COVID-19-Related Post-Traumatic Stress Disorders Relation With Social Media Addiction Among University Students: Mediating Role of Fear of Missing Out

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Objective   Traumatic experiences and stressful life events have crippling outcomes on individuals' psychiatric disorders and are also frequently comorbid with addictive behaviors. This study aims to propose a mediation model to examine the association between coronavirus disease-2019 (COVID-19)-related post-traumatic stress disorder (PTSD) and social media addiction (SMA) among university students, and the mediating role of fear of missing out (FoMO).

Methods   A cross-sectional study with 856 university students (mean age 19.2 years; 67.9% female) was conducted in China. The COVID-19-related PTSD scale, the FoMO scale, and the Bergen Social Media Addiction Scale were used, in addition to an online questionnaire addressing participants' sociodemographic information. Descriptive statistics and correlations were conducted with SPSS 21.0. The Structural Equation Model (SEM) with AMOS 21.0 was performed to assess the hypothesized mediation mode. The bootstrap with the 95% confidence interval (CI) was computed to test the significance of the mediating effect.

Results   SEM demonstrated that COVID-19-related PTSD symptoms significantly and negatively influenced SMA (β=0.247, p<0.001), FoMO significantly and positively affected university students' SMA (β=0.341, p<0.001), and FoMO partially mediated the association between COVID-19-related PTSD symptoms and SMA. The mediation effect of FoMO was 0.176, with bootstrapping 95% CI=0.123, 0.235.

Conclusion   The main effects of COVID-19-related PTSD symptoms and FoMO on SMA among university students were identified, providing intervention strategies for mental health professionals on how to reduce the risk of SMA when confronting future traumatic events and public health crises.   **Psychiatry Investig 2024;21(9):994-1006**

Keywords   COVID-19; Post-traumatic stress disorder; Fear of missing out; Social media addiction; University students.

INTRODUCTION

As an intrinsic part of everyday life, social media platforms, such as WeChat, Facebook, and Instagram, have profoundly changed individuals' social interaction styles. The overuse of social media, however, could lead to the risk of social media addiction (SMA). SMA is characterized as a form of non-chemical behavioral addiction.[1] SMA is also referred to as problematic social media use, social media disorder, and social networking addiction. Different types of behavioral addictions (such as problematic porn use and different types of problematic Internet use) and their psychological consequences have been examined by plenty of prior studies.[2-4] With regard to SMA, individuals who suffer from SMA have symptoms that are similar to other behavioral addictions, such as withdrawal, impaired control, behavioral salience, mood changes, and relapse.[5,6] Some theoretical frameworks were also designed to investigate the predictors of behavioral addictions.[7-9] More recently, it is worth noting that research on SMA is gaining attention, with scholars conducting many empirical studies to examine how pervasive the issue is. For instance, a meta-analysis involving 32 nations conducted by Cheng et al.[10] found that the prevalence of SMA was 14% for individualist countries and 31% for collectivist countries. The associations between different types of behavioral addictions and mental health were also reported by prior studies.[11-15] It has been the-

orized that SMA is associated with a high level of engagement in risky behaviors (e.g., risky sexual behaviors);[16] poor academic performance;[17] negative mental states (e.g., depression and anxiety);[18] and a lower subjective well-being.[19]

Coronavirus disease-2019 (COVID-19) which began in 2019 from China spread over the world in a fast speed. As of 20 April 2021, the COVID-19 pandemic has led to more than 141 million patients and three million deaths globally.[20] The Chinese government changed its previous "dynamic zero-COVID policy" on December 7, 2022. Since then, most Chinese citizens experienced COVID-19 infection. As of April 28, 2023, there had been a total of 216,456,444 infected cases and 1,544,221 deaths in China.[21] COVID-19 pandemic has profoundly changed individual's social attitudes and behaviors.[22] Previous studies have indicated that traumatic experiences and stressful life events have crippling consequences on individuals' psychological health.[23] With regard to COVID-19 pandemic, previous studies have reported the significant mental health outcomes (such as fear, worry, and stress) caused by COVID-19;[24,25] and COVID-19-related trauma and psychological outcomes, such as anxiety, depression, depressive symptoms, and symptoms of insomnia.[26,27] Prior studies have also documented the impact of COVID-19 on mental and behavioral disorders, such as obsessive-compulsive disorder, psychological distress, and eating disorders.[20,28,29] Among psychiatric disorders, post-traumatic stress disorder (PTSD), a psychiatric disorder that arises as a result of experiencing or witnessing a traumatic event, is one of the most common psychiatric disorders.[30] In the context of COVID-19, some empirical studies have documented the prevalence of PTSD in different populations, and the subgroups include females, the elderly, individuals with chronic illness, frontline government workers, teachers, and students, were identified to have a higher risk of psychiatric symptoms among the general public.[31-33] In a cross-sectional study among 999 individuals from 20 countries, Aljaberi et al.[34] reported that participants with PTSD caused by COVID-19 tended to have higher levels of depression, anxiety, and insomnia than those without PTSD.

Parallel to this, it is noteworthy that PTSD is frequently comorbid with addictive behaviors.[35] For instance, Fantasia et al.[36] show the tendency for addictive behaviors to develop through information over-searching and information avoidance in military veteran populations diagnosed with PTSD. Past studies have documented that COVID-19 pandemic-related psychological symptoms, such as the fear of COVID-19,[37] anxiety regarding COVID-19 infection,[38,39] and stressors of COVID-19[40] are all considered predictors of SMA. To our knowledge, however, no studies have investigated the potential relationship between COVID-19-related PTSD symptoms and SMA among university students. An investigation of the potential link between SMA and COVID-19-related PTSD symptoms is necessary, given the potentially addictive nature of social media and the vulnerability of people with PTSD to addiction. Thus, this study attempted to fill this gap.

Based on previous studies and the Person-Affect-Cognition-Execution (I-PACE) model (one of the most used research models in exploring the factors of technology addiction),[41] the present study offers a thorough analysis of the interaction between COVID-19-related PTSD symptoms and SMA among university students from China, highlighting the possible dangers and risk factors for university students with COVID-19-related PTSD symptoms and the mental health professionals who care for them. More specifically, the objectives of the present study are to explore 1) whether COVID-19-related PTSD symptoms have a significant effect on SMA among university students, and 2) the psychological mechanism between COVID-19-related PTSD symptoms and university students' SMA. To conclude, this study examined the presence of COVID-19-related PTSD symptoms among Chinese university students after school reopening and explored many factors influencing students' mental health, providing reasonable school management suggestions for coping with the issue of SMA among university students in the era of post-COVID-19.

COVID-19-related PTSD symptoms and SMA

As a mental health disorder, PTSD may develop after people exposed to disasters and experience or witness a life-threatening event.[42] Individuals who have developed PTSD are usually characterized by the following symptoms: 1) re-experiencing symptoms, such as intrusive and recurrent traumatic memories regarding the trauma, 2) avoidance symptoms affecting feelings, thoughts, or situations that trigger by the trauma, and 3) hyper-arousal symptoms, such as irritability, sleep and concentration problems, and excessive startle responses. After experiencing a stressful event, PTSD symptoms may not appear until months or years afterward. According to a systematic review ranging from 1980 to 2007 conducted by Neria et al.,[43] the burden of post-disaster PTSD was substantial: the range of PTSD in direct victims of disasters ranges is between 30% and 40%; while the prevalence of PTSD rates among the general group is between 5% and 10%. In the context of COVID-19, the prevalence of COVID-19-related PTSD was also documented by some empirical studies.[44] In their study among 270 medical students from Korea, Lee et al.[45] reported that the prevalence of COVID-19-related PTSD was 10.4%. Forte et al.[46] found a high percentage of PTSD (29.5%) among 2,286 Italian participants. Furthermore, a meta-analysis conducted by Ma et al.[47] among 680 Chinese children aged 7–15 years estimated that 20.7% of children reported

experiencing PTSD during the COVID-19 pandemic.

Individuals with PTSD symptoms, like patients with other mental disorders, often suffer from other psychiatric conditions, such as depressive disorder, generalized anxiety disorder, and general psychological distress.[48] More recently, it's worth noting that some research has reported strong associations between psychiatric disorders and the addictive use of technology. For instance, in a large sample of 23,533 adults in Norway, Andreassen et al.[49] reported that symptoms of psychiatric disorders, i.e., symptoms of attention-deficit/hyperactivity disorder, obsessive-compulsive disorder, anxiety, and depression could account for between 7 and 15% of the variance in addictive use of social media and video games. Concerning the association between the COVID-19-related PTSD symptoms and SMA among university students, to our knowledge there was only one qualitative study. Using semi-structured interviews 15 among military veterans diagnosed with PTSD, Fantasia et al.[36] discovered that 4 out of 15 military veterans revealed addictive information-seeking behavior.

Despite lacking direct empirical studies, previous research on the associations between PTSD symptoms and other forms of technology addiction in the context of other traumatic and stressful life events could pave the way for examining the potential effect of COVID-19-related PTSD symptoms on university students' SMA. For instance, Hsieh et al.[50] reported that children who experienced abuse and parental maltreatment were associated with an increased risk of developing PTSD and Internet addiction, with PTSD mediating the associations between maltreatment and Internet addiction. Similarly, using a sample of 347 individuals who have experienced stressful life events, Contractor et al.[51] found that PTSD was associated with problematic smartphone use, and individuals exposed to negative affect and arousal among trauma reported high levels of problematic smartphone use compared to PTSD's avoidance factor. In their study among 341 Turkish university students, Evren et al.[52] reported a strong relationship between impulsivity and Internet addiction, with PTSD symptoms particularly hyperarousal symptoms having a mediating effect. In their study among 404 adults from the U.S.A., Binford et al.[35] reported that media and technology usage (i.e., the frequency of TV viewing, media sharing, and the quantity of online friendships) were positively associated with PTSD symptom severity. Logically, studies of the effects of PTSD symptoms on Internet addiction and problematic smartphone use, are not necessarily applied to SMA. Considering that massive social media and social networking sites are often loaded on smartphones and the Internet and it is the overuse of social media via smartphones and the Internet that results in problematic smartphone use and Internet addiction,[53,54] it is not unreasonably to expect that the association between CO-

VID-19-related PTSD symptoms and SMA among university students might also be the same as those findings about the associations among PTSD, Internet addiction and problematic smartphone use in the context of other traumatic and stressful life events. In sum, this study proposes hypothesis 1 as follows: Hypothesis 1. COVID-19-related PTSD symptoms exert a significant positive prediction effect on SMA among university students.

The role of fear of missing out

Among the cognitive factors influencing SMA, the role of the fear of missing out (FoMO) on rewarding experiences is frequently being highlighted in current empirical studies.[37,38,55,56] According to Przybylski et al.,[57] FoMO is defined as involving two components: 1) apprehension that others might be having rewarding and wonderful experiences from which one is absent, and 2) the need to be persistently connected with the experiences of others in one social network, typically through using social media. It should be noted that FoMO is not a bad thing *per se*, as it positively affects the richness of happiness and enhances the strength of social media connections.[58] Numerous scholars, however, have examined FoMO as a correlate of mental health and negative outcomes such as behavior addiction.[59,60]

In detail, it has been reported moderate to large positive relations between FoMO and technology addiction among adolescents, university students, and adults in numerous empirical studies. For example, a meta-analysis conducted by Fioravanti et al.[61] reported a positive correlation between FoMO and problematic networking site use. Similarly, a recent meta-analysis conducted by Zhang et al.[62] among 85 studies capturing the period from 2016 to 2023 showed that the correlation coefficient between FoMO and mobile phone addiction was r= 0.47. More recently, in a sample of 955 participants in Germany, Montag et al.[63] discovered that FoMO was positively associated with social network use disorder tendencies, which in turn had an inverse effect on meaning in life. A comparative work done by Alshakhsi et al.[64] found a significant effect of FoMO on problematic social media use tendencies among European and Arabian participants. More recently, Liu et al.[65] documented that FoMO significantly positively predicted mobile phone addiction, with depression mediating the direct effect. Based on the above studies, it is expected that individuals with high levels of FoMO tend to have a high risk of excessive use of social media, resulting in SMA. Thus, this study proposes hypothesis 2 as follows: Hypothesis 2. FoMO significantly and positively predicts SMA among university students.

Of note, FoMO might have robust and positive associations with COVID-19-related PTSD symptoms. This is plausible as FoMO is conceptualized as a self-regulator that emerges from

deficiencies in satisfying basic psychological needs through the perspective of the self-determination theory.[66] In the case of the COVID-19 pandemic, since the COVID-19-related measures taken by the government such as lockdowns and social distancing, individuals with PTSD are away from their social environment and not seeing their family members, friends, and partners, resulting in low levels of satisfaction with basic needs. As such, it is reasonable to assume that individuals with PTSD symptoms in the context of COVID-19 may feel emotionally rejected by the social environment, and search for compensation in the external one that could be in favor of FoMO.[67] For example, in their study among 308 American participants, Elhai et al.[68] found that students with PTSD symptoms need touch and increased FoMO, which may further lead to problematic smartphone use. More recently, in their study among 356 Wenchuan earthquake survivors from China, Gong and Ren[69] reported that PTSD symptoms were directly associated with FoMO, which further enhanced the sharing of fake news and misinformation. Consequently, it is reasonable to assume that university students with high levels of PTSD symptoms may be especially susceptible to having high levels of FoMO.

Additionally, some previous studies have shown that FoMO is often considered a driving mechanism for the explanation of different forms of technology addiction.[70] For instance, Elhai et al.[71] analyzed data from 1,034 Chinese young adults found that FoMO mediated the association between depression and anxiety symptoms and problematic smartphone use severity. Similarly, in their study among 296 American college students, Dempsey et al.[72] demonstrated that both FoMO and rumination could mediate relations between social anxiety and problematic Facebook use. In a sample of 405 Italian university students, Servidio[73] reported that FoMO can have a mediating role in the relationship between self-control and problematic smartphone use. More recently, using a sample of 531 Chinese undergraduates, Zhang et al.[74] showed that neuroticism positively influenced the passive use of mobile social networks through the indirect roles of FoMO and online social support. A recent work done by Topino et al.[75] among 303 adults from Italy indicated FoMO played a full mediating role between family functioning patterns and SMA. Thus, based on the above literature discussion, this study proposes hypothesis 3 as follows: Hypothesis 3. FoMO has a mediating role in the link between COVID-19-related PTSD symptoms and SMA among university students.

The Rationale for the present study

Among the theories and models applied in studies of how to develop addictive tendencies towards social media and other excessive technology use,[8,76] a dominant model is the I-PACE

model.[41] In detail, I-PACE proposes complex interactions between person-affect-cognition and execution variables in conceptualizing risk factors influencing addictive online behaviors. As per I-PACE, personal factors, such as psychopathology and personality, can predict addictive online behaviors. Additionally, I-PACE suggests that responses to personal variables, such as coping strategies, impulsivity, self-regulation, and self-control, also function as mediating mechanisms between personal factors and problematic technology use.[77,78] I-PACE has been widely applied in the studies of different forms of technology addiction, and empirical evidence has verified the usefulness of this model.[79,80] In the present study, the P and C variables of the model are relevant. Drawing on the I-PACE mode, the present study constructs a mediated model to examine the mediating effect of FoMO in the relationship between COVID-19-related PTSD symptoms and SMA among university students, which is shown in Figure 1.

METHODS

Participants

The present study was approved by the ethics committee of the Zhoukou Normal university (code number: 2023ZKN U0310). A questionnaire survey was conducted at two universities in China, one in Zhoukou city, and the other in Jilin city between March 14 and April 7, 2023. Participants were enrolled using convenience sampling and criterion sampling together. The survey was conducted by the Declaration of Helsinki, and the questionnaires were distributed through WeChat. Informed consent was gathered before starting, and the scientific purpose and anonymity of the research were also told to the participants. The inclusion criteria were: 1) have been infected with COVID-19, 2) use social media daily. Participants could not submit the survey until all items were finished, so there were no missing data. A total of 915 university students participated in the survey; 59 questionnaires were
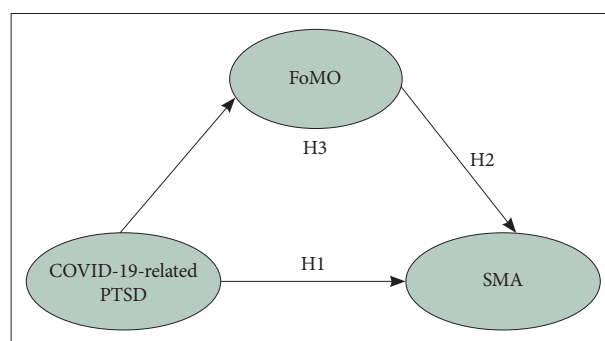

Figure 1. The proposed mediation model. COVID-19, coronavirus disease-2019; PTSD, post-traumatic stress disorder; FoMO, fear of missing out; SMA, social media addiction; H1, Hypothesis 1; H2, Hypothesis 2; H3, Hypothesis 3.

excluded due to irregular responses or the short response time (less than 150s). Consequently, a final sample of 856 participants was collected, with an effective rate of 93.55%.

Measures

Demographic information

Participants provided demographic characteristics, including sex, age, grade, and major.

SMA

To assess the levels of university students' SMA, the Bergen Social Media Addiction Scale (BSMAS-6) developed by Andreassen et al.[81] was used. The BSMAS-6 has been reported to be psychometrically sound across different language versions.[82-84] The Chinese version of the BSMAS-6 was adopted in the present study, which has also shown adequate psychometric properties in some prior studies.[85-87] Respondents were asked to answer the questions that how often best describe the relationship to and use of social media, such as WeChat, Facebook, and the like. Respondents rated each item on a 5-point scale ranging from 1 (very rarely) to 5 (very often), with higher scores indicating higher levels of SMA.

PTSD related to COVID-19

To measure university students' PSTD symptoms during COVID-19, the PTSD related to COVID-19 scale developed by Forte et al.[46] was used. Respondents were asked to indicate how they felt about the experiences caused by the COVID-19 pandemic. This scale is a 19-item self-report measure with a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely), with higher scores suggesting higher levels of COVID-19-related PTSD symptoms.

FoMO

To measure FoMO, the scale developed by Przybylski et al.[57] was used. This single-dimension scale consists of ten items. Respondents were asked to indicate how true each statement was of their general experiences. The responses are rated on a 5-point Likert scale, with scores ranging from 1 (not at all true of me) to 5 (extremely true of me), and higher scores indicate higher degrees of FoMO.

Procedure and data analysis

This study first performed Harman's single factor to test the common method variance (CMV),[88] and confirmatory factor analysis (CFA) was executed to assess the reliability and validity of the measurement model. Then, participants' profiles, descriptive statistics, and correlations were conducted with SPSS 21.0 (IBM Corp., Armonk, NY, USA). The Struc-

tural Equation Model (SEM) with AMOS 21.0 was conducted to assess the hypothesized mediation mode.[89] Finally, the bias-corrected bootstrap method with 5,000 times resampling was computed to further test the rigor of the mediating effect.[90]

CMV test

Since all variables were measured with a self-reported scale among the same participants, there may be a CMV problem. In the present study, the Bartlett test of sphericity reached significance (p<0.001), and the unrotated factor analysis indicated that the Kaiser-Meyer-Olkin was 0.946 (more than 0.8). Furthermore, the analysis of Harman's single factor showed that a total of 5 factors were extracted from the factor analysis, and the explanatory power of the first factor was 36.383%, without passing the 40% threshold,[88] indicating on serious CMV problem.

RESULTS

Participants' profile

A total of 856 participants were enrolled in this study, the results of the participants' profiles are shown in Table 1. As shown, in terms of participants' sex, 275 (32.1%) were male and 581 (67.9%) were female. As to age, 5 (0.6%) were 17-year-old, 178 (20.8%) were 18, 298 (34.8%) were 19, and 375 (43.8%) were 20. In terms of grade, the sample consisted of 528 (61.7%)

Table 1. Demographic profile of participants (N=856)

Item	Value
Sex	
Male	275 (32.1)
Female	581 (67.9)
Age	
≤17	5 (0.6)
18	178 (20.8)
19	298 (34.8)
≥20	375 (43.8)
Grade	
Freshman	528 (61.7)
Sophomore	215 (25.1)
Junior	78 (9.1)
Senior	35 (4.1)
Major	
Arts and humanities	214 (25.0)
Science	407 (47.5)
Engineering	235 (27.5)

Values are presented as number (%).

freshmen, 215 (25.1%) sophomores, 78 (9.1%) juniors, and 35 (4.1%) seniors. In terms of major, 214 (25.0%) were arts and humanities, 407 (47.5%) were science, and 235 (27.5%) were engineering.

Reliability and validity of measurement model

The results of the CFA of the measurement model are dis-played in Table 2. As shown, the factor loading of main vari-ables was ranging from 0.515 to 0.826 (more than 0.5), the composite reliability (CR) value was ranging from 0.847 to 0.950 (more than 0.7), and the average variance extracted (AVE) value was ranging from 0.481 to 0.500 (less than 0.5). According to Fornell and Larcker,[91] even though the AVE is less than the threshold of 0.5, provided the CR value is great-

Table 2. The results of confirmatory factor analysis (N=856)

Dimension	No. of item	Factor loading	CR	AVE	Cronbach's α
COVID-19-related PTSD	PTSD1	0.757	0.950	0.500	0.947
	PTSD2	0.718			
	PTSD3	0.749			
	PTSD4	0.736			
	PTSD5	0.515			
	PTSD6	0.583			
	PTSD7	0.711			
	PTSD8	0.657			
	PTSD9	0.826			
	PTSD10	0.760			
	PTSD11	0.766			
	PTSD12	0.744			
	PTSD13	0.699			
	PTSD14	0.655			
	PTSD15	0.701			
	PTSD16	0.786			
	PTSD17	0.708			
	PTSD18	0.661			
	PTSD19	0.636			
FoMO	FoMO1	0.714	0.904	0.487	0.902
	FoMO2	0.716			
	FoMO3	0.776			
	FoMO4	0.771			
	FoMO5	0.621			
	FoMO6	0.699			
	FoMO7	0.698			
	FoMO8	0.611			
	FoMO9	0.692			
	FoMO10	0.662			
SMA	SMA1	0.625	0.847	0.481	0.844
	SMA2	0.698			
	SMA3	0.710			
	SMA4	0.780			
	SMA5	0.730			
	SMA6	0.604			

CR, composite reliability; AVE, average variance extracted; COVID-19, coronavirus disease-2019; PTSD, post-traumatic stress disorder; FoMO, fear of missing out; SMA, social media addiction

er than 0.6, the convergent validity is still acceptable. The Cronbach's α ranged from 0.844 to 0.947, greater than 0.7, indicating good reliability.

Discriminant validity of main variables

According to Fornell and Larcker,[91] this study calculated the square root of AVE to test the discrimination validity of the main variables. As shown in Table 3, the square root of AVE was greater than the correlation coefficient of each variable, meaning a high discriminant validity.

Descriptive statistics and correlations

Descriptive statistics and correlations are shown in Table 3. The statistical results showed that university students had low levels of COVID-19-related PTSD symptoms (1.827), FoMO (1.889), and SMA (2.223). In addition, the results indicated that COVID-19-related PTSD symptoms negatively and significantly correlated with SMA (r=0.369, p<0.001); COVID-19-related PTSD symptoms negatively and significantly correlated with FoMO (r=0.474, p<0.001); FoMO positively and significantly correlated with SMA (r=0.409, p<0.001).

Structural model

To test the proposed mediation model in Figure 1, SEM analysis was conducted. More specifically, this study adopts the selected absolute, incremental, and parsimonious model-fit indices to test the proposed model fit.[89,92] According to the results shown in Table 4, all indices satisfied the criteria, meaning an acceptable model fit.

The results of the structural relationships are displayed in Figure 2. As shown, COVID-19-related PTSD symptoms sig-

nificantly and negatively influenced SMA (β=0.247, p<0.001); FoMO had a significant and positive effect on SMA (β=0.341, p<0.001); and COVID-19-related PTSD symptoms significantly and negatively influenced FoMO (β=0.515, p<0.001). Taken together, these results suggested that FoMO partially mediated the link between university students' COVID-19-related PTSD symptoms and their levels of SMA.

To further test the stability of the mediation model, the bias-corrected non-parametric percentile bootstrap method with 5,000 times resampling was computed. According to Preacher and Hayes,[90] the method of bootstrap could show larger statistical significance compared to the traditional causal steps. As shown in Table 5, the standardized indirect effect (i.e., COVID-19-related PTSD symptoms → FoMO → SMA) was 0.176 with 95% confidence interval (CI) ranging from 0.123 to 0.235, excluding 0, which indicated a significant mediating effect. The standardized direct effect of COVID-19-related PTSD symptoms on SMA was 0.247 with 95% CI ranging
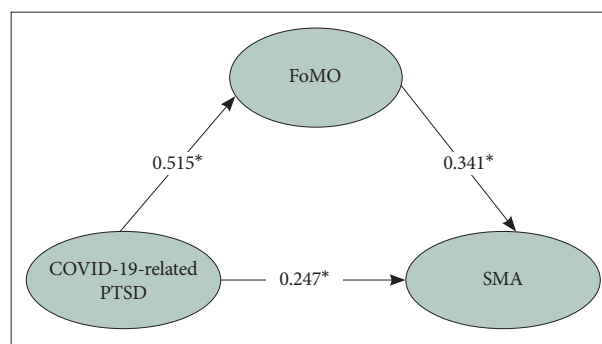

Figure 2. The Mediation Model.*p<0.001. COVID-19, coronavirus disease-2019; PTSD, post-traumatic stress disorder; FoMO, fear of missing out; SMA, social media addiction.

Table 3. Discriminant validity (N=856)

Variable	Mean±SD	1	2	3
1. COVID-19-related PTSD	1.827±0.686	0.707**		
2. FoMO	1.889±0.748	0.474*	0.698**	
3. SMA	2.223±0.764	0.369*	0.409*	0.694**

*p<0.001; **the square root of the AVE. SD, standard deviation; COVID-19, coronavirus disease-2019; PTSD, post-traumatic stress disorder; FoMO, fear of missing out; SMA, social media addiction; AVE, average variance extracted

Table 4. The model-fit of structural model

Model fit measures	Name of index	Acceptable criteria	Estimated values	Fit
Absolute fit	RMSEA	<0.8	0.078	Yes
	GFI	>0.9 or >0.8	0.800	Yes
Incremental fit	CFI	>0.9 or >0.8	0.836	Yes
	TLI	>0.9 or >0.8	0.824	Yes
	NFI	>0.9 or >0.8	0.811	Yes
Parsimonious fit	Chi-square/df	<8.0	6.249	Yes

RMSEA, root mean square of error approximation; GFI, goodness of fit index; CFI, comparative fit index; TLI, Tucker-Lewis index; NFI, normed fit index

Table 5. Standardized direct effect, indirect effect, and total effect

Paths	Estimate value	95% confidence interval	
		Lower limit	Upper limit
Standardized indirect effect	0.176	0.123	0.235
Standardized direct effect	0.247	0.146	0.342
Standardized total effect	0.423	0.338	0.503

from 0.146 to 0.342, excluding 0, which indicated a partial mediating effect. Additionally, the standardized total effect value was 0.423 with 95% CI ranging from 0.338 to 0.503, also without 0. Accordingly, it can be inferred that the mediation effect of FoMO could account for 41.61% of the total effect.

DISCUSSION

Main findings

Drawing upon previous research, in a sample of 856 university students in China, this study aims to investigate the role of COVID-19-related PTSD symptoms in relation to SMA among university students and the mediating role of FoMO. According to the results of the present study, the following findings could be made.

First, the present findings confirm hypothesis 1, supporting that COVID-19-related PTSD symptoms have a significant predictive effect on SMA ($\beta=0.247$, p<0.001). This result is in line with previous studies reporting that PTSD was positively related to Internet addiction and problematic smartphone use.[23,51,52] Aligning with those results, the present study further reported the significant association between COVID-19-related PTSD symptoms and SMA among university students. That is, university students exposed to COVID-19 may experience PTSD symptoms and also tend to have a high risk of SMA. This finding is consistent with the affective processing model of negative reinforcement in the research of substance addiction,[93,94] and the impulsive pathway perspective in the research of technology addiction.[52,77] One reasonable explanation for this finding is the nature of coping strategies used by university students with COVID-19-related PTSD symptoms.

In detail, university students who suffer from COVID-19-related PTSD may use an adaptive or maladaptive strategy to cope with it. One often chosen coping strategy is avoidance, whereby individuals attempt to avoid stressors or distance themselves from their negative affect. In this sense, excessive social media could function as an avoidance coping strategy to avoid emotional distress or escape from the intrusive symptoms of PTSD. According to a quality study by Salzmann-Er-

ikson and Hiçdurmaz,[95] individuals suffering from post-traumatic stress use social media to seek support, discuss health-related issues, and convey authentic narratives of their daily lives, including illness. Although avoidance strategies may temperately reduce psychological distress, they can become maladaptive if individuals overly rely on them and can perhaps develop into an addiction. Thus, social media can be recognized as a maladaptive form of avoidance coping strategy among individuals who experience COVID-19-related PTSD symptoms, which may prevent the processing of traumatic memories and hyper-arousal symptoms. From an avoidance coping strategy perspective, university students with COVID-19-related PTSD symptoms are likely to bury themselves in the cyber world, thereby causing high levels of SMA.

Second, the results of the present study revealed that FoMO could significantly and positively predict university students' SMA ($\beta=0.341$, p<0.001), supporting hypothesis 2. These findings support previous research on the importance of FoMO to the overuse of technology such as social media and smartphones.[59-61] That is, individuals with high levels of FoMO are more likely to develop the risk of SMA in the context of COVID-19. During the cyber era, the FoMO has been identified as an important predictor in the study of SMA.[96] One potential explanation for this link is that individuals who experience FoMO may tend to engage in the excessive use of social media to stay constantly connected, updated, and informed about their other's activities, to not miss the rewarding and wonderful experiences or opportunities others might experience when one is absent. Among the motivations for using social networks, "finding out what is going on" is the most important one.[6] Moreover, some social media platforms may induce and trigger FoMO by designing specific applications, such as notifications and real-time information, which keep users constantly attached to their devices and further contribute to social media self-control failure,[97] resulting in problematic social media use. This interplay between FoMO and social media platform design could create a reinforcing cycle, making it difficult for individuals to disengage from social media, potentially leading to addictive behaviors.

Additionally, according to the results in Figure 2, although both COVID-19-related PTSD and FoMO are predictors of SMA among university students, the strength of predictive effects is different. Compared with the predictive effect of COVID-19-related PTSD ($\beta=0.247$) on SMA, the predictive effects of FoMO on SMA ($\beta=0.341$) are much stronger. This finding corroborated the studies conducted by Elhai et al.[68] and Pontes et al.[98] Using a sample of 308 participants from the U.S.A., Elhai et al.[68] argued that FoMO ($\beta=0.32$) was the most variable in predicting maladaptive smartphone use compared to the need for touch ($\beta=0.20$), anxiety ($\beta=0.18$), and depres-

sion (β=-0.27). In their study among 511 adults, Pontes et al.[98] reported that about 4.9% of all participants had high levels of social networking site addiction risk, with with FoMO (β=0.38) providing the strongest predictive effect on social networking site addiction over and above the effects of maladaptive cognitions (β=0.25), and psychiatric distress (β=0.12). The intricate relationship between FoMO and SMA indicates that in addition to COVID-19-related PTSD symptoms, FoMO is a more important risk factor for SMA among university students.

Third, as expected, the results of the present study supported hypothesis 3, suggesting that FoMO exerted a mediating role between COVID-19-related PTSD symptoms and SMA (the mediation effect was 0.176, with bootstrapping 95% CI= 0.123, 0.235). That is to say, COVID-19-related PTSD symptoms could indirectly affect the university students' levels of SMA through FoMO. The results are in agreement with those of previous studies indicating that FoMO mediated the association between depression and anxiety symptoms and problematic smartphone use severity,[71] between social anxiety and problematic Facebook use,[72] between neuroticism and passive use of mobile social networks,[74] and between family functioning patterns and SMA.[75] Consisting with those empirical studies, the present study further broadens the mediating role of FoMO between COVID-19-related PTSD symptoms and SMA among university students, showing that the effects of university students' COVID-19-related PTSD symptoms on their levels of SPA could be partially mediated by their high levels of FoMO.

The finding of the mediating role of FoMO may be explained by the I-PACE mode. Within the I-PACE model, FoMO is often conceptualized as a response variable, a technology-related maladaptive cognitive bias. It has been theorized that FoMO is skewed towards negative consequences, which also accounts for PTSD symptoms and depression respectively.[99] Since anxiety and depressive symptoms involve social isolation, FoMO can be a natural outcome, in turn driving problem Internet use.[100] In line with I-PACE, several empirical studies have documented FoMO to mediate associations between psychopathological symptoms (i.e., PTSD, depression, and anxiety) and the levels of different forms of technology addiction.[101] Thus, FoMO may be a psychological mechanism that explains how some stressed/anxious individuals with COVID-19-related PTSD symptoms develop the risk of SMA.

Theoretical and practical implications

Based on the I-PACE model, this study proposed a model focusing on the interaction effects of COVID-19-related PTSD symptoms and FoMO on SMA among university students. The main effects of COVID-19-related PTSD symptoms and FoMO on university students' SMA were identified. On the

one hand, to our best knowledge, the present study was the first empirical research in exploring the effect of COVID-19-related PTSD symptoms on SMA among university students. Prior studies found significant associations among PTSD, Internet addiction, and problematic smartphone use in the context of other traumatic and stressful life events, the present study extends earlier work insofar as this study has found associations between COVID-19-related PTSD symptoms and SMA among university students in the context of the COVID-19 pandemic. On the other hand, the psychological mechanism between COVID-19-related PTSD symptoms and university students' SMA was also examined in the present study. To wit, the mediating effect of FoMO was found between PTSD symptoms and university students' SMA. As such, another contribution of this study is that it adds credence to to the existing body of literature by investigating the generalizability of the FoMO mediation effect, exploring the mediating role FoMO in the relationship between COVID-19-related PTSD symptoms and university students' SMA from China.

The results of this study have significant implications for the development of intervention strategies aimed at coping with the issue of SMA among university students in the post-COVID-19 context. First, considering that university students' SMA may be significantly harmed by exposure to trauma and COVID-19-related PTSD, it is suggested that mental health professionals who treat individuals with trauma-related disorders need to include social media use problems in their treatment regimens, including the issues of social media use as part of their treatment strategies. Second, the results of this study also suggest that strategies that manage FoMO or reduce its triggers could be effective in decreasing the levels of SMA, particularly in individuals with high COVID-19-related PTSD symptoms. Some psychological interventions, such as using positive thinking therapy,[102] improving social support networks to satisfy psychological needs,[103] and enhancing social skills, can effectively reduce the levels of FoMO and mitigate the negative effects of SMA on those suffering from COVID-19-related PTSD symptoms.

Limitations and future research

Some limitations of the present study should be noted so that future research can address them. First, this study is cross-sectional using three self-reporting scales, meaning findings may not apply to other cultural contexts. Future studies may design experimental or longitudinal research and adopt the objective measurement method such as structured diagnostic interviews to increase the validity of the findings of the present study.

Second, since the sample involved in the present study only

comprised university students from China, the results of this study could not be necessarily extended to other social groups from different cultures, such as adolescents, older adult, and patients. To test the results of the present study, more samples of different groups from other cultural backgrounds should be enrolled.

Third, this study only examined the predictive effect of COVID-19-related PTSD symptoms on SMA among university students. However, other studies have conceptualized SMA as an antecedent of PTSD symptoms.[104] It is not yet clear whether PTSD symptoms cause SMA, whether SMA causes PTSD symptoms, or whether there is a bidirectional effect. More repeated studies using different measurement instruments may eventually provide answers to this question.[105]

Fourth, the present study only examined the mediating role of FoMO in the association between PTSD symptoms and SMA, further studies should examine the role of other mediators, such as rumination, motives, and positive mental health,[106-108] in the link between PTSD symptoms and SMA.

Fifth, the present study only focused on WeChat addiction, one of the most popular social media among Chinese university students, and did not explore SMA in different social media platforms. Considering that the architectures of social media platforms differ from each other, the determinants of addictive use of other social media may also differ. In this vein, future studies may explore this issue via some other validated instruments (e.g., YouTube Addiction Scale).[109]

In conclusion, based on prior studies and the I-PACE model, this study constructed a mediation model to examine the mediating effect of FoMO in the relationship between COVID-19-related PTSD symptoms and SMA among 856 Chinese university students. The results of SEM analysis showed that COVID-19-related PTSD symptoms had a significant negative predictive effect on SMA and FoMO could significantly and positively predict university students' levels of SMA. Moreover, FoMO mediated the link between COVID-19-related PTSD symptoms and SMA. In the post-COVID-19 era, considering the long-term effects of COVID-19 on mental health and psychopathology, more empirical work on COVID-19-related PTSD symptoms in relation to SMA risk and its psychological mechanisms should be conducted.

Availability of Data and Material
The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Conflicts of Interest
The author has no potential conflicts of interest to disclose.

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