–700. https://doi.org/10.1007/s11469-019-00175-1

Jeffrey, R., Lea, R., Cor, M., Valérie, D., Susan, B., Lauren, B. A., & Susan, N. H. (2009). The influence of rumination and distraction on depressed and anxious mood: A prospective examination of the response styles theory in children and adolescents. *European Child & Adolescent Psychiatry., 18*(10), 635–642. https://doi.org/10.1007/s00787-009-0026-7

Jin, T. L., Lu, G. Z., Zhang, L., Uyun, T. N., & Jin, X. Z. (2018). The effect of violent exposure on online aggressive behavior of college students: The role of ruminative responses and internet moral. *Acta Psychologica Sinica, 50*(09), 1051–1060.

Kales, A., Caldwell, A. B., Soldatos, C. R., Bixler, E. O., & Kales, J. D. (1983). Biopsychobehavioral correlates of insomnia. ii. pattern specificity and consistency with the minnesota multiphasic personality inventory. *Psychosomatic Medicine, 45*(4), 341–56. https://doi.org/10.1097/00006842-198308000-00008

Kecklund, G., & Akerstedt, T. (2004). Apprehension of the subsequent working day is associated with a low amount of slow wave sleep. *Biological Psychology, 66*(2), 169–176. https://doi.org/10.1016/j.biopsycho.2003.10.004

Kim, H., & Davis, K. (2009). Toward a comprehensive theory of problematic Internet use: Evaluating the role of self-esteem, anxiety, flow, and the self-rated importance of Internet activities. *Computers in Human Behavior, 25*, 490–500. https://doi.org/10.1016/j.chb.2008.11.001

King, D. L., Delfabbro, P. H., Zwaans, T., & Kaptsis, D. (2014). Sleep interference effects of pathological electronic media use during adolescence. *International Journal of Mental Health & Addiction, 12*(1), 21–35. https://doi.org/10.1007/s11469-013-9461-2

Kowalski, R. M., Giumetti, G. W., & Lattanner, M. R. (2014). Bullying in the digital age: A critical review and meta-analysis of cyberbullying research among youth. *Psychological Bulletin, 140*(4), 1073–1137. https://doi.org/10.1037/a0035618

Lam, L. (2014). Internet Gaming Addiction, Problematic Use of the Internet, and Sleep Problems: A Systematic Review. *Current Psychiatry Reports, 16*(4), 1–9. https://doi.org/10.1007/s11920-014-0444-1

Liao, J., Jacksonm, T., & Chen, H. (2014). The structure and validity of directional measures of appearance social comparison among emerging adults in China. *Body Image, 11*(4), 464–473. https://doi.org/10.1016/j.bodyim.2014.07.001

Li, T. R., Li, J., & Yu, G. L. (2015). Self-distancing: An Adaptive Self-reflection. *Advances in Psychological Science, 23*, 1052–1060.

Liu, X. C., & Tang, M. Q. (1996). Reliability and validity of the Pittsburgh sleep quality index. *Chinese Journal of Psychiatry, 29*(02), 103–107.

Lundh, L. G., & Broman, J. E. (2000). Insomnia as an interaction between sleep-interfering and sleep-interpreting processes. *Journal of Psychosomatic Research, 49*(5), 299–310. https://doi.org/10.1016/S0022-3999(00)00150-1

Metcalfe, J., & Mischel, W. (1999). A hot/cool-system analysis of delay of gratification: Dynamics of willpower. *Psychological Review, 106*, 3–19.

Michl, L. C., Mclaughlin, K. A., Shepherd, K., & Nolen-Hoeksema, S. (2013). Rumination as a mechanism linking stressful life events to symptoms of depression and anxiety: Longitudinal evidence in early adolescents and adults. *Journal of Abnormal Psychology, 122*(2), 339–352. https://doi.org/10.1037/a0031994

Miranda, R., Tsypes, A., Gallagher, M., & Rajappa, K. (2013). Rumination and hopelessness as mediators of the relation between perceived emotion dysregulation and suicidal ideation. *Cognitive Therapy and Research, 37*(4), 786–795. https://doi.org/10.1007/s10608-013-9524-5

Morrison, R., & O'Connor, R. C. (2005). Predicting psychological distress in college students: The role of rumination and stress. *Journal of Clinical Psychology, 61*(4), 447–460. https://doi.org/10.1002/jclp.20021

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*(4), 569–582.

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

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

Pillai, V., & Drake, C. (2015). Sleep and Repetitive Thought: The Role of Rumination and Worry in Sleep. In K. A. Babson, M. T. Feldner (Eds.), *Sleep and Affect* (pp.201–225). Academic Press. https://doi.org/10.1016/B978-0-12-417188-6.00010-4

Qiu,W. F. (2018). *A study on the relationship among college students' Online risky behavior, cyber-victimization and Depression*. (Master). Fujian Normal University

Qiu, W. F., Lin, G. Y., Ye, Y. D., & Chen, Z. Y. (2017). The Effect of Social Media on College Students' Anxiety: The Serial Mediations of Upward Social Comparison and Psychological Capital Based on an Analysis of Wechat and Qzone. *Chinese Journal of Special Education, 08*, 88–92.

Raes, F. (2010). Rumination and worry as mediators of the relationship between self-compassion and depression and anxiety. *Personality and Individual Differences, 48*(6), 757–761. https://doi.org/10.1016/j.paid.2010.01.023

Roelofs, J., Rood, L., Meesters, C., Dorsthorst, V. T., BGels, S., & Alloy, L. B., et al. (2009). The influence of rumination and

distraction on depressed and anxious mood: A prospective examination of the response styles theory in children and adolescents. *European Child & Adolescent Psychiatry, 18*(10), 635–642. https://doi.org/10.1007/s00787-009-0026-7

Shaw, A. M., Timpano, K. R., Tran, T. B., & Joormann, J. (2015). Correlates of Facebook usage patterns: The relationship between passive Facebook use, social anxiety symptoms, and brooding. *Computers in Human Behavior, 48*, 575–580. https://doi.org/10.1016/j.chb.2015.02.003

Shen, C. P. (2019). *A S tudy on college students' Social Media Use Anxiety and its relationship with Rumination and Sleep Quality* (Master). Fujian Normal University

Spira, A. P., Friedman, L., Aulakh, J. S., Lee, T., & Yesavage, J. A. (2008). Subclinical anxiety symptoms, sleep, and daytime dysfunction in older adults with primary insomnia. *Journal of Geriatric Psychiatry and Neurology, 21*(2), 149–153. https://doi.org/10.1177/0891988707311043

Stewart, J. C., Rand, K., Hawkins, M. A., & Stines, J. A. (2011). Associations of the shared and unique aspects of positive and negative emotional factors with sleep quality. *Personality and Individual Differences, 50*(5), 609–614. https://doi.org/10.1016/j.paid.2010.12.004

Theresa, D., & Lee, K. F. (2014). Correlates of Social Anxiety, Religion, and Facebook. *Journal of Media and Religion, 13*(4), 208–225. https://doi.org/10.1080/15348423.2014.971566

Thomsen, D. K., Mehlsen, M. Y., Christensen, S., & Zachariae, R. (2003). Rumination - relationship with negative mood and sleep quality. *Personality and Individual Differences, 34*(7), 1293–1301. https://doi.org/10.1016/S0191-8869(02)00120-4

Urponen, H., Partinen, M., Vuori, I., & Hasan, J. (1991). Sleep quality and health: Description of the sleep quality index. In J. H. Peter, T. Penzel, T. Podszus, & P. von Wichert (Eds), *Sleep and health risk* (pp. 555–558). Springer. https://doi.org/10.1007/978-3-642-76034-1_63

Ulrich, A. K., Full, K. M., Cheng, B., Gravagna, K., Nederhoff, D., & Basta, N. E. (2021). Stress, anxiety, and sleep among college and university students during the COVID-19 pandemic. *Journal of American College Health, 9*, 1–5. https://doi.org/10.1080/07448481.2021.1928143

Wang, D. M., Zhang, L. X., & Zhang, Z. (2017). The Relationship Between Problematic Internet Use, Well-being, Social Anxiety and Depression-A Longitudinal Study. *Studies of Psychology and Behavior, 15*(4), 569–576.

Wang, J. (2012). An analysis study on the sleep status and influencing factors of college students. *Journal of Public Health and Preventive MedIcine, 23*(01), 56–58.

Wang, Y., Yang, H., Montag, C., & Elhai, J. (2020). Boredom proneness and rumination mediate relationships between depression and anxiety with problematic smartphone use severity. *Current Psychology,* 1-11. https://doi.org/10.1007/s12144-020-01052-0

Wen, Z. L., & Ye, B. J. (2014). Analyses of Mediating Effects: The Development of Methods and Models. *Advances in Psychological Science, 05*, 731–745.

Wolniczak, I., Cáceres-DelAguila, J. A., Palma-Ardiles, G., Arroyo, K., Solís-Visscher, R., Paredes-Yauri, S., Mego-Aquije, K., & Bernabé-Ortiz, A. (2013). Association between Facebook Dependence and Poor Sleep Quality: A Study in a Sample of Undergraduate Students in Peru. *Plos One, 8*(3), e59087. https://doi.org/10.1371/journal.pone.0059087

Wong, H. Y., Mo, H. Y., Potenza, M., Chan, M. N., Lau, W., Chui, T. K., Pakpour, A., & Lin, C. (2020). Relationships between Severity of Internet Gaming Disorder, Severity of Problematic Social Media Use, Sleep Quality and Psychological Distress. *International Journal of Environmental Research and Public Health, 17*(6), 1879. https://doi.org/10.3390/ijerph17061879

Woods, H. C., & Scott, H. (2016). #Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *Journal of Adolescence, 51*, 41–49. https://doi.org/10.1016/j.adolescence.2016.05.008

Xiong, H. X., Zhang, J., Ye, B. J., Zheng, X., & Sun, P. Z. (2012). Common Method Variance Effects and the Models of Statistical Approaches for Controlling It. *Advances in Psychological Science, 20*(05), 757–769.

Xuan, Z. X. (2017). *Relationships Among Rumination, Resilience, Depression and Anxiety and Interventions in College Students.* (Master). Zhe Jiang University

Yang, B. L., Lin, G. Y., & Yan, Y. W. (2018). The Effect of the Passive Use of Social Networking Sites on Master's Degree Candidates' Sleep Quality: A Mode of Moderation-Oriented Mediation. *Chinese Journal of Special Education, 03*, 83–90.

Zhang, Y., & l., Li, S., & Yu, G. l. (2021). The relationship between social media use and fear of missing out: A meta-analysis. *Acta Psychologica Sinica, 03*, 273–290.

Zhou, H., & Long, L. R. (2004). Statistical Remedies for Common Method Biases. *Advances in Psychological Science, 06*, 942–950.

Zung, W. W. K. (1971). A rating instrument for anxiety disorders. *Psychosomatics, 12*(6), 371–379.