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Depression and Smartphone Addiction Among College Students: The Mediating Effect of Emotional Exhaustion

ABSTRACT

Objective: Multiple studies claim that depression was a triggering factor for smartphone addiction among college students. But we still know very little about the underlying mechanisms of smartphone addiction. The aim was to shed light on the underlying mechanisms of smartphone addiction from the perspective of depression and emotional exhaustion, to provide alternative paths for university administrators to address smartphone addiction among college students.

Methods: A total of 2764 Chinese college students participated in the survey. They independently filled out self-assessment questionnaires including the Cell Phone Addiction Scale, Beck Depression Inventory II, and Emotional Exhaustion Scale. Subsequently, mediation analysis was conducted using the PROCESS macro developed by Hayes (v 4.0; Model 4).

Results: Statistical analysis showed that depression was positively correlated with emotional exhaustion and smartphone addiction, emotional exhaustion was positively correlated with smartphone addiction, all of which were statistically significant. In addition, the effect of depression on smartphone addiction among college students was partially mediated by emotional exhaustion.

Conclusion: The impact of depression and emotional exhaustion on smartphone addiction had been preliminarily explored, which had certain value for further understanding of smartphone addiction among college students. This study could provide references for universities to develop intervention measures for smartphone addiction.

Keywords: Depression, emotional exhaustion, smartphone addiction, college students, cross-sectional design

Introduction

Smartphones represent a significant milestone in the realm of communication technology, serving as a pivotal achievement. Notably, by 2015, smartphone adoption among college students had already reached an impressive rate of 99.2% in China.[1] Smartphones have emerged as indispensable technological tools for college students.[2] However, it should be noted that smartphone bring both benefits and hazards to people. The judicious utilization of smartphones among college students can offer them various conveniences such as effective communication and knowledge sharing, efficient completion of homework and learning tasks, as well as seamless mobile payment options.[3-5] Unreasonable use of smartphones may lead to a series of problems such as impaired hand functionality, musculoskeletal discomfort, fatigue, sleep disruption, academic underachievement, psychological anguish, and so forth,[6-11] and even leaded to smartphone addiction.[12-14] Smartphone addiction, also known as smartphone dependence syndrome, has 4 main characteristics: overindulgence, dependence, compulsion, and withdrawal disorder. It makes it impossible for individuals to control the urge and desire to use smartphones and their apps, leading to feelings of panic when deprived of these devices.[6,15-17] Previous studies had explored the causes of smartphone addiction,[12,18,19] which enriched our understanding of smartphone addiction, but we still know very little. We found

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that previous studies have shown a relationship between depression and smartphone addiction,[20,21] but no research has explored the psychological mechanisms between depression and smartphone addiction and whether emotional exhaustion plays a mediating role in this mechanism.

Depression is a kind of mental disease with a high incidence rate, which is a worldwide public health problem,[22] and is also frequently reported among college students.[23,24] Recent studies have highlighted a sharp rise in the incidence of depression among students during the coronavirus disease 2019 (COVID-19) pandemic.[25-27] A survey of about 10,000 secondary school students (ages 11-20) from China showed that the prevalence of depression among this demographic increased by 20.4% in April 2020, as compared to February 2020.[28] The investigation conducted on Australian adolescents revealed a noteworthy surge in depression rates subsequent to the COVID-19 pandemic compared to pre-pandemic levels, especially among girls.[26] Studies indicated that the relationship between depression and smartphone addiction was statistically significant.[20,21] A study on 421 college students from China showed that depression can directly predict smartphone addiction.[29] A cross-lagged panel model study of Chinese adolescents revealed a significant prospective effect of depression on smartphone addiction.[30] A study found that depression could cause the individual's physical and mental health to be in state of exhaustion for a long time, and accompanied by anxiety, insomnia, palpitation, muscle twitching, lack of energy, and low mood,[31] which may lead to emotional exhaustion of individuals.

Emotional exhaustion was described as the overload of tension and chronic fatigue caused by academic requirements and lack of emotional resources.[32] A study indicated that depression positively predicts emotional exhaustion,[33] and a study on 569 university students of Peru found that depression was one of the factors that affected emotional exhaustion.[34] Of course, it cannot be ignored that depression and emotional exhaustion interact with each other as both cause and effect.[35,36] In addition, it has been confirmed that the relationship between emotional exhaustion and smartphone addiction was statistically significant.[37] College students with emotional exhaustion and academic burnout may be disinterested in learning, unable to stay engaged in their courses, and feel worthless in their learning activities,[38] who are more likely to habitually use smartphones to overcome negative emotional distress and gain pleasure and enjoyment.[39] This is the double expression of entertainism and escapism.[40]

Based on past research experience,[41-43] researchers typically use the Interaction of Person Effect Cognition Execution Model (I-PACE) to explain these relationships.[44,45] In the I-PACE model, categories of key variables that had impacts on smartphone addiction were conceptualized, such as background predisposing variables (e.g., personality, cognitions), affective and cognitive responses (e.g., response strategy, mood dysregulation, responses to environmental stressors), and executive functioning impairment (e.g., inhibitory control, decision-making). Researchers generally believe that depression is closely related to a range of cognitive deficits.[46] So, we could consider depression as a background susceptibility variable in the I-PACE model. Emotional exhaustion involves response strategies in the affective and cognitive response domains, whereas smartphone addiction could be seen as a result of decision-making and execution. Regarding emotional regulation, the theory has proposed that the more severe the deficits in emotion regulation, the higher the likelihood of risk-taking behavior, attempting to reduce or alleviate negative emotional experiences.[47] Individuals with deficits in emotion regulation are likely to use smartphones to diffuse stress and escape from reality, rather than using positive strategies to regulate negative emotions, such as problem-solving or actively seeking support from others.[48] Based on the existing literature, we hypothesize that emotional exhaustion may mediate the relationship between depression and smartphone addiction among college students.

Based on the above comprehensive analysis, we put forward 2 hypotheses. With the ultimate purpose of testing the potential mediating role of emotional exhaustion in the relationship between depression and smartphone addiction among college students, so as to provide alternative paths for college administrators to deal with the phenomenon of smartphone addiction among college students (Figure 1).

Hypothesis 1: Depression positively predicts smartphone addiction among college students.

Hypothesis 2**:** Emotional exhaustion mediates the impact of depression on smartphone addiction.

MAIN POINTS

- *Among the college students, 40.9% of them were identified as smartphone addicts, and 32.7% of college students were diagnosed with depression, mainly mild and moderate depressions.*
- *Depression was positively correlated with emotional exhaustion ($r = 0.306$, $P < .001$) and smartphone addiction ($r = 0.230$, $P < .001$). Emotional exhaustion was positively correlated with smartphone addiction ($r = 0.311$, $P < .001$).*
- *Emotional exhaustion partially mediated the impact of depression on smartphone addiction, accounting for 34.4% of the total effect.*

Material and Methods

Study Design and Subjects

The present study recruited 2764 college students from Chinese universities from August 2022 to September 2022. The inclusion criteria included 3: (i) college students who independently own smartphones; (ii) willing to sign an informed consent form and able to cooperate in filling out questionnaires; (iii) Chinese university students who were over 18 years old. The exclusion criteria included 4: (i) patients who have been diagnosed with depression and were currently receiving treatment; (ii) patients with other mental illnesses or medical histories; (iii) graduated college students or current master's

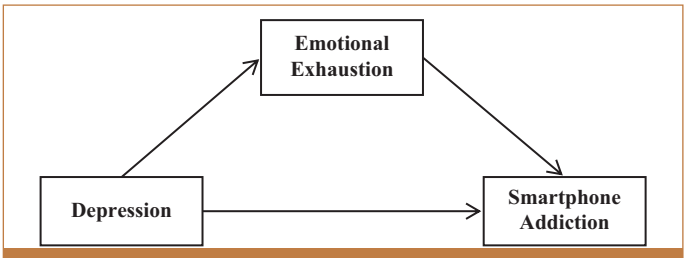


Figure 1. Conceptual model.

and doctoral students; (iv) college students who were not Chinese nationals.

The ethics committee of Quzhou College of Technology approved the study (Approval No: 202401710; Date: January 17, 2024), and the procedure adhered to the tenets of the Declaration of Helsinki.

Procedure and Measurement

We developed a baseline questionnaire including 3 scales, such as the Cell Phone Addiction Scale, the Beck Depression Inventory Ⅱ, and the Emotional Exhaustion Scale. Meanwhile, demographic data including age, gender, grade, and daily smartphone use hours were also collected. We publicly provided self-evaluation questionnaires, including informed consent forms, to college students nationwide on the Internet. All participants could withdraw at any time without any explanation. Additionally, all the participants participated anonymously and their information was kept confidential to protect their privacy. After collecting survey data, samples with regular self-evaluation were deleted. Based on inclusion and exclude criteria, a total of 2764 college students were identified as valid participants in the present study.

Instruments

Smartphone Addiction: Smartphone addiction was measured by Cell Phone Addiction Scale.[49] It is a 4-item scale, such as "I get agitated when my cell phone is not in sight", the score rated from "1 = strongly disagree" to "7 = strongly agree". A higher score indicates a higher level of smartphone addiction. If the total score was less than 20 points, it was considered an ordinary smartphone user, and if the total score was 20 points or more, it was considered a smartphone addict.[50] The validity of the Chinese version scale was proved to be acceptable.[50] Cronbach's α is 0.80.

Depression: The current study used the Beck Depression Inventory Ⅱ developed by Beck et al[51] to measure the level of depression among college students. This scale includes 21 items, and participants were asked to report specific symptoms during the previous week. The scale was rated on a 4-point Likert scale, with scores ranging from "0 = no symptoms" to "3 = severe symptoms, can barely endure it", the lowest total score is 0 points, and the highest total score is 63 points. Those with a final score of less than 13 are considered normal, those with a score of 14-19 are considered to have mild depression, those with a score of 20-28 are considered to have moderate depression, and those with a score of 29-63 are considered to have severe depression.[51] A decent validity of the scale has been verified in Chinese samples.[52,53] Cronbach's α is 0.92.

Emotional Exhaustion: We measured emotional exhaustion by the Emotional Exhaustion Scale including 3 items developed by Watkins et al.[54] These items included "I feel emotionally drained from my work", "I feel burned out from my work", and "I feel exhausted when I think about having to face another day on the job". It uses a 7-point Likert scale (1 = *never*, 7 = *very often*), and higher scores indicate higher levels of emotional exhaustion. The Chinese version of this scale has been widely used in Chinese samples and its validity has been recognized.[55,56] Cronbach's α is 0.91.

Statistical Methods

Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM SPSS Corp.; Armonk, NY, USA) and AMOS version 24.0 (IBM SPSS Corp.; Armonk, NY, USA) were used to perform statistical analysis. First, we used Harman single factor method to detect the common method bias, and multi-collinearity was tested using multi-linear regression analysis. Second, we relied on the confirmatory factor analysis (CFA) of AMOS 24.0 software to perform the detection of the measurement model. Third, internal consistency coefficients were estimated, and descriptive statistics, ANOVA tests, *t*-test, and Pearson correlations between variables, and the criterion for determining whether it had statistical significance was that the *P*-value was less than .05. Finally, we used Hayes'[57] PROCESS macro (v 4.0) and Model 4 to examine the potential mediating effect of emotional exhaustion. Previous studies found that age, gender, and grade may affect smartphone addiction,[58,59] so the present study included them as covariates. Thereafter, 5000 bias-corrected bootstrapped sampling was used to estimate the 95% CI (confidence interval; the criterion for statistical significance is that the middle between lower and upper does not include 0) of the mediating effect.[60]

Results

Preliminary Analyses

First, a common method bias test was performed for the three scales in the questionnaire. We carried out principal component analysis on these scales based on Harman single factor method, and extracted a total of four eigenvalues greater than 1. The explanatory variation of the first factor was 31.03%, which was significantly less than 40%, indicating that the first factor did not play a major role in explaining the degree of variation. Therefore, there was no obvious problem of common method bias in the data.[61] In addition, to test the multicollinearity between variables, this study used multilinear regression analysis to check the value of the variance inflation factor (VIF). Our test results showed that all the VIF values (1.132 to 1.183) were well below the threshold of 5,[62] and there is no evidence of multi-collinearity. In addition, CFA was conducted with AMOS 24.0 and the results showed that the hypothesized model's fitness was good ($\chi^2/df = 3.59$, $P < .001$, Root Mean Square Error of Approximation [RMSEA] = 0.03, Comparative Fit Index [CFI] = 0.97, Tucker-Lewis Index [TLI] = 0.97), indicating that this model fitted the data well.[63]

Demographic and Descriptive Characteristics

The average age of participants was 19.9 (1.2) years (range 18 to 25 years); 854 (30.9%) were males and 1910 (69.1%) were females. Additionally, 835 (30.2%) were freshmen, 1197 (43.3%) were sophomores, 536 (19.4%) were juniors, and 196 (7.1%) were seniors. Among all of the participants, 16 (0.6%) used smartphones for less than 1 hour per day, 226 (8.2%) used smartphones for 1-3 hours per day, 1148 (41.5%) used smartphones for 3-6 hours per day, and 1374 (49.7%) used smartphones for more than 6 hours per day, as shown in Table 1.

Table 1 showed that the average score of depression was 10.6 (SD = 9.4) (95% CI: 10.244-10.942, range from 0-63), the proportion of college students with normal, mild, moderate, and severe depression was 67.3%, 16.3%, 11.9%, and 4.5% respectively. From this, it can be seen that 32.7% of college students were identified as patients with depression, although the degree of depression varied, which was consistent with the research results of Quan et al.[64] The average emotional exhaustion score was 11.3 (SD = 4.1) (95% CI: 11.161-11.464, range from 3-21), the median score was 12.00, consistent with the theoretical median (12.00), which indicated a moderate level of emotional exhaustion among college students. The average score

Table 1. Demographic and Descriptive Characteristics

Variable		Frequency (%)/ Mean (SD)
Age	Range 18-25	19.9 (SD = 1.2)
Gender	Male	854 (30.9)
	Female	1910 (69.1)
Grade	Freshman	835 (30.2)
	Sophomore	1197 (43.3)
	Junior	536 (19.4)
	Senior	196 (7.1)
Smartphone use per day (hours)	<1 hours	16 (0.6)
	1-3 hours	226 (8.2)
	3-6 hours	1148 (41.5)
	>6 hours	1374 (49.7)
Depression	Total sample	10.6 (SD = 9.4)
	Normal	1859 (67.3)
	Mild	450 (16.3)
	Moderate	330 (11.9)
	Severe	125 (4.5)
Emotional exhaustion	Total sample	11.3 (SD = 4.1)
Smartphone addiction	Total sample	18.1 (SD = 5.1)
	Smartphone addict	1131 (40.9)

N = 2764.
SD, standard deviation.

of smartphone addiction was 18.1 (SD = 5.1) (95% CI: 17.879-18.263, range from 4-28), the median score (18.00) was slightly higher than the theoretical median (16.00), which meant that in general, the smartphone addiction score of college students was slightly above the moderate level. The study found that 40.9% of college students were identified as smartphone addicts, which was slightly higher than Saudi Arabia (37.4%),[65] but much lower than Malaysia (58%),[66] Brazil (56.37%),[67] and Iran (53.3%)[68] during the same period.

Correlation analysis showed that depression was positively correlated with emotional exhaustion ($r = 0.306$; $P < .001$) and smartphone addiction ($r = 0.230$; $P < .001$). Emotional exhaustion was positively correlated with smartphone addiction ($r = 0.311$; $P < .001$), seen Table 2 for details.

Testing for the Mediation Model

To test our hypothesis, the present study tested a mediation model using Hayes'[57] PROCESS macro statistical software 3.5 (Model 4). Depression was a risk factor of smartphone addiction ($\beta = 0.122$; $P < .001$; 95% CI = [0.103, 0.142]). As can be seen from Table 3, depression can remain predicted smartphone addiction when both depression and emotional exhaustion were included ($\beta = 0.081$; $P < .001$; 95% CI = [0.061, 0.100]). Depression can predict emotional exhaustion ($\beta = 0.131$; $P < .001$; 95% CI = [0.116, 0.146]), and emotional exhaustion was a predictor of smartphone addiction ($\beta = 0.317$; $P < .001$; 95% CI = [0.272, 0.363]). At the same time, as shown in Table 4, both the direct effect of depression on smartphone addiction and the indirect effect of emotional exhaustion on smartphone addiction were significant, because the 95% CI did not include 0. Thus, emotional exhaustion partially mediated the relationship between depression and smartphone addiction, accounting for 34.4% of the total effect (as shown in Figure 2).

Table 2. Pearson Correlation Analysis of Major Variables

Variables		1	2	3	4	5
Age		–				
Grade[a]	*r*	0.665	–			
	P	.000				
Depression	*r*	0.043	0.045	–		
	P	.024	.018			
Emotional exhaustion	*r*	0.037	0.074	0.306	–	
	P	.054	.000	.000		
Smartphone addiction	*r*	0.017	0.066	0.230	0.311	–
	P	.369	.000	.000	.000	

N = 2764.
[a]Grade: freshman = 1, sophomore = 2, junior = 3, senior = 4.

Discussion

Under the guidance of the I-PACE,[44,45] we developed a mediating model based on previous literature and research experiences to examine the potential mediating effect of emotional exhaustion between depression and smartphone addiction among college students. As hypothesized, this study found that depression was a predictor of smartphone addiction, with emotional exhaustion partially mediating the effect of depression on smartphone addiction. Our findings provided more evidence on the mechanisms of smartphone addiction.

The Influence of Depression on Smartphone Addiction

The present study found that depression could predict smartphone addiction, which indicates that depression could enhance the

Table 3. Mediation Analysis

	Emotional Exhaustion			Smartphone Addiction		
Predictors[a]	*B* (*P*)	SE	95% CI	*B* (*P*)	SE	95% CI
Age	–0.077 (.337)	0.080	[–0.235, 0.080]	–0.098 (.323)	0.099	[–0.291, 0.096]
Gender	0.469 (.003)	0.160	[0.157, 0.782]	2.107 (<.001)	0.196	[1.722, 2.491]
Grade	0.354 (.002)	0.111	[0.136, 0.573]	0.348 (.011)	0.137	[0.079, 0.616]
Depression	0.131 (<.001)	0.008	[0.116, 0.146]	0.081 (<.001)	0.010	[0.061, 0.100]
Emotional exhaustion				0.317 (<.001)	0.023	[0.272, 0.363]
R^2		0.100			0.155	
F (*P*)		76.983 (<.001)			101.215 (<.001)	

N = 2,764.
SE, standard error.
[a]Gender: male = 1, female = 2. Grade: freshman = 1, sophomore = 2, junior = 3, senior = 4.

Table 4. Bootstrapping Analysis Results of Mediation Model

	Estimated Effect	SE	95% CI	Ratio to Total Effect
Total effect	0.122	0.010	[0.103, 0.142]	
Direct effect	0.080	0.010	[0.061, 0.100]	65.6%
Indirect effect	0.042	0.005	[0.032, 0.052]	34.4%

N = 2764.
SE, standard error.

tendency of college students to become addicted to smartphones. Thus, hypothesis 1 was supported, which was consistent with previous research results.[29,30] We believe that the Mood Enhancement Hypothesis is more suitable to explain this phenomenon. This theory explains that individuals suffering from negative emotions (such as depression) are more likely to release or relieve psychological pressure through recreational activities (e.g., internet use, online shopping, electronic games), thereby improving their emotional state,[69,70] and smartphones may be used as one of their entertainment tools. As stressors increase, so does the susceptibility of college students to psychological distress, including depression.[71] Their use of smartphones may become a convenient way to disperse fear, distress, and depression.[72] In this case, they are likely to become dependent on smartphones, and their addiction tendency will gradually increase. In summary, depression can be identified as an important risk factor for behavioral addiction.[73]

The Mediating Role of Emotional Exhaustion

The results showed that depression can positively predicts emotional exhaustion and emotional exhaustion positively predicts smartphone addiction. The further tests on the mediating effect showed that emotional exhaustion played a partial mediating role between depression and smartphone addiction, which partially supported hypothesis 2.

Emotional exhaustion refers to resource depletion and mental fatigue caused by long-term or excessive emotional demands.[74] When college students are experiencing negative emotions, especially depression, their mental resources will be consumed. Further research has pointed out that when a job is received as exceeding the limit that an individual can handle, he or she experiences a decrease in the level of available temporary resources.[75] One of the key buffers against psychopathology is emotion regulation.[47] Emotional regulation is the process by which an individual regulates their emotions to achieve an optimal state.[48] Regarding emotional regulation, the theory has proposed out that individuals with higher emotional regulation deficits are more likely to engage in risky behavior, attempting to reduce or alleviate negative emotional experiences.[47] Such individuals may use distraction, avoidance, and disengagement via their smartphones, rather than using adaptive coping strategies to regulate emotion, such as problem-solving or social support.[48] Smartphones were their first and perhaps only choice for releasing negative emotions. In addition, the excessive reassurance seeking motive observed among the distressed individuals drives the uncontrollable smartphone use,[76,77] which increases the risk of smartphone addiction.

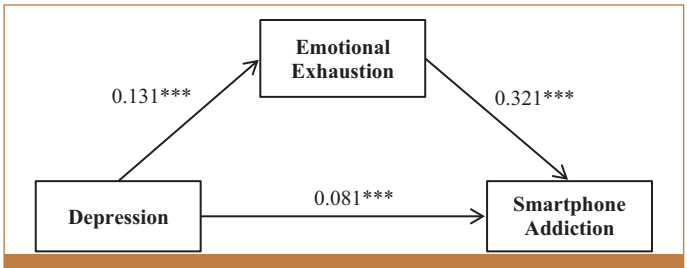


Figure 2. Confirmed model. ***$P < .001$.

This study investigated the degree and interaction of depression, emotional exhaustion, and smartphone addiction among college students. The results showed that depression was related to age, emotional exhaustion and smartphone addiction were related to gender, and depression, emotional exhaustion, and smartphone addiction were all related to the grade of college students. At the same time, there were significant positive correlations between depression, emotional exhaustion, and smartphone addiction. Emotional exhaustion played a partial mediating role between depression and smartphone addiction. Considering the crucial role of depression in emotional exhaustion and smartphone addiction, various positive coping strategies (psychological counseling, social support, behavioral activity arrangements) should be recommended to college students to reduce the negative impact of depression on emotional exhaustion and smartphone addiction. Due to the challenge of assessing the severity of the negative effects of depression and when and how to implement interventions, the existence of smartphone addiction among college students might be a valuable warning signal; that is, college students' smartphone addiction should be timely and properly intervened, especially for individuals with serious negative emotions. Finally, as the mental health of college students might vary over time, it was necessary to conduct dynamic assessments of their mental health issues and provide long-term social and psychological care or support to vulnerable populations who feel extremely fearful.

Limitations and Future Studies

Due to several limitations, the current research results require careful interpretation. First, the use of cross-sectional design in our study is not conducive to causal inference. Future research can use longitudinal or experimental designs to test the causal relationships between these variables. Second, the self-reporting method used to obtain survey data in this study may introduce social expectation bias or other biases, thereby limiting the validity of the data. In future research, multiple assessments (such as those from teachers and peers) can be included to obtain stronger evidence. Third, the COVID-19 epidemic is also one of the factors that lead to smartphone addiction.[78] This study did not control it as a covariate. In future studies, unrelated variables should be effectively controlled. Although there are some limitations, this study still has theoretical and practical implications. First, this study explains the relationship between depression, emotional exhaustion, and smartphone addiction, providing a new explanation for understanding the causes of smartphone addiction among college students. At the same time, this study was carried out against the background of the COVID-19 lockdown, providing an important reference for the prevention and intervention of smartphone addiction among college students in major public health events.

Data Availability: *The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.*

Ethics Committee Approval: *This study was approved by the Ethics Committee of Quzhou College of Technology (Approval No: 202401710; Date: January 17, 2024).*

Informed Consent: *Informed consent was obtained from the participants who agreed to take part in the study.*

Peer-review: *Externally peer-reviewed.*

Author Contributions: *Concept – B.F.; Design – B.F., G.D.; Supervision – B.F.; Resources – B.F., G.D.; Materials – B.F., G.D.; Data Collection and/or Processing – B.F., G.D.; Analysis and/or Interpretation – B.F., G.D.; Literature Search – B.F., G.D.; Writing – B.F., G.D.; Critical Review – B.F.*

Declaration of Interests: *The authors have no conflicts of interest to declare.*

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