



Mechanism study of social media overload on health self-efficacy and anxiety

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ABSTRACT

Previous studies have found that people's excessive use of social media may have a negative impact on their crisis coping skills. This study focuses on the effects of social media overload (information overload, communication overload and social overload) on anxiety and health self-efficacy during the COVID-19 pandemic. The study used an online questionnaire and partial least squares structural equation modeling (PLS-SEM) to obtain data (816 valid samples), analyze the data and validate the model. The findings revealed that social media overload (information overload, communication overload and social overload) triggers increased social media fatigue, which in turn leads to the development of anxiety and the consequence of diminished health self-efficacy; social media fatigue plays a partially mediating role between social media and health self-efficacy and a fully mediating role between communication overload and health self-efficacy. The results of this study can inform the development of crisis communication strategies during public health emergencies.

1. Introduction

The eruption of the novel coronavirus pneumonia (COVID-19) poses a great threat to people's health and even their lives. Countries have adopted closed management measures to contain the spread of COVID-19, including home quarantine and home health monitoring. Social media has become a major platform for people to obtain information about COVID-19 and communicate with the outside world [1,2]. Therefore, the role of social media in the COVID-19 pandemic has garnered significant interest from scholars. Some academics have shown that social media can bring many benefits to people dealing with the threat of COVID-19. Studies have pointed out that social media is an effective and essential way for individuals to obtain epidemic information and health advice [3]. The use of social media can help raise public awareness of health maintenance and personal COVID-19 response plans, access social support and relationship maintenance, and help the public cope with isolation [4–6]. However, as the COVID-19 pandemic progresses, the dark side of social media continues to emerge. In fact, several years ago, researchers have suggested a need for greater awareness of the negative aspects of social media research [7–9]. That makes it all the more important to ignore the adverse effects that social media can impose on individuals during the COVID-19 pandemic.

With the popularity of social media, there is an increasing volume of research on the negative consequences of social media overload [10]. Overload means how an individual subjectively perceives and assesses something when confronted with more

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information, people or objects than he or she can process [11]. Social media overload refers to the experience of being overloaded during the use of social media, and is one of the typical negative consequences of users' overuse of social media. Scholars have found that social media overload can lead to negative psychological conditions such as social media fatigue and technological stress [12,13], which can lead to various adverse outcomes such as anxiety [14], unhappiness [15], depressive symptoms [16], and sleep problems [9]. Social media overload, caused by people's inappropriate use of social media during the COVID-19 pandemic, has received attention from researchers. Social media is a way for people to get information about the COVID-19 pandemic, to maintain communication with others, and to participate in online group activities. Some users have difficulty reducing or stopping their social media use for fear of missing important information and activities on social media, and even develop self-compulsive use behaviors, which can lead to social media overload and a range of negative consequences [17,18]. It has also been suggested that excessive use of social media during the COVID-19 can lead to negative emotions such as anxiety and unhappiness [15,19]. Scholars have expressed worries about the potential impact of excessive social media usage during the COVID-19 pandemic, suggesting that it could potentially lead to adverse psychological outcomes and hinder individuals from responding effectively to the pandemic's threat [15,20].

Social media fatigue has been found to be a significant causal factor in a range of negative outcomes. Social media fatigue has been defined as a subjective, multifaceted psychological state that includes feelings of tiredness, annoyance, anger, disappointment, caution, loss of interest or reduced need/motivation related to different facets of social media use and interaction [21]. Studies point to social media fatigue as a significant trigger not only for negative psychological states such as anxiety and depression in users [22,23] but also for poor academic and work performance [24,25]. The negative impact of social media fatigue on users during the COVID-19 pandemic has also attracted the attention of scholars. Zhang et al. [26] found that social media fatigue tends to make users take negative measures to cope with the COVID-19 pandemic. Islam et al. [20] suggested that social media fatigue is an important incentive for users to share fake news and rumors during the COVID-19 pandemic. Scholars have highlighted that mental health problems can hinder people from responding appropriately to the threat of the COVID-19 pandemic [15,20]. However, less research has been conducted on the impact of social media fatigue on mental health than on behavioral consequences. The present study sought to strengthen this aspect of the work. On the one hand, anxiety is a generalized state of mind of apprehension, referring to worries about potentially difficult situations or threats [27]. Studies have noted that social media fatigue can result in anxiety in users [23]. Scholars have also found that anxiety affects people's preventive behaviors and increases the risk of disease infection [28]. So, whether social media fatigue during the COVID-19 pandemic exacerbates people's anxiety about the COVID-19 pandemic, there is still less research on this aspect. On the other hand, self-efficacy pertains to an individual's belief in their capability to successfully attain desired objectives within a specific field of activity [29]. Public health experts have identified "health-related self-efficacy" as an important factor influencing an individual's response to the threat of the COVID-19 pandemic [30]. People having high self-efficacy are in a more positive state to cope with the threat of the COVID-19 pandemic. Positive psychological states can enhance self-efficacy, while negative psychological states can diminish it [29]. Social media overload can trigger users to experience negative psychological states such as social media fatigue [31]. It can be hypothesized that social media fatigue may reduce users' health self-efficacy, which may have a negative impact on their ability to cope with the threat of COVID-19. However, limited empirical studies have explored the connection between social media fatigue and anxiety and health self-efficacy, and no research has been conducted in this area in the context of the new pandemic.

In summary, this study proposes to investigate the following questions: (1) Does social media overload lead to social media fatigue? (2) Does social media fatigue trigger users' anxiety? (3) Does social media fatigue undermine users' health self-efficacy?

Current scholarly research on the use and impact of social media in infectious public health emergencies has focused on positive effects. As highlighted by Baccarella et al. [7], it is very necessary to study the possible negative consequences caused by social media, which enables us to have a thorough comprehension of the possible impact of social media. This study has three main contributions: First, by studying the influence of social media overload on users' anxiety and health self-efficacy during the COVID-19 pandemic, it expands the current research on health communication. Second, the findings deepen our understanding of the potential negative impact of users' excessive use of social media on their response to the threat of COVID-19 and the mechanisms that influence it. Thirdly, the conclusions of our study can be a reference for the formulation of information communication strategies for the public during public health emergencies.

2. Theoretical foundations and research framework

The SSO theoretical framework was originally proposed by Koeske et al. [32] in 1993 and utilized in the field of psychology to study the internal psychological processes of the body as influenced by stressors originating from the external environment. The SSO theoretical framework comprises three primary elements: Stressor, the environmental factors that induce stress and impact an individual's mental well-being; Strain, the individual's subjective psychological response to the stressor, encompassing their perceptions, emotions, and thoughts; and Outcome, the individual's response to stress, including psychological or behavioral reactions [32]. The fundamental idea of the SSO theoretical framework is that stressors induce strain reactions in individuals, which in turn influence people's behavioral responses, and that stressors do not directly influence people's behavioral outcomes; they influence it indirectly through the mediation of internal. They affect it indirectly via the mediation of psychological experiences [32].

The SSO theoretical framework can better explain the psychological or behavioral consequences of stress-related situations during the use of social media systems, can present the relationships between these factors in a rational and structured way, and is widely used to study human social media use behavior [23,33]. Therefore, this study proposes to form a research model based on the SSO theoretical framework, considering social media overload as a stressor factor, social media fatigue as a strain response factor triggered by the influence of the stressor, and anxiety and health self-efficacy as the outcome factors.

2.1. Stressors - social media overload

Public health experts have stressed social distancing as the optimal approach for averting the spread of COVID-19. During the COVID-19 pandemic, people's communication, conferences, classes, shopping and many other activities have shifted from offline to online. Therefore, people spend more time using social media, which easily leads to social media overload [23,34]. Social media overload includes three main forms: information overload, communication overload and social overload [8,35,36]. Information overload refers to a kind of subjective perception caused by the continuous influx of massive information to users and the information touched by users beyond their own processing ability [12]. Communication overload refers to the subjective perception that communication and conversation requests initiated by social media platforms are beyond one's processing capacity [10]. Communication overload means more information and more connections with more people, and over-communication with others can interrupt the user's attention and interfere with their behavior [10]. Social overload is based on reciprocity principle in social relationships, where people may feel obligated to respond to social requests from others and offer some type of assistance [37]. Research suggests that the time and effort required to continuously build and maintain a network of social relationships in social media can be a burden for users if it continues over time [38], and that social overload will persist unless social interactions are significantly reduced or social media use is discontinued.

2.2. Strain - social media fatigue

Past research has found that individuals who engage in cognitive activities for extended periods of time experience mental fatigue [37]. Social media use can be a continuous drain on one's cognitive energy, and the current significant increase in the length and frequency of social media use in people's daily lives has led to the phenomenon of social media fatigue becoming increasingly common [39]. The intensity of fatigue experienced by different individuals in the same situation varies, and may be either a mild sense of fatigue or a state of severe fatigue. Some users may struggle to manage a certain level of communication load with other social media users and become easily fatigued, while others may be adept at coping effectively with the same level of communication load without becoming easily fatigued [21]. People in the midst of a new epidemic can be in a state of high emotional stress for long periods of time, and that social media fatigue can easily develop if they use social media frequently for long periods of time [14,15].

2.3. Outcomes - anxiety, health self-efficacy

Anxiety is one of the most typical negative psychological effects triggered by social media overload. Anxiety can lead to a variety of perceptual and evaluative impairments, such as misinterpretation and warning of danger and threat, as well as irrational judgments and information processing [23]. Asmundson et al. [40] found that people with anxiety will experience higher COVID-19-related stress compared to healthy individuals. Harper et al. [41] also showed that anxiety will further exacerbate people's fear of COVID-19. Therefore, some scholars have advocated for attention to be given to people's anxiety during the COVID-19 pandemic to minimize the negative effects of anxiety on individuals [11]. Self-efficacy is an individual's belief in his or her own ability to act, which controls his or her own thoughts, decisions and actions, and is a central motivating factor in the individual's self-system [29]. People with a high sense of self-efficacy are able to use their wisdom and skills at critical times and deal with problems rationally. The concept of healthy self-efficacy is derived from the concept of self-efficacy developed by Bandura [29]. Health self-efficacy refers to an individual's confidence or belief in his or her ability to manage health [2]. Health self-efficacy would affect individuals' health management behaviors when facing the threat of public health emergencies [42]. People having high health self-efficacy tend to accept health advice and take positive action to maintain their health status [43,44]. Public health experts have emphasized that when responding to public health emergencies with infectious diseases, it is important for public health departments to develop strategies to help people improve their health self-efficacy, which will help them better cope with the threats posed by the emergencies [45,46].

2.4. Research hypothesis and model

2.4.1. Social media overload and social media fatigue

Social media overload occurs when users process more information and interaction requests through social media than they can effectively manage to cope with [34]. Previous research has shown that social media overload can lead to negative psychological states, including social media fatigue [34,47]. During the COVID-19 pandemic, people need to be in a relatively closed and isolated environment for a long period due to the isolation requirements in the prevention and control policy, and their emotions and behaviors are more susceptible to social media [48]. In this study, social media overload was categorized into information overload, communication overload and social overload.

The length and frequency of social media use has increased significantly, and people are constantly searching, receiving, discerning, reading and processing a constant stream of information on social media, leading to a great deal of personal time and energy being consumed, and thus a sense of information overload [1]. Users can experience excessive consumption of human cognitive energy after processing vast quantities of information on social media for long periods, leaving them feeling overwhelmed and experiencing fatigue [47,49]. Therefore, this study proposes the following hypothesis.

H1. Information overload has a significant positive effect on social media fatigue.

Social media services provide users with the opportunity to establish and continuously maintain contact with many people.

Consequently, social media users may need to manage multiple communication requests simultaneously [50]. On the one hand, this frequent communication can cause an imbalance between users' cognitive abilities and communication needs, resulting in their inability to cope with such a plethora of communication requests. On the other hand, too many social media communication requests can distract the user's attention, resulting in frequent interruptions to the task they are performing. It takes more energy for the user to bring the interrupted attention back to the state before the interruption, or to revert from the terminal to the previous task state [8], so communication overload tends to lead to user fatigue. Hence, the study posits the following hypothesis.

H2. Communication overload has a significant positive effect on social media fatigue.

Social media allows people to stay in touch with their friends anytime and anywhere, but constant exposure to social networks and intensive social activities can make users feel overloaded with social support for others, which in turn can lead to fatigue [8,36]. Social media became the main interpersonal communication channel during the COVID-19 pandemic [14]. Too many requests for social media interaction forced users to respond to their friends as quickly as possible [39], which could lead to social overload and consequently social media fatigue [34]. Therefore, the following hypothesis is proposed.

H3. Social overload has a significant positive effect on social media fatigue.

2.4.2. Social media fatigue and anxiety

Social media fatigue as an experience of psychological fatigue is closely related to the development of anxiety. Previous studies have noted that people experience reduced cognitive abilities when experiencing fatigue, which results in their inability to adequately regulate or control their emotions [23,51]. Studies by scholars such as Vannucci et al. [52] and Teng et al. [19] have also found that frequent social media use is linked to an increased likelihood of the emergence of anxiety psychology. Studies by scholars such as Dhir et al. [23] found that social media fatigue is more likely to increase depression and anxiety in adolescents. As a result, the following hypothesis is proposed.

H4. social media fatigue has a significant positive effect on anxiety psychology.

2.4.3. Social media fatigue and health self-efficacy

Social media fatigue is a psychological fatigue experience. Previous research has shown that mental fatigue interferes with an individual's cognitive activities. As fatigue levels increase, an individual's executive and control functions are interfered with, with reduced flexibility and planning, and with more errors in tasks [53]. Bandura [29] emphasized that mental state is an important factor in self-efficacy and that a positive mental state can enhance self-efficacy, while a negative mental state may diminish self-efficacy. For example, people in stressful situations often display negative emotions such as fatigue, anxiety and fear, which can sap their will and shake their confidence. As a result, the following hypothesis is proposed.

H5. Social media fatigue has a significant negative effect on health self-efficacy.

2.4.4. The mediating role of social media fatigue

Previous research has shown that social media overload can produce behavioral and psychological consequences by triggering strain responses in individuals [31]. Social media fatigue has been found to be a mediator of social media overload leading to negative psychological consequences for individuals [19,33]. Therefore, this study will further explore whether social media fatigue mediates the relationship between the effects of social media overload on anxiety, and health self-efficacy.

Based on the hypotheses presented in the previous study, we suggest that there are two processes: First, overuse of social media leads to excessive consumption of users' cognitive energy, resulting in social media overload, and then social media fatigue. When people experience fatigue, their cognitive ability will decline, which will lead to their inability to fully regulate or control emotions and easily produce anxiety. Secondly, overuse of social media leads to an excessive drain on the user's cognitive energy, leading to social media overload and consequently social media fatigue, and the growth of the experience of social media fatigue interferes with the individual's cognitive activity, resulting in a weakening of healthy self-efficacy. Building on the aforementioned discussion, we

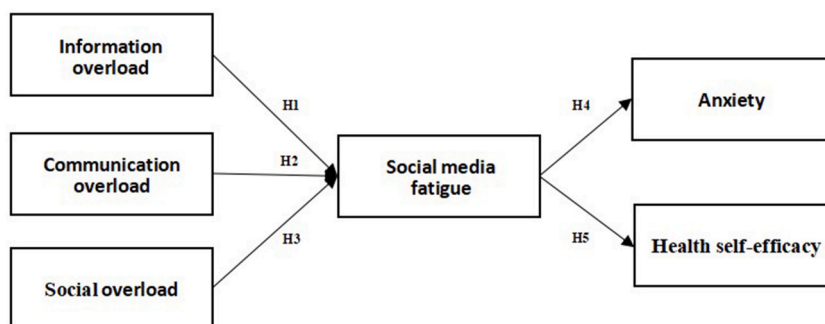


Fig. 1. Theoretical model and research hypothesis.

propose the following hypothesis.

- H6. social media fatigue mediates information overload and anxiety.
- H7. Social media fatigue mediates communication overload and anxiety.
- H8. Social media fatigue mediates social overload and anxiety.
- H9. Social media fatigue mediates information overload and healthy self-efficacy.
- H10. Social media fatigue mediates communication overload and healthy self-efficacy.
- H11. Social media fatigue mediates social overload and health self-efficacy.

Based on the SSO theoretical framework and the above discussion, the final theoretical model of this study can be obtained, which is shown in Fig. 1.

3. Research methods

3.1. Questionnaire design

The questionnaire of this study consists of two parts: the first part is the basic personal information items (including: gender, age, and education). The second part is for measuring variables and contains six variables. The questionnaire items used to measure variables in this study derived from previous studies and adapted based on the context of an infectious public health emergency to ensure that the measurement items are accurate and effective: The measurement items of information overload consist of 4 questions, using the scale used in the study of Cao et al. [8]. The measurement items of communication overload consist of 4 questions, using the scale used in the study of Cao et al. [8]. The measurement items of social overload consist of 4 questions, using the scale used in the study of Maier et al. [39]. The measurement items of social media fatigue consist of 5 questions, using the scale used in the study of Lee et al. [47]. There are four questions for the measurement of anxiety, using the scale used in the study of scholars such as Brooks et al. [54]. The measurement items of health self-efficacy consist of 4 questions, using the scale used in the study of Sheer [55]. Measurement variables were measured on a 5-point Likert scale (ranging from 1 = strongly disagree, to 5 = strongly agree). Also, the questionnaire began with the option "I mainly used social media to obtain information about a public health emergency during the event" to screen out those who did not use social media as their main channel of communication during the event.

Since the original measurement items were all in English, we invited a translator to convert the original version into Chinese, and a health communication expert to check the precision of the translation of the questionnaire, and corrected the measurement items to guarantee that the questionnaire was easily comprehensible for the respondents. In order to improve the effectiveness of the formal investigation, this study carried out a small range of pre-surveys, and distributed a total of 20 pre-survey questionnaires (undergraduates in Guangxi University). According to the analysis results of pre-survey data, items with factor loading lower than 0.7 were deleted, and the remaining items comprised the official questionnaire used in this study. The data gathered from the preliminary survey was not used in the analysis of the final results.

3.2. Data collection

The study noted that university students are a vulnerable group in their formative years and are highly susceptible to influence. This study is an exploratory study and therefore the group of university students was proposed as the study population [56].

In the formal questionnaire, we used an online questionnaire powered by www.wjx.cn to survey a convenience sample of university students in mainland China. The data was collected from September 13, 2022, to October 18, 2022, with 935 questionnaires returned. Before filling out the questionnaire, participants were briefed on the study's objectives and were informed that the survey was anonymous. A total of 935 questionnaires were gathered. After removing some invalid questionnaires that contained missing responses and apparently contradictory answers, the final valid sample was 816, with a sample pass rate of 87.3%. The sample size of the survey met the requirement of 10 times the number of items on the scale. Table 1 shows the demographic characteristics of the valid sample.

Table 1
Sample basic Information (816 people).

Items	Content	Frequency	%
Gender	male	355	43.5 %
	female	461	56.5 %
Age	under 18	7	0.9 %
	18–22	575	70.5 %
	23–27	195	23.9 %
	over 28	39	4.8 %
Educational background	University (undergraduate and tertiary)	619	75.9 %
	postgraduate	197	24.1 %

4. Data analysis and results

In this study, Partial Least Squares Structural Equation Modeling (PLS-SEM) was used for data analysis and model verification for the following reasons: First of all, compared with Covariance-base Structural Equation Modeling (CB-SEM), PLS-SEM is more suitable for exploratory research. Secondly, the PLS-SEM method is appropriate for the study of small samples [57]. The study uses SmartPLS 3.2.9 software to measure the reliability, validity, path between variables and significance level of the data.

4.1. Test of measurement model

The measurement model test primarily assesses the reliability, convergent validity, and discriminant validity of various indicators [56]. In this study, Cronbach’s α and combined reliability (CR) values were used to test reliability measurement. As depicted in Table 2, Cronbach’s α values of all variables ranged from 0.75 to 0.89, greater than the threshold value of 0.6, while CR values ranged from 0.85 to 0.94, greater than the threshold value of 0.7, indicating good reliability and internal consistency of the measurement scale.

Convergence validity refers to the degree of correlation between the scale and the corresponding variable, which can be evaluated by checking the AVE value of the variable [58]. Table 2 shows that the AVE values of each variable range from 0.66 to 0.75, all higher than the threshold value of 0.5, indicating that the measurement scale exhibits strong convergent validity.

Discriminant validity pertains to the extent to which a variable is genuinely distinguishable from other variables based on empirical criteria. The method commonly used to evaluate discriminant validity is to compare the correlation coefficient between the square root value of AVE of each variable and other variables according to the Fornell-Larcker standard [59]. As shown in Table 3, the values on the diagonal (in bold) are the square root values of AVE for each variable, and they are all greater than the correlation coefficients with

Table 2
Test of the measurement model.

Variables	Measurements	Loading	AVE	CR	α	rho_A
AN	AN1	0.889	0.746	0.921	0.885	0.890
	AN2	0.907				
	AN3	0.864				
	AN4	0.790				
HS	HS1	0.857	0.745	0.921	0.886	0.886
	HS2	0.865				
	HS3	0.866				
	HS4	0.865				
SMF	SMF1	0.853	0.768	0.943	0.925	0.925
	SMF2	0.868				
	SMF3	0.888				
	SMF4	0.890				
	SMF5	0.883				
IO	IO1	0.753	0.591	0.853	0.772	0.780
	IO2	0.776				
	IO3	0.762				
	IO4	0.784				
CO	CO1	0.749	0.709	0.906	0.862	0.879
	CO2	0.884				
	CO3	0.869				
	CO4	0.859				
SO	SO1	0.806	0.744	0.921	0.885	0.885
	SO2	0.900				
	SO3	0.878				
	SO4	0.864				

Note: 1. α = Cronbach’s α 2. AN = Anxiety, HS = Health Self-Efficacy, SMF = Social Media Fatigue, IO = Information overload, CO = Communication overload, SO = social overload.

Table 3
Differential validity test.

Variable	AN	CO	HS	IO	SMF	SO
AN	0.863					
CO	0.415	0.842				
HS	-0.174	-0.334	0.863			
IO	0.320	0.533	-0.381	0.769		
SMF	0.367	0.414	-0.590	0.526	0.876	
SO	0.372	0.604	-0.323	0.337	0.362	0.863

Note: 1. The diagonal elements (in bold) are the square root of variance shared between the AVE, whereas the off-diagonal elements are correlations among constructs. 2. AN = Anxiety, CO = Communication overload, HS = Health Self-Efficacy, IO = Information overload, SMF = Social Media Fatigue, SO = social overload.

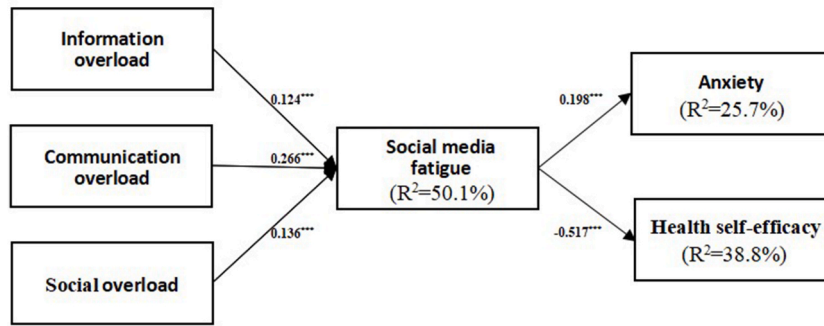


Fig. 2. Results of the structural model. (Note: ***: $p < 0.001$).

all other variables, indicating that the scale has strong discriminative validity.

4.2. Structural model test

The significance test was performed based on SmartPLS 3.2.9 by running the Bootstrapping method (sampling times = 5000 times). According to the test results (Fig. 2), information overload, communication overload and social overload are positively correlated with social media fatigue, and the hypotheses H1 ($\beta = 0.124, p < 0.001$), H2 ($\beta = 0.266, p < 0.001$) and H3 ($\beta = 0.136, p < 0.001$) are valid. There was a significant positive correlation between social media fatigue and anxiety, and hypothesis H4 ($\beta = 0.198, p < 0.001$) was valid. Social media fatigue was negatively correlated with health self-efficacy, and hypothesis H5 ($\beta = -0.517, p < 0.001$) was valid. The explanatory power of information overload, communication overload and social overload on social media fatigue was 20.1 %, the explanatory power of social media fatigue on anxiety was 25.7 %, and the explanatory power of social media fatigue on health self-efficacy was 38.8 %.

This study made reference to the evaluation method proposed by Zhao et al. to analyze the mediating effect. Table 4 shows the results of the mediating effect analysis, social media fatigue mediates the influence of information overload on anxiety, hypothesis H6 is valid, VAF value is 36.23 %. Social media fatigue does not play a mediating role in communication overload and the relationship between social overload and anxiety. Hypothesis H7 and H8 are not valid. Social media fatigue mediates the effects of information overload, communication overload and social overload on health self-efficacy. Assuming that H9, H10 and H11 are all true, the VAF values are 106.2 %, 24.81 % and 65.42 %, respectively.

5. Research results

5.1. Research findings

The study was conducted to explore the possible adverse effects of excessive use of social media during the coronavirus pandemic on how people cope with the pandemic. This study, based on the theoretical framework of SSO, examined whether social media overload (information overload, communication overload, social overload) leads to social media fatigue, and whether social media fatigue increases anxiety and weakens healthy self-efficacy. Specific research results are as follows:

First, hypotheses H1, H2 and H3 are all valid, indicating that information overload, communication overload and social overload all lead to elevated of social media fatigue, i.e. social media overload leads to elevated levels of social media fatigue. Hypothesis H1 holds, suggesting that information overload triggers social media fatigue, This finding validates the results of previous studies (Pang [15] and Teng et al. [19]), users' prolonged exposure to and processing of different forms of information from social media will persist in consuming their cognitive energy, resulting in a sense of information overload and thus social media fatigue. The hypothesis H2 holds and suggests that communication overload will lead to social media fatigue. This finding validates the results of previous studies (Lin et al. [60] and Kasim et al. [35]), as frequent communication requests cause users' attention to be continuously interrupted, and users will consume more energy to return to their previous state, which will easily lead to excessive consumption of users' cognitive

Table 4
Results of mediation effect analysis.

Hypothesis	Independent variables	Mediator	Dependent variables	Direct effect (T)	Indirect effect (T)	Overall effect	VAF	Result
H6	IO	SMF	AN	0.045 (1.049)	0.025 (2.598)	0.069	36.23 %	true
H7	CO			0.226 (4.186)	0.053 (3.703)	0.278	19.06 %	false
H8	SO			0.160 (3.309)	0.027 (2.476)	0.187	14.44 %	false
H9	IO	SMF	HS	-0.193 (5.057)	-0.064 (2.981)	-0.258	24.81 %	true
H10	CO			0.008 (0.184)	-0.137 (5.291)	-0.129	106.20 %	true
H11	SO			-0.037 (0.898)	-0.070 (3.054)	-0.107	65.42 %	true

Note: The VAF >80 % indicates full mediation, $20 \% \leq \text{VAF} < 80 \%$ shows partial mediation while VAF <20 % assumes no mediation.

energy, resulting in communication overload and social media fatigue. Hypothesis H3 is valid, suggesting that excessive and frequent social support given by users to their friends on social media may cause users to feel overwhelmed and depleted, resulting in social overload and social media fatigue. This finding is in line with the research of Xiao et al. [49] and Fu et al. [33]. This finding validates the results of previous studies (Xiao et al. [49] and Fu et al. [33]). The results of the H1, H2 and H3 path coefficients also show that the effect of communication overload on social media fatigue is significantly greater than that of information overload and social overload, which is consistent with the study of Whelan et al. [50]. We believe that there are two main reasons for this: first, providing online social services is the core function of social media, and people naturally engage in more social activities than information browsing activities; second, social activities require much more time and cognitive energy than information browsing activities, and are therefore more likely to lead to social media fatigue.

Second, hypothesis H4 holds, indicating that social media fatigue results in the elevation of anxiety level. Users in a state of social media fatigue are prone to psychological anxiety because they are physically and mentally exhausted due to excessive cognitive energy and have difficulty in adequately regulating or controlling their emotions. Previous research has also confirmed that users may experience cognitive decline and become easily anxious when experiencing fatigue (Vannucci et al. [52] and Dhir et al. [23]). College students are psychologically fragile and more likely to re-social media fatigue and develop anxiety, and the intensity of anxiety increases with the level of social media fatigue.

Third, hypothesis H5 holds, indicating that social media fatigue results in the demotion of health self-efficacy level. When users are in the negative psychological state of social media fatigue, there is a consequence of diminished health self-efficacy [29]. This result confirms Bandura's findings that mental states are an important factor in self-efficacy, and that negative mental states can be demotivating, shake confidence, and diminish self-efficacy [29]. Scholars have highlighted that health self-efficacy is an important factor influencing individual health management and decision-making behaviors, a finding that reminds us of the negative influence of social media overuse on people's coping with the COVID-19 pandemic [2,61].

Fourth, hypothesis H6 hold and hypotheses H7 and H8 are invalid, indicating that due to social media fatigue, information overload indirectly results in the user's elevation of anxiety level. This could be attributed to the fact that social media is a core channel for obtaining information about the COVID-19 pandemic and that information about all types of epidemics can exacerbate anxiety [62, 63]. Hypotheses H7 and H8 do not hold, indicating that social media fatigue does not mediate between communication overload, social overload, and anxiety psychology. Although communication among good friends and social support can drain users' cognitive energy causing fatigue, interpersonal interactions are often an important way for people to reduce uncertainty about the situation around them and gain a sense of security, and therefore are not likely to lead to anxiety [63,64].

Fifth, hypotheses H9, H10, and H11 all hold, indicating that social media fatigue mediates the effects of information overload, communication overload and social overload on health self-efficacy. That is, social media overload (information overload, communication overload, and social overload) triggers social media fatigue among users, and social media fatigue weakens users' sense of healthy self-efficacy. Basically, if a user experiences social media overload, it does not necessarily lead to a significant reduction in health self-efficacy without further causing social media fatigue. There is little research on the mediating effect of social media fatigue on social media overload and health self-efficacy, and the results of this study are innovative in filling the current research gap.

6. Conclusions

Social media has played a pivotal role in facilitating people's response to the crisis; however, excessive use of social media can inevitably result in negative impact. Therefore, it is crucial to conduct research and deepen our understanding of these adverse effects to avoid further adverse consequences. Social media overload and social media fatigue are common factors that negatively influence users' psychological and behavioral well-being. In light of the COVID-19 pandemic, this study examined a sample of 816 college social media users to investigate the underlying psychological mechanisms behind their experience of social media overload and social media fatigue. These factors subsequently lead to diminished health self-efficacy and the elevation of anxiety level among college students. This study reveals that information overload, communication overload and social overload contribute to the development of social media fatigue. Social media fatigue tends to lead to the elevation of anxiety level and diminished health self-efficacy. Furthermore, social media fatigue mediates the influence of information overload on anxiety. Social media fatigue mediates the effects of information overload, communication overload and social overload on health self-efficacy.

6.1. Theoretical implications

- (1) This is a significant contribution given that it unveils the mediating role of social media fatigue, thereby enhancing our understanding of the mechanism through which social media overload leads to diminished health self-efficacy and the elevation of anxiety during crisis events. Furthermore, this study adds to the existing body of literature on social media.
- (2) This study broadens the application of the S-O-R framework to encompass a novel and significant phenomenon: the influencing mechanism of social media overload on users' health self-efficacy and crisis anxiety during crisis events. Besides, it contributes to the literature on S-O-R.
- (3) This study emphasizes the adverse aspects associated with the utilization of social media during infectious public health emergencies, expanding the negative aspects of social media research. Specifically, the findings of this study provide a new case study on the use of social media to promote awareness and protective behaviors against infectious disease outbreaks, while ignoring the potential negative effects of social media overuse.

6.2. Practical implications

Based on the research findings, this study makes the following suggestions to prevent the adverse effects resulting from the overuse of social media during infectious public health emergencies:

- (1) Social media operators or administrators should make emergency response plans. Preventing social media overload, social media fatigue, and other negative psychological states that are detrimental to college students' ability to cope with crises due to overuse of social media during crises. For example, users who are addicted to social media for a long time can take compulsory rest measures.
- (2) Social media operators can try to develop user mental state assessment procedures by using built-in sensors of mobile phones and other technological means, so as to help users timely evaluate their mental and emotional states after using social media.
- (3) As college students have poor self-control ability, parents and schools should focus on the phenomenon of excessive use of social media, and timely remind or even intervene.

7. Research limitations and prospects

Like all research endeavors, this study has faced certain limitations.

- (1) This study is carried out within the context of the COVID-19 pandemic with Chinese university students, which might impact the generalizability of the findings. To derive more overarching conclusions, the researchers may in the future conduct surveys based on different contexts, in different countries or regions, and for different populations.
- (2) All data are obtained from self-reports of respondents, which may have subjective bias. However, due to its convenience and low cost, this approach has gained significant acceptance among the scholarly community. Henceforth, methods such as text analysis and experiment can be considered in future research to improve the objectivity of research conclusions.
- (3) This study is exploratory in nature, and only one variable, social media fatigue, is viewed as the mediating factor leading to the reduction of health self-efficacy of users. This study only considers the negative mental state of social media fatigue as an intermediary factor. Social media overload may also lead to other negative mental states (such as neuroticism, fear of missing, etc.), and the consequences caused by these negative mental states should not be ignored.
- (4) This study is a cross-section study, unable to observe the time changes and trajectories of respondents' mental states. Future studies can be gradually integrated to carry out further studies. Subsequent research could endeavor to gather longitudinal data to further examine the causal relationship between the variables in the research framework.

Ethical guidelines

This study was approved by the Medical Ethics Committee of Guangxi University (GXU-2022-152). All procedures were carried out in accordance with relevant guidelines and regulations. Informed consent was obtained from all individual participants included in the study.

Data availability statement

All scales used for the study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy restrictions.

CRediT authorship contribution statement

Kai Li: Writing - review & editing, Writing - original draft, Supervision, Resources, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization. **Shanshan Jiang:** Writing - original draft, Visualization, Methodology, Formal analysis. **Xingde Yan:** Writing - original draft, Visualization, Methodology, Formal analysis. **Jie Li:** Writing - review & editing, Validation, Investigation.

Declaration of competing interest

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

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Appendix A. Scale of the Study

Variables	Measurements
Information overload	IO1 I feel that the main problem at the moment is that there is too much information about COVID-19 to deal with on social media, not a lack of it.
	IO2 I have to spend a lot of time every day sifting through COVID-19 information from social media.
	IO3 There are too much information about COVID-19 that I have been exposed. It's hard to tell the important ones from the unimportant ones.
	IO4 I am often distracted by the overwhelming amount of information on social media
Communication overload	CO1 I get too many messages, notifications, and announcements from the system on social media that I can't cope with.
	CO2 I receive more messages and news from friends on social media than I can handle.
	CO3 I receive frequent notifications from social media such as news, messages, and updates while I am doing other things.
	CO4 I often feel overburdened by social media socializing
Social overload	SO1 I spend too much time following what my friends are posting on social media about COVID-19.
	SO2 I spend too much time on social media trying to keep track of how my friends are doing.
	SO3 I spend a lot of time on social media dealing with things related to my friends.
	SO4 I follow my friends on social media too often.
Social media fatigue	SMF1 After using social media, I have difficulty concentrating in my spare time.
	SMF2 I find it difficult to relax after consistent use of social media.
	SMF3 After using social media on a consistent basis, I feel really fatigued.
	SMF4 Due to using social media, I feel rather exhausted.
	SMF5 In the process of receiving information on social media, I often feel very tired and cannot complete other tasks well.
Anxiety	AN1 I feel nervous in the face of COVID-19.
	AN2 I feel anxious in the face of COVID-19.
	AN3 I feel apprehensive in the face of COVID-19.
	AN4 I feel worried in the face of COVID-19.
Health self-efficacy	HS1 Belief about ability to exert behaviors: I feel confident in my ability to protect myself from COVID-19.
	HS2 Mixed knowledge: I feel confident in my knowledge of COVID-19 prevention.
	HS3 Task difficulty: I find it easy to deal with the treat of COVID-19.
	HS4 Behavioral intention: I am confident that I can effectively protect myself from COVID-19

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