

Do Boys and Girls Display Different Levels of Depression in Response to Mobile Phone Addiction? Examining the Longitudinal Effects of Four Types of Mobile Phone Addiction

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Purpose: Prior research has indicated that mobile phone addiction (MPA) significantly contributes to depression. However, there is a research gap in exploring the distinct impacts of various types of MPA on depression, along with the potential moderating effect of gender. The current study investigated whether the relationship between MPA and depression varies depending on the types of MPA and gender.

Methods: A one-year longitudinal study was undertaken at two high schools in Central China. Data was gathered at two time points (Time 1/T1 and Time 2/T2) with a one-year gap between assessments. A total of 480 adolescents, aged 12 to 19 years old, completed all questionnaires assessing four types of mobile phone addiction at T1, as well as depression at T1 and T2.

Results: The findings demonstrated significant positive associations between all four types of MPA at T1 and depression at T2. Additionally, gender was found to moderate the associations between three types of MPA and depression. Specifically, among girls, T1 social media addiction had a stronger predictive effect on T2 depression compared to boys. Conversely, among boys, T1 game addiction had a more pronounced predictive effect on T2 depression, which was less significant among girls. Moreover, in boys, T1 short-form video addiction had a noteworthy predictive effect on T2 depression, but this effect was not significant in girls. However, it is worth noting that T1 information acquisition addiction had a significant predictive effect on T2 depression in both boys and girls, with no noticeable gender difference.

Conclusion: The current study has enhanced our understanding of the impact of MPA on mental health by examining the correlation between different types of MPA and depression across genders. The findings provide valuable insights for reducing depression among adolescents of different genders by considering their mobile phone usage patterns.

Keywords: mobile phone addiction, depression, gender, moderating effects, adolescents

Introduction

Depression stands as one of the most severe mental health challenges. Its prevalence is strikingly significant among both children and adolescents^{1,2} as well as young and older adults.^{3,4} Theoretical research^{5,6} and practical interventions⁷⁻⁹ aimed at addressing depression have become hot topics of exploration for researchers spanning numerous disciplines. Adolescents, owing to their unique developmental stage, are particularly vulnerable to experiencing depression due to a multitude of influencing factors.^{10,11} Adolescent depression issues have persistently been a prominent social concern across multiple countries, notably including China.^{12,13} Recent meta-analytic findings have indicated a substantial surge in the detection rate of depression among adolescents in China over the past decade.^{14,15} The detection rate of depression

has reached 24% (confidence interval 22%-26%) among junior high school students,¹⁴ and 28% (confidence interval 25%-33%) among senior high school students.¹⁵ Depression not only negatively impacts adolescents' academic development^{16,17} but also correlates with sleep disorders,^{18,19} non-suicidal self-injury,^{20,21} and even suicidal behaviors.²² Therefore, Identifying the causes of adolescent depression and analyzing the underlying conditions are essential for understanding and addressing mental health problems among adolescents.

The advent of the digital age has transformed contemporary adolescents into digital natives, deeply immersed in the online environment throughout their development. The engagement with the internet introduces new challenges to the mental health of adolescents. Internet use, especially when it escalates to the level of addiction, significantly increases the risk of developing depression. The predictive relationship between internet addiction and depression has been consistently reinforced by numerous cross-sectional²³⁻²⁵ and longitudinal studies,^{26,27} particularly within adolescent populations.^{28,29} In the current era of mobile internet, mobile phones have emerged as the predominant medium for adolescents to engage with and utilize the online sphere. Problematic mobile phone use, such as mobile phone addiction (MPA), notably heightens the susceptibility of adolescents to depression.^{30,31}

Mobile Phone Addiction and Depression

MPA has been found to have detrimental effects on mental health, particularly in relation to depression. Zhang et al conducted a prospective longitudinal study that revealed MPA at Year 1 significantly predicted adverse mental health outcomes at Year 3, including diminished subjective well-being and increased levels of anxiety and depression.³⁰ Coyne et al demonstrated through longitudinal analysis that early mobile phone addiction (MPA) serves as a predictor of subsequent depression, rather than the reverse relationship.³¹ Two theories can elucidate the relationship between MPA and depression. The first, the displacement hypothesis of mobile phone use, posits that excessive use of mobile phones can displace activities such as daily exercise, socializing, and sleep, resulting in a diminished quality of life and an increased risk of depression.³² Conversely, the interference hypothesis of mobile phone use suggests that problematic smartphone use directly disrupts individuals' cognitive processes and social interactions, potentially fostering negative thinking patterns or interpersonal conflicts, ultimately contributing to the development of depression.^{32,33}

Previous studies have indicated that MPA not only directly predicts depression,^{34,35} but it can also indirectly predict depression through various mediating factors, such as phubbing behaviors,³⁶ social anxiety,³⁷ sleep quality,³⁸ and parent-child relationships.³⁹ Furthermore, MPA plays a crucial mediating role in the association between certain risk factors (such as neuroticism and academic stress) and depression.^{40,41} For instance, Gao et al demonstrated that neuroticism can indirectly predict depression via the mediating role of maladaptive personality attributes (MPA).⁴⁰ Similarly, Zhang et al revealed that perceived stress also exerts an indirect effect on depression through the mediation of MPA.⁴¹ The association between MPA and depression has been observed not only among children and adolescents,⁴² but also in young adults and older adults.^{43,44} The effect of MPA on depression has been supported by both cross-sectional questionnaire studies and a few longitudinal questionnaire studies.^{30,31,45} Specifically, in cross-sectional studies, the correlation coefficient between MPA and smartphone addiction typically ranges from 0.16 to 0.53.³⁴⁻⁴⁴ Conversely, longitudinal research more frequently demonstrates that earlier MPA serves as a predictor for later depression, rather than indicating a reverse relationship.^{30,31} A comparative analysis indicates that a significant proportion of studies examining the relationship between MPA and depression utilize cross-sectional survey methods. In contrast, longitudinal tracking studies, which provide greater validity, are relatively scarce. Moreover, beyond the methodological limitations, there is a lack of research examining the potential variations in the effects of various types of MPA on depression. As smartphones become increasingly complex, user behaviors are also diversifying. These varied usage patterns are likely to give rise to different forms of Mobile Phone Addiction (MPA). A general analysis of the relationship between MPA and depression, without examining specific behaviors, does not clarify whether distinctions exist among the various types of MPA in relation to depression. Specifically, it does not evaluate whether all forms of MPA significantly predict depression.

Research indicates that MPA can be categorized into four main types based on specific behaviors, including social media addiction, game addiction, information acquisition addiction, and short-form video addiction.⁴⁶ These four subtypes of MPA display unique behavioral characteristic. Social media addiction is marked by an excessive longing

for and reliance on social media, which in turn leads to impaired psychological and social functioning. Similarly, game addiction involves an excessive desire for and excessive use of online games, resulting in impaired psychological and social adaptation. Information acquisition addiction, on the other hand, encompasses an excessive craving for and overuse of online information, which leads to impaired psychological and social functioning. Finally, short-form video addiction refers to an excessive desire for and reliance on short-form video applications, leading to impaired psychological and social adaptation. Previous studies have revealed a significant predictive effect of social media addiction and game addiction on depression.^{47–50} Foroughi et al demonstrated that Facebook addiction significantly predicted depression.⁴⁷ Wang et al found that social media addiction was not only directly associated with depression but also indirectly related to it through the mediating effect of rumination.⁴⁸ Fazeli et al reported that internet gaming disorder significantly predicted depression and also had an indirect effect on insomnia, mediated by depression.⁴⁹ Furthermore, Yu et al indicated that internet gaming disorder directly impacts depression and indirectly influences suicidal ideation through the mediating role of depression.⁵⁰ Although studies have investigated the relationships between social media addiction, gaming addiction, and depression, the existing research remains limited. Furthermore, most studies primarily examine gaming behaviors within the context of internet addiction mediated by computers, overlooking smartphone addiction as a distinct category. As smartphones have become the dominant medium for internet use due to their convenience and personalization, smartphone addiction often exhibits different characteristics compared to traditional computer-mediated internet addiction. More critically, the connections between information acquisition addiction, short-form video addiction, and depression have been the subject of minimal research attention. Even less work has been done to concurrently analyze and compare social media addiction, gaming addiction, information acquisition addiction, and short-form video addiction. Analyzing whether the effect of MPA on depression varies with different addiction types can provide specific insights into the predictive effects of the specific types of MPA on depression, deepening the understanding of the association between MPA and depression in previous studies. Additionally, from a methodological standpoint, a significant limitation inherent in previous cross-sectional survey studies is their inability to establish influencing relationships. Since these studies collect data at a single point in time, they often cannot determine the temporal sequence of variables, making it challenging to identify which variable should be considered as an independent variable and which as a dependent variable. Employing a longitudinal design to examine whether earlier mobile phone addiction (MPA) at Time 1 (T1) significantly predicts subsequent depression at Time 2 (T2) offers a more robust framework for establishing the longitudinal relationship between these two variables compared to a cross-sectional questionnaire approach. Building on prior theoretical and empirical evidence, we posit the following hypotheses:

Hypothesis 1a: T1 social media addiction will significantly predict T2 depression.

Hypothesis 1b: T1 game addiction will significantly predict T2 depression.

Hypothesis 1c: T1 information acquisition addiction will significantly predict T2 depression.

Hypothesis 1d: T1 short-form video addiction will significantly predict T2 depression.

Moderating Effect of Gender

Gender may moderate the relationship between MPA and depression. Previous studies have found significant gender differences in depression, with females experiencing higher levels of depression compared to men.^{51,52} Females exhibit greater sensitivity to negative environmental factors, and when confronted with similar adverse life events, they are more prone to depression than males.^{53,54} Similarly, the overall level of MPA also shows significant gender differences with females displaying a higher level of addiction compared to males.^{45,55} Consequently, females may exhibit significantly higher levels of depression compared to males, as a result of more severe smartphone addiction. Hence, it is plausible to suggest that the correlation between MPA and depression may be more pronounced in females and less pronounced in males.

Nevertheless, it is important to note that the influence of gender on the association between MPA and depression may vary depending on the specific type of MPA being examined. For instance, research has shown that females tend to

exhibit significantly higher levels of social media addiction compared to males,^{56,57} while males tend to display significantly higher levels of gaming addiction compared to females.^{58,59} Consequently, the relationship between a specific type of MPA and depression may be stronger in males, whereas another type of MPA may have a stronger association with depression in females. However, there are currently very few studies that explore the potential gender differences in the relationship between specific types of mobile phone addiction and depression, and even fewer that examine how different types of phone addiction, in combination with gender, predict mobile addiction. If there is a complex interaction between addiction types and gender in relation to adolescent depression, it is evident that practical interventions for reducing depression risk should tailor different goals and activities for various types of mobile phone addiction among adolescent boys and girls. Taking into consideration both the types of behavioral addiction and gender roles will undoubtedly greatly assist in analyzing the complex relationship between MPA and adolescent depression, thereby more accurately identifying the differences in intervention priorities for a particular type of MPA between boys and girls. Drawing on existing theoretical and empirical evidence, we propose the following hypotheses:

Hypothesis 2a: Gender will moderate the relationship between T1 social media addiction and T2 depression.

Hypothesis 2b: Gender will moderate the relationship between T1 game addiction and T2 depression.

Hypothesis 2c: Gender will moderate the relationship between T1 information acquisition addiction and T2 depression.

Hypothesis 2d: Gender will moderate the relationship between T1 short-form video addiction and T2 depression.

The Present Study

In summary, the present study aimed to investigate potential variations in the relationship between MPA and depression based on gender and type of addiction. In order to obtain more robust research findings, we employed a longitudinal design and conducted a one-year questionnaire survey to analyze whether four different types of MPA could reliably predict depression levels one year later. In addition, the study also examined whether gender could moderate the association between the four types of MPA and depression. The findings can contribute to a more rigorous understanding of the long-term relationship between various types of smartphone addiction and depression, as well as the potential gender differences.

Materials and Methods

Participants Measurements

The present study received approval from the ethics committee at the institution of the first author. Prior to their involvement, all participants provided informed consent. For individuals under the age of 18, consent was also obtained from their guardians. At Time 1, a total of 512 students from two high schools located in Central China completed all the questionnaires in the initial survey. One year later, at Time 2, the same procedure was used and 93.8% of the initial sample ($N = 480$) completed the survey. During the data collection process, we assigned each student a unique identification number based on the list provided by the school. Each student was instructed to clearly display their assigned number during both data collection sessions, enabling us to accurately match the two datasets. Among the 480 adolescents, 230 (47.92%) were female and 250 (52.08%) were male. Furthermore, 257 (53.54%) adolescents were junior high school students, while 223 (46.46%) were senior high school students. Participants' ages ranged from 12 to 19 years ($M = 14.76$, $SD = 1.84$). The demographic characteristics of the participants at Time 1 and Time 2 are detailed in Table 1.

Measurements

Mobile Phone Addiction

The Mobile Phone Addiction Type Scale was utilized to evaluate four different types of smartphone addiction.⁴⁶ The scale consists of 26 items, with six items dedicated to measuring social media addiction, six items for game addiction,

Table 1 Characteristics of the Participants

Characteristics		Number (percentage)	
		T1 group	T2 group
Gender	Boy	273 (53.32%)	250 (52.08%)
	Girl	239 (46.68%)	230 (47.92%)
Educational stage	Junior high school	276 (53.91%)	257 (53.54%)
	Senior high school	236 (46.09%)	223 (46.46%)

Note: $N_{T1} = 512$, $N_{T2} = 480$.

seven items for information acquisition addiction, and seven items for short-form video addiction. Participants were asked to rate each item on a five-point scale ranging from 1 (“almost never”) to 5 (“almost always”). The reliability of the subscales was assessed using Cronbach’s α coefficient. The obtained coefficients were 0.92, 0.94, 0.90, and 0.95 for the subscales of social media addiction, game addiction, information acquisition addiction, and short-form video addiction, respectively. Additionally, we performed a confirmatory factor analysis (CFA) to evaluate the validity of the MPATS. The model fit indices were as follows: $\chi^2/df = 3.10$, RMSEA = 0.07, CFI = 0.94, NFI = 0.92, and TLI = 0.94. These results indicate that the MPATS demonstrates good reliability and validity in our study.

Depression

Depression was assessed using the ten-item Center for Epidemiologic Studies Depression Scale (CES-D).⁶⁰ Participants were asked to rate on a four-point scale (ranging from 0 to 3) how frequently they experienced the described feelings in the past week. Higher scores indicate greater levels of depression. The Cronbach’s α coefficients for the CES-D were 0.78 at Time 1 and 0.91 at Time 2. The CFA indices for the CES-D at Time 1 were as follows: $\chi^2/df = 3.25$, RMSEA = 0.07, CFI = 0.96, NFI = 0.95, and TLI = 0.95. At Time 2, the CFA indices were: $\chi^2/df = 2.67$, RMSEA = 0.06, CFI = 0.98, NFI = 0.97, and TLI = 0.97. These findings indicate that the CES-D exhibits strong reliability and validity in our study.

Analytic Strategies

Pearson correlation analysis was performed to examine the relationship between depression and four specific types of MPA. Additionally, an independent samples t -test was conducted to determine if there were any gender differences in both depression and the four types of MPA. To further investigate the potential moderating effect of gender, moderation analysis was conducted using the PROCESS macro for SPSS.⁶¹ In order to control for any potential confounding effects on the results, covariates such as age and mobile phone use duration were included in the analysis. Additionally, as we examined the predictive effects of four types of mobile phone addiction on depression and the associated gender differences, we employed the Bonferroni correction to mitigate the likelihood of Type I error. We set the Type I error threshold at $\alpha = 0.05/4$ (ie, 0.0125) to determine the significance of the p -values. Consequently, in our analysis, we deemed an indicator significant if the p -value was less than 0.0125.

Results

Preliminary Analysis

The relationships between the core variables are outlined in Table 2. The analysis revealed statistically significant positive correlations between four distinct types of MPA and depression at both Time 1 ($p < 0.001$) and Time 2 ($p < 0.001$).

Table 3 presents the differences in core variables between boys and girls. No significant gender differences were found in T1 information acquisition addiction ($t = -1.65$, $p = 0.10$). However, girls exhibited higher scores in T1 social media addiction ($t = -5.72$, $p < 0.001$) and depression at both T1 and T2 ($t_{T1\text{depression}} = -5.08$, $p < 0.001$; $t_{T2\text{depression}} = -3.95$, $p < 0.001$) compared to boys. Conversely, boys demonstrated higher scores in T1 game addiction ($t = 4.08$, $p < 0.001$) and T1 short-form video addiction ($t = 3.77$, $p < 0.001$) compared to girls.

Table 2 Intercorrelations Between Variables

Variables	M	SD	1	2	3	4	5	6
1. T1 Social media addiction	2.56	1.24	—					
2. T1 Game addiction	2.32	1.09	0.35***	—				
3. T1 Information addiction	2.17	1.01	0.48***	0.55***	—			
4. T1 Short-form video addiction	2.15	1.08	0.41***	0.51***	0.4***	—		
5. T1 Depression	8.70	5.24	0.26***	0.12***	0.24***	0.17***	—	
6. T2 Depression	8.77	7.47	0.38***	0.30***	0.36***	0.34***	0.48***	—

Notes: N = 480. *** $p < 0.01$.

Table 3 Gender Differences in Mobile Phone Addiction and Depression

Variables	Group	M	SD	t	p
1. T1 Social media addiction	Boys	2.26	1.18	-5.72	<0.001
	Girls	2.89	1.29		
2. T1 Game addiction	Boys	2.51	1.19	4.08	<0.001
	Girls	2.11	0.92		
3. T1 Information addiction	Boys	2.10	1.04	-1.65	0.10
	Girls	2.25	0.98		
4. T1 Short-form video addiction	Boys	2.33	1.17	3.77	<0.001
	Girls	1.96	0.94		
5. T1 Depression	Boys	7.56	4.93	-5.08	<0.001
	Girls	9.93	5.30		
6. T2 Depression	Boys	7.49	7.07	-3.95	<0.001
	Girls	10.16	7.67		

Testing for Moderation of Gender

Table 4 illustrates the moderating role of gender in the relationship between social media addiction and depression. After controlling for age, mobile phone usage duration, and T1 depression, we found a significant association between T1

Table 4 Moderation of Gender Between T1 Social Media Addiction and T2 Depression

Regression Equation		Significance of Regression Coefficients				Bootstrap	
Outcome variable	Independent variables	β	SE	t	p	LLCI	ULCI
T2 Depression	Age	0.03	0.04	0.88	0.379	-0.04	0.11
	Mobile phone use duration	0.15***	0.04	3.88	<0.001	0.07	0.22
	T1 Depression	0.39***	0.05	8.42	<0.001	0.30	0.48
	Gender	0.06	0.08	0.78	0.436	-0.09	0.22
	T1 Social media addiction	0.24***	0.04	5.44	<0.001	0.15	0.33
	T1 Social media addiction \times Gender	0.21 ^a	0.08	2.43	0.015	0.04	0.37

Notes: N = 480. *** $p < 0.001$. ^amarginally significant.

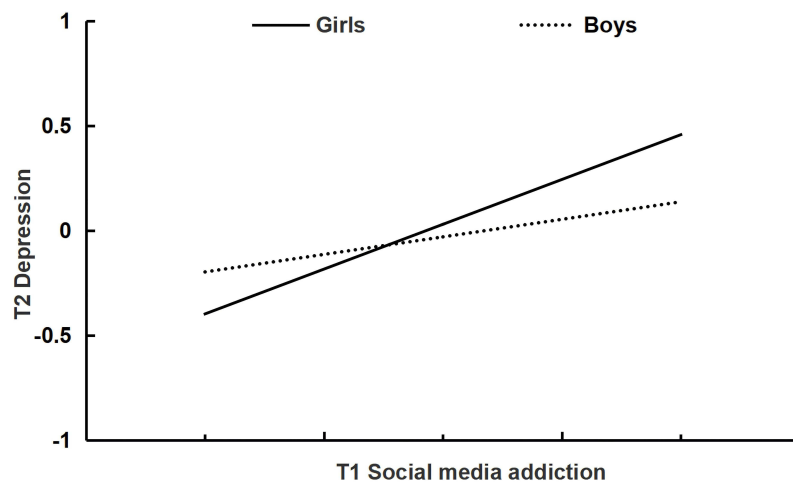


Figure 1 Gender moderated the effect of T1 social media addiction on T2 depression.

social media addiction and T2 depression ($\beta = 0.24, p < 0.001$). Moreover, the effect of the interaction between T1 social media addiction and gender on T2 depression was marginally significant ($\beta = 0.21, p = 0.015 > 0.0125$). The association between T1 social media addiction and T2 depression was more pronounced in girls ($\beta = 0.35, p < 0.001$) compared to boys ($\beta = 0.14, p = 0.028$) (see Figure 1).

Table 5 illustrates the moderating role of gender in the relationship between game addiction and depression. After controlling for age, mobile phone usage duration, and T1 depression, both gender ($\beta = 0.27, p < 0.001$) and T1 game addiction ($\beta = 0.23, p < 0.001$) had a positive effect on T2 depression. Moreover, the interaction between T1 game addiction and gender had a negative effect on T2 depression ($\beta = -0.23, p = 0.007$). The association between T1 game addiction and T2 depression was potent in boys ($\beta = 0.34, p < 0.001$), but not significant in girls ($\beta = 0.11, p = 0.123$) (see Figure 2).

Table 6 illustrates the moderating role of gender in the relationship between information acquisition addiction and depression. After controlling for age, mobile phone usage duration, and T1 depression, we found a significant association between T1 information acquisition addiction and T2 depression ($\beta = 0.23, p < 0.001$). However, the interaction between T1 information acquisition addiction and gender had no significant effect on T2 depression ($\beta = -0.05, p = 0.505$). The association between T1 information acquisition addiction and T2 depression was significant in girls ($\beta = 0.26, p < 0.001$) and boys ($\beta = 0.20, p = 0.001$) (see Figure 3).

Table 7 illustrates the moderating role of gender in the relationship between short-form video addiction and depression. After controlling for age, mobile phone usage duration, and T1 depression, both gender ($\beta = 0.28, p <$

Table 5 Moderation of Gender Between T1 Game Addiction and T2 Depression

Regression Equation		Significance of Regression Coefficients				Bootstrap	
Outcome variable	Independent variables	β	SE	t	p	LLCI	ULCI
T2 Depression	Age	0.04	0.04	0.94	0.348	-0.04	0.11
	Mobile phone use duration	0.15***	0.04	4.17	<0.001	0.08	0.22
	T1 Depression	0.39***	0.04	9.53	<0.001	0.31	0.47
	Gender	0.27***	0.08	3.36	<0.001	0.11	0.42
	T1 Game addiction	0.23***	0.04	5.18	<0.001	0.14	0.31
	T1 Game addiction \times Gender	-0.23**	0.09	-2.71	0.007	-0.40	-0.06

Notes: N = 480. *** $p < 0.001$.

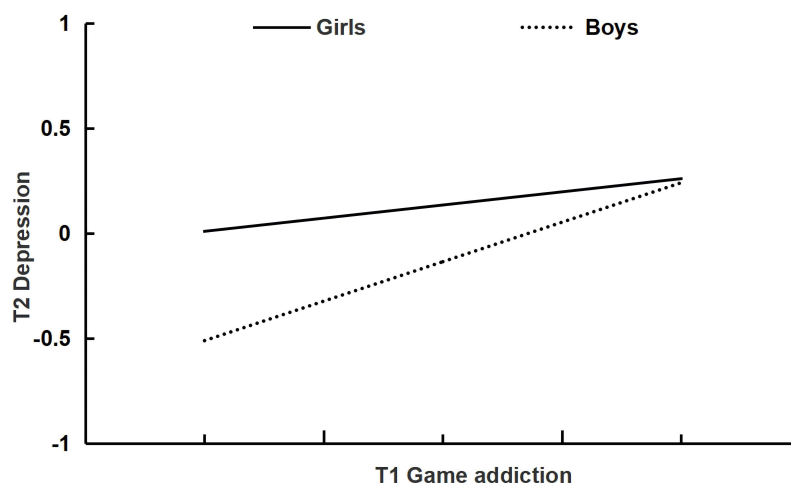


Figure 2 Gender moderated the effect of T1 game addiction on T2 depression.

0.001) and T1 short-form video addiction ($\beta = 0.26$, $p < 0.001$) had a positive effect on T2 depression. Moreover, the interaction between T1 game addiction and gender had a negative effect on T2 depression ($\beta = -0.24$, $p = 0.007$). The association between T1 game addiction and T2 depression was potent in boys ($\beta = 0.37$, $p < 0.001$), but not significant in girls ($\beta = 0.13$, $p = 0.071$) (see Figure 4).

Discussion

Building upon existing research, we undertook a comprehensive analysis to examine whether various forms of MPA have distinct impacts on depression, particularly when considering the influence of gender. The results indicate that, even after accounting for initial levels of depression, all four types of MPA displayed a notable and positive correlation with depression one year later. However, among the three types of MPA (ie, social media addiction, game addiction, and short-form video addiction), significant gender disparities were observed in their association with depression. These results highlights the complex interplay of addiction type and gender in the relationship between MPA and depression. By refining previous findings, our study provides practical insights for mitigating the detrimental effects of MPA on depression within different gender cohorts.

Firstly, the present study discovered that all four types of MPA were found to have a significant positive correlation with depression one year later. Hypotheses 1a, 1b, 1c, and 1d were all supported. These findings align with previous studies examining the association between general MPA and depression, where specific types of MPA were not

Table 6 Moderation of Gender Between T1 Information Addiction and T2 Depression

Regression Equation		Significance of Regression Coefficients				Bootstrap	
Outcome variable	Independent variables	β	SE	t	p	LLCI	ULCI
T2 Depression	Age	0.04	0.04	0.97	0.334	-0.04	0.11
	Mobile phone use duration	0.14***	0.04	3.75	<0.001	0.07	0.22
	T1 Depression	0.39***	0.04	8.91	<0.001	0.30	0.47
	Gender	0.16	0.08	1.94	0.053	-0.01	0.31
	T1 Information addiction	0.23***	0.04	5.20	<0.001	0.14	0.32
	T1 Information addiction \times Gender	-0.05	0.08	-0.67	0.505	-0.22	0.11

Notes: N = 480. *** $p < 0.001$.

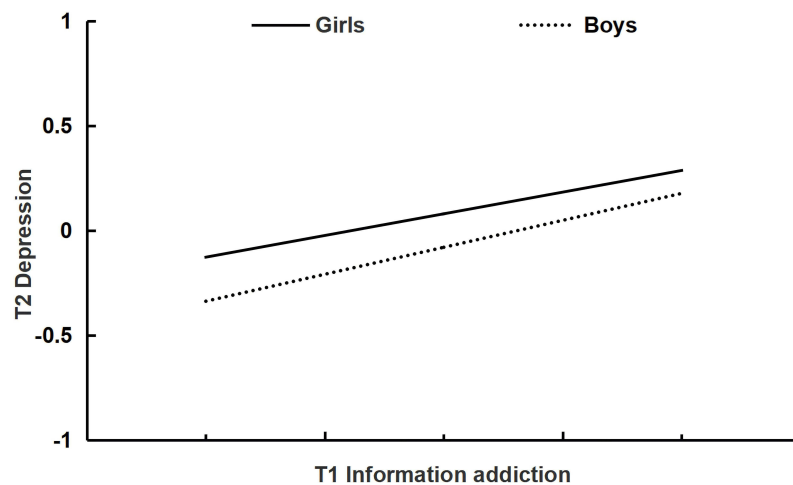


Figure 3 Gender moderated the effect of T1 information addiction on T2 depression.

individually analyzed. Previous research indicates that general MPA significantly predicts depression across various age groups, including adolescents, young adults, and the elderly, with observed effect sizes ranging from low to moderate.^{34–45} Our research builds upon existing findings by introducing a detailed classification of mobile phone addiction, further revealing that all four identified types demonstrate notable predictive effects. In essence, irrespective of the specific type of smartphone usage behavior, adolescents who exhibit higher levels of problematic smartphone use are at a greater risk of experiencing depression. Additionally, our results are in line with the significant role of social addiction in predicting depression and the increased risk of depression linked to game addiction.^{47–50} In terms of specific addictive behaviors, the predictive effects of social media addiction^{47,48} and gaming disorder^{49,50} on depression have been examined in various cross-sectional studies. However, prior studies have largely utilized a cross-sectional questionnaire design, which restricts their capacity to rigorously assess the effects between variables, particularly in relation to long-term effects. Our longitudinal research provides a more rigorous confirmation of the longitudinal relationship between these two forms of addiction and depression. In addition, the present study extends previous research by finding that two other types of MPA, specifically information acquisition addiction and short-form video addiction, also have a significant predictive effect on depression. Information addiction and short-form video addiction are two emerging forms of smartphone addiction, yet their relationships with depression have been infrequently examined, even in cross-sectional studies. Implementing a rigorous longitudinal questionnaire to investigate the associations between these two types of mobile phone addiction and depression will undoubtedly enhance the foundation for future research. Previous research have demonstrated that the use of short-form videos can lead to body dissatisfaction through upward appearance

Table 7 Moderation of Gender Between T1 Short-Form Video Addiction and T2 Depression

Regression Equation		Significance of Regression Coefficients				Bootstrap	
Outcome variable	Independent variables	β	SE	t	p	LLCI	ULCI
T2 Depression	Age	0.05	0.04	1.30	0.196	-0.02	0.12
	Mobile phone use duration	0.14***	0.04	4.14	<0.001	0.07	0.21
	T1 Depression	0.37***	0.04	8.29	<0.001	0.28	0.45
	Gender	0.28***	0.08	3.58	<0.001	0.13	0.44
	T1 Short-form video addiction	0.26***	0.05	5.60	<0.001	0.17	0.34
	T1 Short-form video addiction \times Gender	-0.24**	0.09	-2.71	0.007	-0.42	-0.07

Notes: N = 480. **p < 0.01, ***p < 0.001.

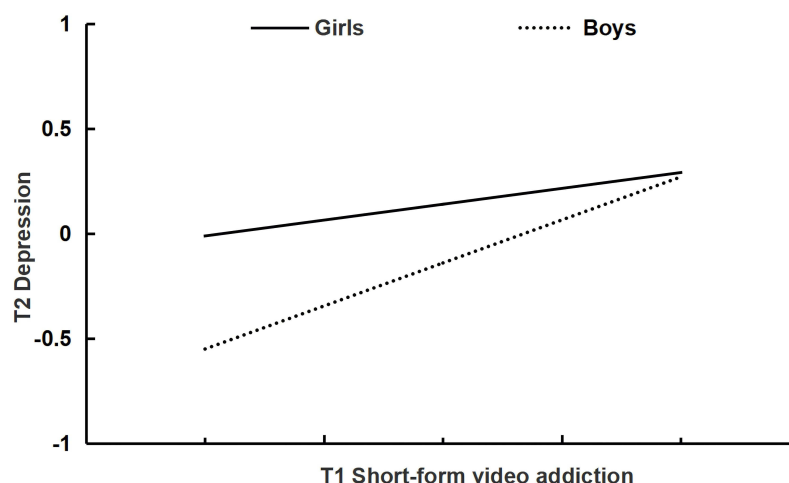


Figure 4 Gender moderated the effect of T1 short-form video addiction on T2 depression.

comparisons.⁶² Moreover, both the posting and watching of short-form videos can trigger social comparisons.⁶³ Negative social comparisons and the resulting damage to self-concept may contribute to the development of depression.^{64,65} Furthermore, the act of seeking information has been found to function as a coping mechanism for individuals experiencing stress in the digital age.⁶⁶ Nonetheless, an excessive dependence on online information may not effectively aid individuals in dealing with stressful situations they encounter. On the contrary, it could intensify rumination and negative emotions. Therefore, it is imperative to promote independent thinking, decision-making, and seeking support from one's immediate social environment among university students, rather than relying excessively on mobile devices for solutions.

Secondly, we revealed significant gender differences in the association between three classifications of MPA (social media addiction, gaming addiction, and short-form video addiction) and depression. Therefore, hypotheses 2a, 2b, and 2d were supported, while hypothesis 2c was not confirmed. Previous research on the relationship between mobile phone addiction and depression has largely overlooked the different types of addiction and has not examined gender differences, let alone analyzed the interaction between the two. The significant advancement of our study lies in its examination of different types of mobile phone addiction, while also considering the interactions between addiction types and gender. We explored whether a particular type of mobile phone addiction has a more significant predictive effect on depression among boys, while assessing whether another type has a more pronounced predictive effect on depression among girls. Specifically, among girls, social media addiction exhibited a more robust predictive influence on depression after one year, whereas among boys, the effect of social media addiction was weaker. On the other hand, among boys, game addiction demonstrated a more pronounced predictive effect on depression one year later, while among girls, the effect of game addiction was less significant. In boys, short-form video addiction had a noteworthy predictive effect on depression after one year, whereas in girls, the effect of short-form video addiction was not significant. It is essential to highlight that, under stricter criteria ($p < 0.0125$), the interaction between social media addiction and gender exhibits only a marginally significant predictive effect on depression. Upon examining the specific contexts for boys and girls under stricter criteria ($p < 0.0125$), we found that social media addiction had a significant predictive effect on depression in girls but not in boys, indicating a notable difference between the two groups. To address the apparent discrepancy between the significance of the interaction and the simple effects, we have decided to interpret the marginally significant results in light of gender differences. In addition, information acquisition addiction had a significant predictive effect on depression after one year in both boys and girls, with no noticeable gender difference. These disparities in the predictive impacts of MPA on depression among genders can primarily be ascribed to gender differences within distinct types of MPA.

In the present study, significant gender differences were found in social media addiction, gaming addiction, and short-form video addiction. Females exhibited higher levels of social media addiction compared to boys, while boys showed higher levels of gaming and short-form video addiction compared to females. Previous studies found that females are

more prone to depression under negative circumstances.^{67,68} Females not only have higher levels of social media addiction but are also more susceptible to the negative impacts of social media, such as negative social comparisons and envy.⁶⁹ They also experience a greater reduction in subjective well-being compared to males.⁷⁰ As a result, girls are more likely to experience higher levels of depression once they become addicted to social media. On the contrary, males exhibit significantly higher levels of gaming addiction, which not only disrupts sleep quality⁷¹ but also potentially affects academic performance,⁷² impairs coping abilities,⁷³ and may lead to depression.^{74–76} Therefore, boys are more severely affected by gaming addiction compared to girls. Similarly, boys show significantly higher levels of short-form video addiction, which also impacts cognitive functioning,⁷⁷ academic performance,⁷⁸ and coping strategies,⁷⁹ thereby disrupting mental health. Consequently, short-form video addiction has a more severe impact on boys compared to girls. As for information acquisition addiction, there is no significant gender difference between boys and girls, and their levels of depression are also not significantly different under the influence of information addiction. This result indicates that the need for information is similar in boys and girls, reflecting that adolescents growing up in the information age are influenced by online media regardless of gender. However, it is important to note that the measurement tools we used can only assess the levels of information acquisition addiction in adolescents and cannot indicate whether there are differences in the content of information obtained by boys and girls. Due to the fact that various types of information are prevalent in current online media, it is worth exploring whether boys and girls would respond differently to information bias towards different content.

Furthermore, the varying levels of depression exhibited by boys and girls in response to mobile phone addiction can be examined in the context of their awareness of the COVID-19 pandemic awareness, virus anxiety, and contagious fear. The pandemic has prompted increased attention to pandemic-related information in both males and females,^{80,81} potentially resulting in information addiction and heightened levels of depression. However, women may experience a greater pandemic awareness, alongside increased virus anxiety, and contagious fear.^{82–85} Consequently, females may be more hesitant to participate in in-person social interactions and more inclined to engage in online socializing, which may exacerbate the risk of developing a more severe form of social addiction. Nevertheless, it is essential to approach the examination of gender differences in the relationship between MPA and depression with caution, especially regarding social media addiction and its link to depression. Future research may prioritize longitudinal studies involving larger sample sizes from diverse cultural groups to analyze and compare the gender-specific predictive effects of different forms of MPA on depression more thoroughly.

Limitations and Implications

The present study has several limitations. Firstly, it focused on a non-clinical sample of ordinary high school students, which limits the generalizability of the results to clinical populations. Future research may consider exploring the effects of different types of MPA and the moderating role of gender in populations with depression. Secondly, the current study only examined adolescent population and did not concurrently analyze and compare multiple groups. Future researchers should investigate the relationship between different types of MPA and depression in young adults and older adults. Furthermore, our study only examined the moderating effect of gender, without investigating other individual and environmental factors that may also moderate the relationship between MPA and depression. Analyzing more potential moderating factors would undoubtedly be instrumental in gaining a comprehensive understanding of when the relationship between MPA and depression is stronger/weaker, or for whom it is stronger/weaker. Finally, concerning both short-form video addiction and information acquisition addiction, our study lacks the capability to determine whether various usage patterns of short-form video apps (active usage like uploading or sharing short videos, or passive usage like browsing and watching short videos) or diverse informational content lead to distinct effects. Future research could investigate potential gender disparities in the consequences of problematic short-form video use or compulsive behaviors associated with various types of information among adolescents.

Despite some limitations, our study contributes significantly to theoretical innovation and practical significance. Firstly, this study is among the earliest to examine and compare the association between different types of MPA and depression. These findings enhance and deepen the conclusions drawn from prior research on the overall connection between MPA and depression. Secondly, this study employed a one-year longitudinal design, offering statistical

advantages over the many previous cross-sectional studies. By controlling for initial depression levels, the study provides a more precise understanding of the predictive impact of MPA on depression. Thirdly, by investigating the relationship between MPA and depression considering addiction types and gender differences, our study offers valuable insights for practical interventions in adolescent depression. Implementing gender-specific intervention programs tailored to various types of MPA is essential. Since the impact of diverse addictive behaviors on depression differs by gender, intervention strategies addressing both addictive behaviors and gender-specific factors are likely to produce more significant practical effects. For instance, parents and schools should prioritize addressing boys' gaming and short-form video addictions, while dedicating more attention and resources to prevent and manage girls' social media addiction. A variety of recreational activities, such as sports, watching movies, and traveling, have the potential to provide boys with psychological relaxation and pleasure similar to that achieved through gaming and short videos. In contrast, girls may require high-quality parent-child relationships, teacher-student relationships, or peer connections to experience a sense of belonging and connection akin to social media.

Conclusion

We conducted a one-year longitudinal study on adolescents to investigate the potential relationship between four types of MPA and depression. Specifically, we examined whether different types of MPA have distinct effects on depression, with a particular focus on considering the moderating role of gender. The findings showed that all four types of MPA were significantly and positively correlated with depression one year later. However, gender emerged as a moderator in the associations between the three types of MPA and depression. Social media addiction was more strongly associated with depression in girls and less so in boys, whereas game addiction had a stronger association with depression in boys and a weaker one in girls. Moreover, the relationship between short-form video addiction and depression was significant for boys but not for girls. These findings expand upon previous research on the impact of MPA and offer empirical support and scientific recommendations for mitigating the negative effects of MPA and improving depression among different gender groups.

Data Sharing Statement

The datasets used during the current study are available from the corresponding author on reasonable request.

Ethics Statement

All participants in the study provided informed consent, and all the methods and research procedures were conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethical Committee of Henan Normal University.

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Disclosure

The authors report no conflicts of interest in this work.

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