RESEARCH ARTICLE

Modeling the Mediating Effect of Anxiety on Cell Phone Addiction and Depression Among College Students: A Structural Equation Analysis

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Abstract

(1) Objective: This study aims to examine the relationships between college students' cell phone addiction, anxiety, and depression, and to explore the mediating role of anxiety in the association between cell phone addiction and depression. (2) Methods: Data were statistically analyzed using SPSS and AMOS. Independent samples t-tests and F-tests were employed to analyze differences in cell phone addiction (and its dimensions) across demographic variables. Pearson correlation analysis was conducted to assess the relationships among cell phone addiction, anxiety, and depression. Structural equation modeling (SEM) via AMOS was used to validate the hypothetical model, and regression analysis combined with the bias-corrected percentile Bootstrap method was applied to test the mediating effect. (3) Results: College students' cell phone addiction showed significant differences by gender and grade. Their addiction characteristics were primarily reflected in prominent withdrawal symptoms, with a mean score of 16.64 ± 5.40. Significant positive correlations were observed among cell phone addiction, anxiety, and depression (all $p<0.05$). Furthermore, anxiety played a fully mediating role in the relationship between cell phone addiction and depression. (4) Conclusions: Cell phone addiction among college students is not an isolated issue but is closely associated with mental health problems such as anxiety and depression. Cell phone addiction can indirectly influence the development of depression through the mediating effect of anxiety. Therefore, interventions and treatments for college students' cell phone addiction should consider the underlying psychological mechanisms—particularly the mediating role of anxiety—to develop more comprehensive and effective strategies.

Keywords: cell phone addiction, anxiety, depression, mediating effect, structural equation.

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1 Introduction

According to the Statistical Report on Internet Development in China, as of June 2023, China had 1.076 billion mobile phone users, with mobile Internet users accounting for 99.8% of the total Internet user base [1]. College students are the primary group of smartphone users; "phubbers" (individuals overly engrossed in their phones) are ubiquitous on university campuses, and mobile phones have become indispensable tools for their daily lives and academic pursuits. However, this heavy reliance has also given rise to a series of issues, most notably cell phone addiction.

Cell phone addiction is defined as the excessive and uncontrollable use of mobile phones, and it has emerged as a critical risk factor affecting college students' physical and mental health. It is not merely a behavioral problem but a comprehensive threat to physical and psychological well-being [2, 3]. Physiologically, prolonged screen time not only causes eye strain and neck discomfort but also impairs sleep quality, thereby undermining overall physical health [4–6]. Psychologically, cell phone addiction can lead to anxiety, depression, social dysfunction, and even disrupt an individual's self-cognition and emotional regulation [7–10]. Without effective intervention and treatment, cell phone addiction can result in severe physical and mental consequences.

Anxiety and depression often co-occur, and in many cases, anxiety precedes the onset of depression [11, 12]. Jacobson et al. [13] conducted a study on adolescent mental health to explore the relationship between anxiety and depression, concluding that anxiety serves as a precursor to depression. A study by Zeng et al. [14] found that individuals with high levels of anxiety and cell phone addiction are more likely to exhibit depressive behaviors. Additionally, a significant correlation exists between anxiety and cell phone addiction [15]. Xiao et al. [16] observed that greater dependence on mobile phones leads individuals to spend more time and energy on their devices, reducing face-to-face communication. This reduction can lower self-efficacy, increase loneliness, and ultimately induce anxiety.

College students are in a pivotal stage of life and play a vital role in society. Cell phone addiction not only threatens their physical and mental health and academic progress but may also have adverse effects on family relationships and social stability. Faced with pressures from academics, daily life, and future employment, college students often turn to mobile phones as an escape from reality. However, prolonged addiction can easily trigger psychological issues such as anxiety and depression. Therefore, in-depth research on the relationships among cell phone addiction, anxiety, and depression is of great significance for promoting college students' mental health. It not only helps students better understand their behavioral patterns but also enables them to identify and address problems promptly, fostering healthy psychological development.

2 Objects and Methods

2.1 Research Objects and Sampling Method

2.1.1 Research Objects

The participants in this study are undergraduate students from universities in Guizhou Province, China.

2.1.2 Sampling Method

A multistage sampling approach was adopted: (1) Three undergraduate universities were randomly selected from all undergraduate institutions in Guizhou Province; (2) Stratified sampling was conducted within the selected universities based on grade, class, and gender; (3) All students in the sampled classes were included in the survey. A questionnaire survey was administered, yielding 295 valid responses. Of these, 102 were male (34.58%) and 193 were female (65.42%). By grade, there were 79 freshmen (26.78%), 85 sophomores (28.82%), 104 juniors (35.25%), and 27 seniors (9.15%). A total of 83 students (28.14%) were identified as having cell phone addiction, as shown in Table 1.

Table 1. Basic information of surveyed college students.

Variable	Subcategory	Number of Respondents	Percentage (%)
Gender	Male	102	34.58
	Female	193	65.42
Grade	Freshman	79	26.78
	Sophomore	85	28.82
	Junior	104	35.25
	Senior	27	9.15
Cell Phone Addiction	Yes	83	28.14
	No	212	71.86

2.2 Research Methodology

2.2.1 Research Tools

1. *Mobile Phone Addiction Tendency Scale (MPATS) for College Students*
   This study used the MPATS developed by Li

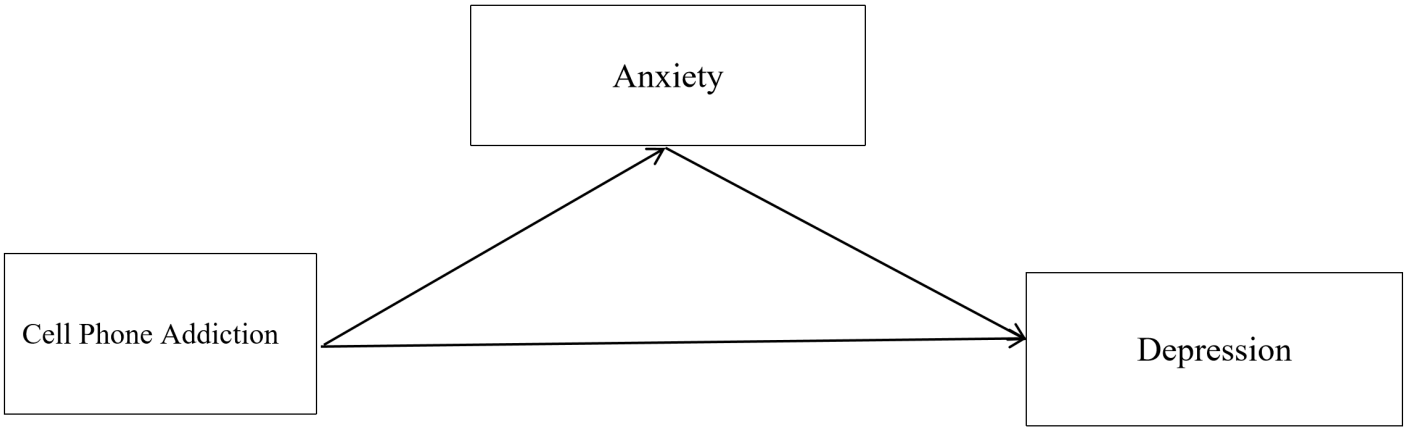

Figure 1. Hypothetical model diagram. Arrows indicate the direction of influence; "Cell Phone Addiction → Anxiety → Depression" represents the mediating pathway.

et al. [17] The scale consists of 16 self-reported items scored on a 5-point Likert scale (1 = "strongly disagree" to 5 = "strongly agree"), with a total score ranging from 16 to 80. It includes four dimensions: withdrawal symptoms, salient behaviors, social soothing, and altered state of mind. A total score exceeding 48 indicates cell phone addiction. The scale demonstrates good internal consistency and reliability; in this study, its Cronbach's α coefficient is 0.961.

2. *Zung Self-Rating Anxiety Scale (SAS)*
The SAS, developed by Zung et al. [18], was used to assess anxiety levels. It comprises 20 items scored on a 4-point scale (1 = "none or a little of the time" to 4 = "most or all of the time"). Among the items, 15 are positively scored, while 5 (items 5, 9, 13, 17, and 19) are reverse-scored (4 = "none or a little of the time" to 1 = "most or all of the time"). A standard score is calculated by summing all item scores and multiplying by 1.25. According to established criteria: standard scores <50 indicate no anxiety, 50-59 indicate mild anxiety, 60-69 indicate moderate anxiety, and $\geq$70 indicate severe anxiety [18]. The Cronbach's α coefficient of the SAS in this study is 0.949.

3. *Zung Self-Rating Depression Scale (SDS)*
The SDS, developed by Dugan et al. [19], is a widely recognized tool for assessing depression. It includes 20 items scored on a 4-point scale (1 = "none or a little of the time" to 4 = "most or all of the time"). Ten items are positively scored, and 10 are reverse-scored (4 = "none or a little of the time" to 1 = "most or all of the time"). The depression severity index is calculated as (total item score)/80. Criteria for depression severity are: index <0.5 (no depression), 0.5-0.59 (mild depression), 0.6-0.69 (moderate to severe depression), and $\geq$0.7 (severe depression). The Cronbach's α coefficient of the SDS in this study is 0.919.

2.2.2 *Statistical Analysis Methods*

In this study, cell phone addiction is treated as the independent variable, depression as the dependent variable, and anxiety as the mediating variable to examine the mediating role of anxiety in the relationship between cell phone addiction and depression. Two research hypotheses were proposed: (1) Cell phone addiction is significantly correlated with anxiety and depression; (2) Anxiety plays a mediating role between cell phone addiction and depression. The hypothetical model is shown in Figure 1.

Data analysis steps are shown as follows: (1) A database was established and data were entered using SPSS 25.0, followed by data cleaning and validation; (2) Descriptive statistics were conducted to summarize the main characteristics of the variables; (3) Independent samples t-tests and one-way analysis of variance (ANOVA, F-test) were used to analyze differences in cell phone addiction (and its dimensions) across demographic variables; (4) Pearson correlation analysis was performed to explore the correlations among cell phone addiction, anxiety, and depression; (5) AMOS was used to validate the hypothetical model via SEM; (6) The mediating effect was tested using regression analysis, the bias-corrected percentile Bootstrap method, and the SPSS macro program PROCESS (developed by Hayes).

Table 2. Current status of cell phone addiction among college students.

Variable	Subcategory	Total Respondents	Number of Addicts	Number of Non-Addicts	Addiction Rate (%)
Gender	Male	102	21	81	20.59
	Female	193	62	131	32.12
Grade	Freshman	79	9	70	11.39
	Sophomore	85	28	57	32.94
	Junior	104	37	67	35.58
	Senior	27	9	18	33.33
Ethnic Group	Han	213	60	153	28.17
	Minority	82	23	59	28.05
Total	-	295	83	212	28.14

3 Results and Analysis

3.1 Basic Status of Cell Phone Addiction, Anxiety, and Depression Among College Students

3.1.1 Current Situation of Cell Phone Addiction

Based on the MPATS criteria (total score >48 = cell phone addiction), the distribution of cell phone addiction across demographic groups is shown in Table 2. By gender, female students had a higher addiction rate (32.12%) than male students (20.59%). By grade, juniors had the highest addiction rate (35.58%), followed by seniors (33.33%), while freshmen had the lowest (11.39%). The overall cell phone addiction rate among college students is 28.14%.

3.1.2 Descriptive Statistics of Cell Phone Addiction, Anxiety, and Depression

Descriptive statistics for the total score of cell phone addiction (and its dimensions), anxiety score, and depression score are presented in Table 3. The total score of cell phone addiction is 42.62±13.96, with the highest score observed in the withdrawal symptoms dimension (16.64±5.40). The mean anxiety score is 43.52±14.47, and the mean depression score is 41.35±10.56. The scores of the cell phone addiction dimensions, in descending order, are: withdrawal symptoms > salient behaviors > social soothing > altered state of mind.

3.1.3 Demographic Differences in Cell Phone Addiction

Independent samples t-tests were used to compare cell phone addiction scores by gender and ethnic group, while one-way ANOVA was used to compare scores by grade. Results showed significant differences in total cell phone addiction scores by gender and grade (all $p<0.001$) (Table 4). Further analysis of the dimensions revealed significant gender and grade differences in all four dimensions of cell phone addiction, with female students scoring significantly higher than male students in all dimensions. No significant differences were found in cell phone addiction scores by ethnic group.

Table 3. Scores of cell phone addiction, anxiety, and depression among college students.

Item	Mean	Standard Deviation
Withdrawal Symptoms	16.64	5.40
Salient Behaviors	9.97	3.74
Social Soothing	8.15	2.93
Altered State of Mind	7.86	2.87
Total Cell Phone Addiction Score	42.62	13.96
Anxiety	43.52	14.47
Depression	41.35	10.56

3.2 Relationships Among Cell Phone Addiction, Anxiety, and Depression

3.2.1 Correlation Analysis

Pearson correlation analysis was conducted to examine the relationships between the four dimensions of cell phone addiction (and its total score), anxiety (standard score), and depression (total score). Results showed significant positive correlations among cell phone addiction, anxiety, and depression (all $p<0.001$) (Table 5). Specifically, cell phone addiction was positively correlated with anxiety ($r=0.545$, $p<0.001$) and depression ($r=0.350$, $p<0.001$), and anxiety was positively correlated with depression ($r=0.678$, $p<0.001$).

3.2.2 Multicollinearity Diagnosis

Multicollinearity diagnosis was performed for cell phone addiction, anxiety, and depression. As shown in Table 6, the variance inflation factor (VIF) for all three variables was <5, and the tolerance value was >0.3, indicating no multicollinearity. The Durbin-Watson (DW) value is 1.83 (close to 2), suggesting no

Table 4. Demographic differences in cell phone addiction among college students (t/F and p Values).

Variable	Withdrawal Symptoms		Salient Behaviors		Social Soothing		Altered State of Mind		Total Score	
	t/F	p	t/F	p	t/F	p	t/F	p	t/F	p
Gender	-3.891	0.000	-3.199	0.002	-4.233	0.000	-3.375	0.001	-3.932	0.000
Grade	9.244	0.000	11.768	0.000	7.486	0.000	9.557	0.000	11.032	0.000
Ethnic Group	1.291	0.198	0.320	0.749	0.865	0.388	1.068	0.286	0.986	0.325

Table 5. Correlation analysis of cell phone addiction (and its dimensions) with anxiety and depression.

Variable	Cell Phone Addiction	Withdrawal Symptoms	Salient Behaviors	Social Soothing	Altered State of Mind	Anxiety	Depression
Cell Phone Addiction	1						
Withdrawal Symptoms	0.960***	1					
Salient Behaviors	0.933***	0.841***	1				
Social Soothing	0.897***	0.834***	0.770***	1			
Altered State of Mind	0.924***	0.839***	0.868***	0.769***	1		
Anxiety	0.545***	0.468***	0.541***	0.466***	0.554***	1	
Depression	0.350***	0.326***	0.317***	0.329***	0.338***	0.678***	1

*Note: *$p<0.01$ (*two-tailed test*); *the same notation applies below.*

Table 6. Multicollinearity diagnosis results.

Variable	VIF	Tolerance	DW Value
Cell Phone Addiction	1.424	0.702	
Anxiety	2.316	0.432	1.83
Depression	1.854	0.539	

autocorrelation in the model and no correlation between sample data.

3.2.3 *Regression Analysis of the Anxiety-Mediated Model*

Regression analysis was used to test the mediating effect of anxiety, following the three-step approach proposed by Baron and Kenny. Results are shown in Table 7 and Figure 2.

1. **Step 1 (Model 1):** Cell phone addiction significantly and positively predicted depression ($\beta = 0.265$, $p < 0.001$).
2. **Step 2 (Model 2):** Cell phone addiction significantly and positively predicted anxiety ($\beta = 0.565$, $p < 0.001$).
3. **Step 3 (Model 3):** When both cell phone addiction and anxiety were included in the regression model to predict depression, only anxiety significantly and positively predicted depression ($\beta = 0.506$, $p < 0.001$), while the predictive effect of cell phone addiction on depression became non-significant ($\beta = -0.022$, $p = 0.576$).

These results indicate that anxiety fully mediates the relationship between cell phone addiction and depression, as the direct effect of cell phone addiction on depression became non-significant after controlling for anxiety.

The path analysis (Figure 2) revealed that cell phone addiction had a significant total effect on depression (c = 0.265, p < 0.01). However, when anxiety was included as a mediator, the direct effect became non-significant (c′ = -0.022), while the indirect effect through anxiety was significant (a = 0.565, p < 0.001; b = 0.506, p < 0.001). This pattern indicates full mediation.

3.2.4 *Validation of the Mediating Effect via SEM and Bootstrap*

SEM was used to validate the hypothetical model, and the Bootstrap method (with 5000 resamples) was applied to test the significance of the mediating effect. Results are shown in Table 8 and Figure 3.

1. **Model Fit Indices**: The SEM exhibited good fit: $\chi^2/\text{df} = 7.15$, CFI=0.97 (> 0.9), NFI=0.99 (> 0.9), RMSEA=0.07 (< 0.08). All fit indices met the recommended criteria, confirming the rationality of the hypothetical model.
2. **Path Analysis**: Cell phone addiction had no significant direct effect on depression ($\beta = -0.028$, $p > 0.05$) but significantly and positively predicted anxiety ($\beta = 0.565$, $p < 0.001$), and anxiety significantly and positively predicted depression ($\beta = 0.506$, $p < 0.001$). These

Table 7. Regression analysis of the anxiety-mediated model.

Predictor Variable	Model 1 (Depression as DV)		Model 2 (Anxiety as DV)		Model 3 (Depression as DV)	
	B	t	B	t	B	t
Cell Phone Addiction	0.265	6.386***	0.565	11.126***	-0.022	-0.559
Anxiety	-	-	-	-	0.506	13.540***
R^2	0.122		0.397		0.461	
F	40.781***		123.788***		124.747***	

Note: DV = dependent variable; Model 1: Cell phone addiction predicts depression;
Model 2: Cell phone addiction predicts anxiety;
Model 3: Cell phone addiction and anxiety jointly predict depression.

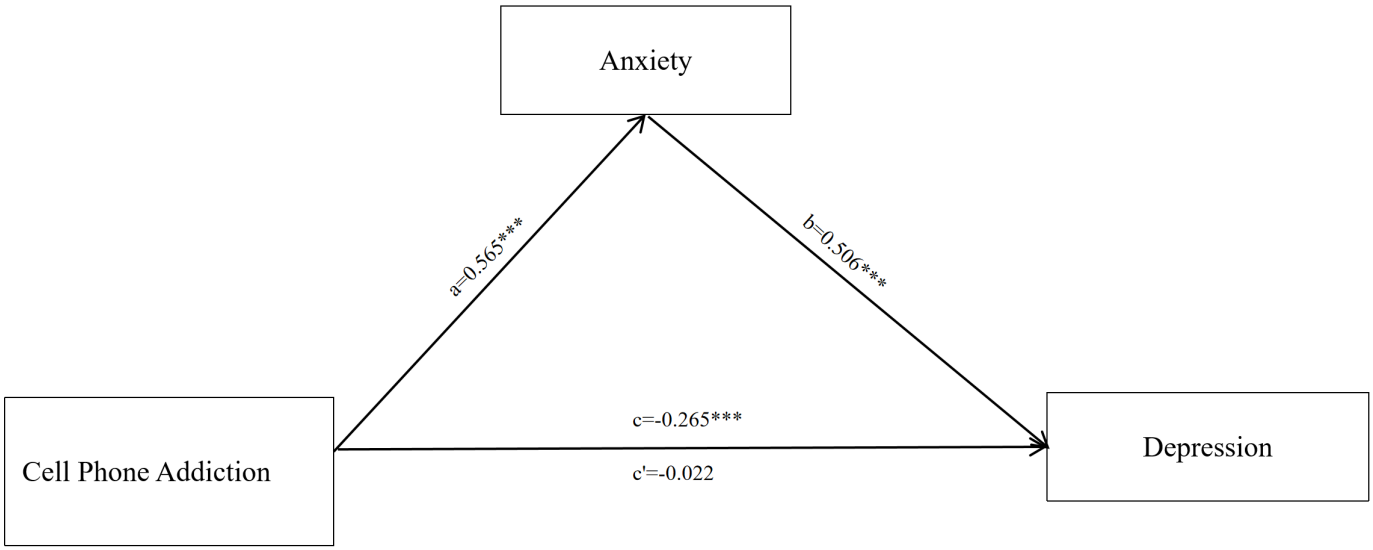

Figure 2. Path diagram of cell phone addiction, anxiety, and depression. c=0.265** (total effect of cell phone addiction on depression); a=0.565*** (effect of cell phone addiction on anxiety); b=0.506*** (effect of anxiety on depression); c′=-0.022 (direct effect of cell phone addiction on depression after controlling for anxiety); p<0.01.

results further confirm that anxiety plays a fully mediating role.

3. **Bootstrap Test**: The 95% confidence interval (CI) for the indirect effect of the pathway "cell phone addiction → anxiety → depression" was $[0.29, 0.47]$, which does not include 0, indicating the mediating effect is statistically significant. The mediating effect value is 0.286.

The structural equation model (Figure 3) confirmed the fully mediating role of anxiety. In this model, all four dimensions of cell phone addiction (withdrawal symptoms, salient behaviors, social soothing, and altered state of mind) significantly loaded onto the latent factor of cell phone addiction (standardized coefficients: 0.953, 0.928, 0.892, and 0.919, respectively). The path from cell phone addiction to anxiety was significant (0.565), as was the path from anxiety to depression (0.506). However, the direct path from cell phone addiction to depression was non-significant (-0.022), further supporting the fully mediating role of anxiety.

4 Discussion

4.1 Overall Situation of Cell Phone Addiction Among College Students

Among the 295 surveyed college students, 83 (28.14%) were identified as having cell phone addiction, with a mean total MPATS score of 42.62±13.96. This addiction rate and score are consistent with those reported in previous studies using the same scale [20, 22, 23], indicating that approximately 3 out of 10 college students are affected by cell phone addiction—a phenomenon that significantly impacts their academic performance and daily lives.

In terms of addiction symptoms, the dimensions of cell phone addiction scored in the order: withdrawal symptoms > salient behaviors > social soothing > altered state of mind. The top five highest-scoring

items on the MPATS were: (1) "I immediately check for text messages/missed calls if I haven't had my phone with me for a while" (3.21±1.13); (2) "I feel uncomfortable if I don't use my phone for a long time" (2.91±1.08); (3) "I feel lonely without my phone" (2.80±1.10); (4) "My phone is part of me, and I feel like I've lost something if I lose it" (2.76±1.10); (5) "I feel more comfortable communicating with others via my phone" (2.74±1.11). Notably, the first four items belong to the withdrawal symptoms dimension, highlighting that college students with cell phone addiction experience strong discomfort and psychological dependence when separated from their devices.

Demographic comparisons revealed that female students had a significantly higher addiction rate (32.12%) than male students (20.59%), with significant differences in total addiction scores and all four dimensions. This aligns with previous findings that female college students are more prone to cell phone addiction [24, 25], a pattern also observed in studies conducted in other cultural contexts [21]. Possible explanations include: (1) Females may have weaker self-control over phone use; (2) Females are more likely to use phones for emotional communication and maintaining interpersonal relationships, leading to stronger psychological dependence; (3) Females experience more severe withdrawal symptoms when unable to use their phones. However, some studies have reported inconsistent gender differences in cell phone addiction [26–28], which may be attributed to variations in measurement tools, sample gender ratios, and sample sizes.

By grade, significant differences in cell phone addiction were observed, consistent with the findings of Wang et al. [29] and Ding et al. [30]. Juniors had the highest addiction rate (35.58%), possibly due to reduced academic pressure compared to freshmen (who are adapting to college life) and seniors (who are preparing for graduation/employment), leading to more unstructured time spent on phones. However, other studies have found no significant grade differences [31, 32], which may reflect differences in research contexts (e.g., academic requirements across universities). No significant differences in cell phone addiction were found between Han and minority students, suggesting that ethnicity has little impact on this behavior.

4.2 Relationships Among Cell Phone Addiction, Anxiety, and Depression

This study confirmed significant positive correlations among cell phone addiction, anxiety, and depression, consistent with previous research. Several mechanisms may explain these relationships:

1. **Reduced Physical Activity**: Cell phone addicts often spend excessive time on their devices, leading to reduced physical exercise. This sedentary lifestyle is associated with lower levels of endorphins and serotonin—neurotransmitters that regulate mood—thereby increasing the risk of anxiety and depression [33].
2. **Impaired Interpersonal Skills**: Excessive phone use replaces face-to-face communication, reducing college students' opportunities to develop social skills. This can lead to weaker social support networks, increased feelings of loneliness, and heightened anxiety and depression [34, 35]. For example, Saeb et al. [36] used mobile phone sensors to find that less active phone addicts were more likely to exhibit depressive symptoms, consistent with the motivational deficits and social avoidance patterns characteristic of depression.
3. **Poor Sleep Quality**: Prolonged phone use (especially before bedtime) exposes users to blue light, which disrupts the secretion of melatonin—a hormone that regulates sleep. Poor sleep quality, in turn, exacerbates anxiety and depression [37]. Nyer et al. [38] noted that sleep quality is a key predictor of anxiety and depression among college students, with a significant positive correlation between poor sleep and these mental health issues.

These findings highlight the destructive impact of cell phone addiction on college students' academic performance, interpersonal relationships, and mental health. Interventions targeting cell phone addiction may therefore help alleviate symptoms of anxiety and depression.

4.3 The Mediating Role of Anxiety

This study found that anxiety plays a fully mediating role in the relationship between cell phone addiction and depression, meaning that cell phone addiction indirectly affects depression through its influence on anxiety. This result aligns with previous studies. For example, Demirci et al. [39] found that problematic smartphone use is significantly correlated

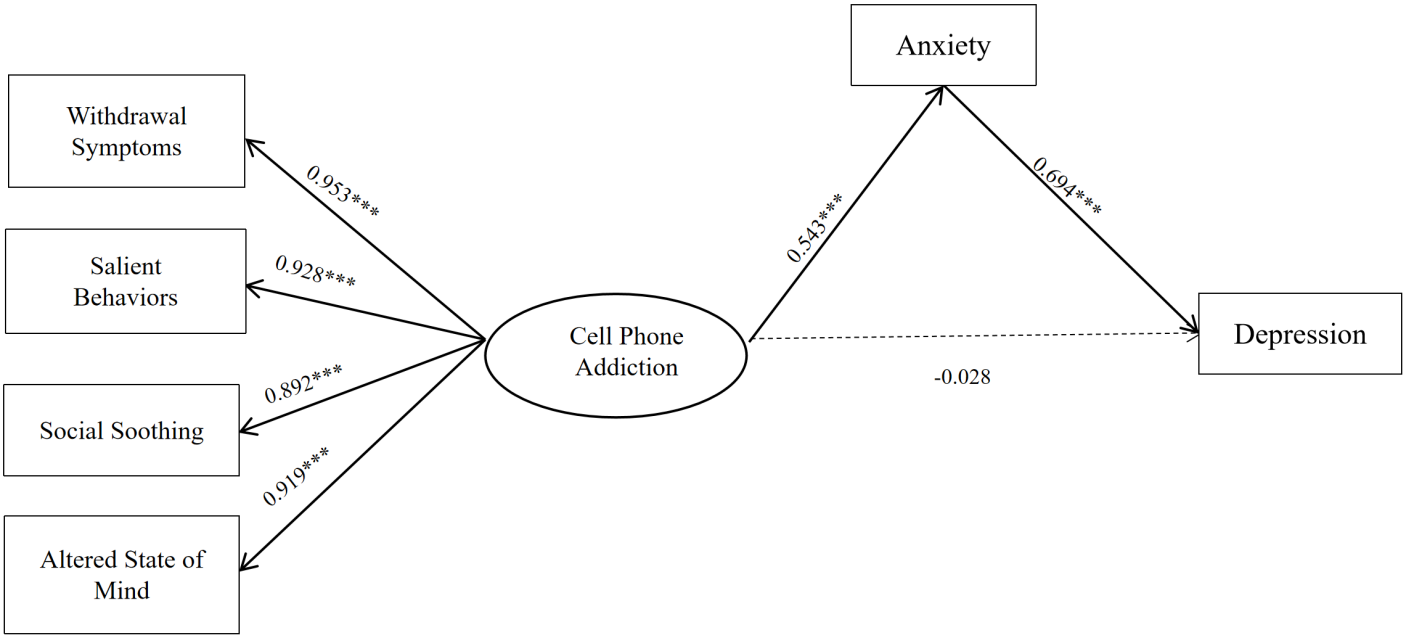

Figure 3. Mediating role of anxiety between cell phone addiction and depression.

Table 8. Bootstrap analysis of the mediating effect.

Path	Notation	Effect Type	Effect Value	95% CI (Lower)	95% CI (Upper)	t-Value	*p*-Value	Conclusion
Cell Phone Addiction → Anxiety → Depression	a*b	Indirect Effect	–	0.288	0.472	6.142	0.000	Fully Mediating
Cell Phone Addiction → Anxiety	a	Direct Effect	0.565	0.466	0.665	11.126	0.000	Significant
Anxiety → Depression	b	Direct Effect	0.506	0.433	0.580	13.540	0.000	Significant
Cell Phone Addiction → Depression	c′	Direct Effect	-0.022	-0.098	0.054	-0.559	0.576	Non-Significant
Cell Phone Addiction → Depression	c	Total Effect	0.264	0.183	0.346	6.386	0.000	Significant

Note: Standardized path coefficients are shown; p<0.01; non-significant paths are indicated by dashed lines.

with both anxiety and depression, supporting the interconnectedness of these constructs.

The mediating mechanism may be as follows: Cell phone addiction leads to a range of stressors (e.g., reduced academic performance, impaired interpersonal relationships, poor sleep), which trigger or exacerbate anxiety. Over time, chronic anxiety can develop into depression—a more severe mood disorder. Additionally, cell phone addicts may use their devices to cope with anxiety (e.g., seeking social support or distraction), creating a vicious cycle: anxiety drives more phone use, which worsens addiction, further increasing anxiety, and ultimately leading to depression.

From a neurobiological perspective, chronic anxiety is associated with hyperactivity in the hypothalamic-pituitary-adrenal (HPA) axis, leading to elevated cortisol levels. Prolonged cortisol exposure can damage the hippocampus—a brain region involved in mood regulation—thereby increasing the risk of depression [40]. Cell phone addiction may amplify this process by reducing physical exercise (which normally regulates the HPA axis) and increasing stress exposure [41].

5 Conclusion

This study explored the relationships among cell phone addiction, anxiety, and depression among college students in Guizhou Province. Key findings are as follows:

1. The overall cell phone addiction rate among college students was 28.14%, with significant differences by gender (females > males) and grade (juniors > seniors > sophomores > freshmen). Withdrawal symptoms were the most prominent addiction characteristic.

2. Significant positive correlations were observed among cell phone addiction, anxiety, and depression.

3. Anxiety played a fully mediating role in the relationship between cell phone addiction and depression: cell phone addiction indirectly increased the risk of depression by exacerbating anxiety.

These findings have important practical implications for interventions targeting college students' cell phone addiction and mental health:

4. **Psychological Interventions**: Universities should establish professional mental health centers to provide regular anxiety screenings and counseling services. Cognitive-behavioral therapy (CBT) could be used to help students develop healthier phone use habits and coping strategies for anxiety.
5. **Structured Time Management**: Colleges could offer workshops on time management to help students balance academic, social, and leisure activities, reducing unstructured time spent on phones.
6. **Promote Physical Activity**: Encouraging students to participate in sports and outdoor activities can reduce sedentary phone use, improve sleep quality, and alleviate symptoms of anxiety and depression.
7. **Family and Peer Support**: Involving families and peers in interventions can create a supportive environment that encourages healthy phone use and open communication about mental health.

Limitations of this study include: (1) A cross-sectional design, which cannot establish causal relationships among variables; (2) A sample limited to college students in Guizhou Province, reducing the generalizability of results to other regions; (3) Reliance on self-reported questionnaires, which may be subject to response bias. Future research should use longitudinal designs, expand the sample to other regions, and combine objective measures (e.g., phone use logs, physiological indicators) to validate these findings.

Data Availability Statement

Data will be made available on request.

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Conflicts of Interest

The authors declare no conflicts of interest.

AI Use Statement

The authors declare that no generative AI was used in the preparation of this manuscript.

Ethical Approval and Consent to Participate

This study was exempt from ethical approval as it involved anonymous questionnaire surveys with no collection of personally identifiable information. All participants provided informed consent prior to completing the survey.

References

[1] China Internet Network Information Center (CNNIC). (2023). The 52nd Statistical Report on China's Internet Development. Beijing, China. Retrieved from https://www.cnnic.com.cn/IDR/ReportDownloads/202311/P020231121355042476714.pdf

[2] Zhang, G., Yang, X., Tu, X., Ding, N., & Lau, J. T. (2020). Prospective relationships between mobile phone dependence and mental health status among Chinese undergraduate students with college adjustment as a mediator. *Journal of affective disorders, 260*, 498-505. [CrossRef]

[3] Leung, L. (2008). Linking psychological attributes to addiction and improper use of the mobile phone among adolescents in Hong Kong. *Journal of children and media, 2*(2), 93-113. [CrossRef]

[4] Liu, M., & Lu, C. (2022). Mobile phone addiction and depressive symptoms among Chinese University students: The mediating role of sleep disturbances and the moderating role of gender. *Frontiers in public health, 10*, 965135. [CrossRef]

[5] Li, S., Deng, Y., Cai, L., & Wu, L. (2025). The relationship between smartphone addiction and sleep disorder among college students: negative emotions as a mediator and gender as a moderator. *Frontiers in Psychiatry, 16*, 1542243. [CrossRef]

[6] Yang, X., Yang, Y., Qin, D., & Zhong, M. (2025). Who is the antecedent? Mapping the relation from mental health to mobile phone addiction using cross-lagged panel network analysis. *Current Psychology, 44*(4), 2334-2347. [CrossRef]

[7] Kil, N., Kim, J., McDaniel, J. T., Kim, J., & Kensinger, K. (2021). Examining associations between smartphone use, smartphone addiction, and mental health outcomes: A cross-sectional study of college students. *Health Promotion Perspectives, 11*(1), 36. [CrossRef]

[8] Hu, Y., Guo, J., Jou, M., Zhou, S., Wang, D., Maguire, P., ... & Qu, F. (2020). Investigating the attentional bias and information processing mechanism of mobile phone addicts towards emotional information. *Computers in Human Behavior, 110*, 106378. [CrossRef]

[9] Yang, G. H., Cao, X. X., Fu, Y. Y., Wang, N. D., & Lian, S. L. (2024). Mobile phone addiction and academic

burnout: the mediating role of technology conflict and the protective role of mindfulness. *Frontiers in Psychiatry, 15*, 1365914. [CrossRef]

[10] Elhai, J. D., Levine, J. C., Dvorak, R. D., & Hall, B. J. (2016). Fear of missing out, need for touch, anxiety and depression are related to problematic smartphone use. *Computers in Human Behavior, 63*, 509-516. [CrossRef]

[11] Fauzi, M. F., Anuar, T. S., Teh, L. K., Lim, W. F., James, R. J., Ahmad, R., ... & Salleh, M. Z. (2021). Stress, anxiety and depression among a cohort of health sciences undergraduate students: the prevalence and risk factors. *International journal of environmental research and public health, 18*(6), 3269. [CrossRef]

[12] Cummings, C. M., Caporino, N. E., & Kendall, P. C. (2014). Comorbidity of anxiety and depression in children and adolescents: 20 years after. *Psychological bulletin, 140*(3), 816. [CrossRef]

[13] Jacobson, N. C., & Newman, M. G. (2014). Avoidance mediates the relationship between anxiety and depression over a decade later. *Anxiety Disorders, 28*(5), 437–445. [CrossRef]

[14] Zeng, M., Chen, S., Zhou, X., Zhang, J., Chen, X., & Sun, J. (2022). The relationship between physical exercise and mobile phone addiction among Chinese college students: Testing mediation and moderation effects. *Frontiers in Psychology, 13*, 1000109. [CrossRef]

[15] Li, X., Li, W., Liu, M., Xiao, W., & Zhou, H. (2022). How does shyness affect Chinese college Students' tendency to Mobile phone addiction? Testing the mediating roles of social anxiety and self-control. *Frontiers in Public Health, 10*, 902425. [CrossRef]

[16] Xiao, Z., & Huang, J. (2022). The relation between college students' social anxiety and mobile phone addiction: the mediating role of regulatory emotional self-efficacy and subjective well-being. *Frontiers in Psychology, 13*, 861527. [CrossRef]

[17] Li, G., Xie, J., An, L., Hou, G., Jian, H., & Wang, W. (2019). A generalizability analysis of the mobile phone addiction tendency scale for Chinese college students. *Frontiers in psychiatry, 10*, 241. [CrossRef]

[18] Zung, W. W. (1971). Depression in the normal adult population. *Psychosomatics: Journal of Consultation and Liaison Psychiatry*. [CrossRef]

[19] Dugan, W., McDonald, M. V., Passik, S. D., Rosenfeld, B. D., Theobald, D., & Edgerton, S. (1998). Use of the Zung Self-Rating Depression Scale in cancer patients: Feasibility as a screening tool. *Psycho-Oncology: Journal of the Psychological, Social and Behavioral Dimensions of Cancer, 7*(6), 483-493. [CrossRef]

[20] Diao, Y., Feng, Z., Ma, H., Liu, M., Zhao, S., Long, M., ... & Wang, Y. (2023). Loneliness and anxiety among Chinese medical students: the mediating role of mobile phone addiction and the moderating role of gender. *Social Science Computer Review, 41*(2), 482-494. [CrossRef]

[21] Uchegbu, I. C., Igiriogu, J. U., & Ngala, C. O. (2021). Personality traits, social anxiety and gender as predictors of smartphone addiction among students in tertiary institutions. *African Journal of Social and Behavioural Sciences, 11*(1).

[22] Ding, Y., Wan, X., Lu, G., Huang, H., Liang, Y., Yu, J., & Chen, C. (2022). The associations between smartphone addiction and self-esteem, self-control, and social support among Chinese adolescents: A meta-analysis. *Frontiers in psychology, 13*, 1029323. [CrossRef]

[23] Li, Y., Li, G., Liu, L., & Wu, H. (2020). Correlations between mobile phone addiction and anxiety, depression, impulsivity, and poor sleep quality among college students: A systematic review and meta-analysis. *Journal of behavioral addictions, 9*(3), 551-571. [CrossRef]

[24] Xie, G., Wu, Q., Guo, X., Zhang, J., & Yin, D. (2023). Psychological resilience buffers the association between cell phone addiction and sleep quality among college students in Jiangsu Province, China. *Frontiers in Psychiatry, 14*, 1105840. [CrossRef]

[25] Wang, J. L., Rost, D. H., Qiao, R. J., & Monk, R. (2020). Academic stress and smartphone dependence among Chinese adolescents: A moderated mediation model. *Children and Youth Services Review, 118*, 105029. [CrossRef]

[26] Arpaci, I. (2020). Gender differences in the relationship between problematic internet use and nomophobia. *Current Psychology, 41*(9), 4644–4653. [CrossRef]

[27] Tu, W., Jiang, H., & Liu, Q. (2022). Peer victimization and adolescent mobile social addiction: Mediation of social anxiety and gender differences. *International journal of environmental research and public health, 19*(17), 10978. [CrossRef]

[28] Dong, W., Li, S., & Wang, X. (2023). Parental phubbing and Chinese adolescents' SNSs addiction: Loneliness as a mediator and self-esteem as a moderator. *Current Psychology, 42*(19), 16560-16572. [CrossRef]

[29] Wang, Z., & Xuan, B. (2024). The effect of adult attachment on mobile phone dependence among university students: the mediating role of loneliness. *Frontiers in Psychology, 15*, 1494262. [CrossRef]

[30] Ding, X., Jin, X., Tang, Y. Y., & Yang, Z. (2024, March). Associations between mobile phone addiction and depressive symptoms in college students: A conditional process model. In *Annales Médico-psychologiques, revue psychiatrique* (Vol. 182, No. 3, pp. 258-265). Elsevier Masson. [CrossRef]

[31] Liu, M., Li, X., & He, Z. (2022). Self-control mediates, and mobile phone dependence moderates, the relationship between psychological capital and attitudes toward physical exercise among Chinese university students. *Frontiers in Psychology, 13*, 888175. [CrossRef]

[32] Chen, H., Wang, C., Lu, T., Tao, B., Gao, Y., & Yan, J. (2022). The relationship between physical

activity and college students' mobile phone addiction: the chain-based mediating role of psychological capital and social adaptation. *International journal of environmental research and public health, 19*(15), 9286. [CrossRef]

[33] Ko, C. H., Liu, T. L., Wang, P. W., Chen, C. S., Yen, C. F., & Yen, J. Y. (2014). The exacerbation of depression, hostility, and social anxiety in the course of Internet addiction among adolescents: A prospective study. *Comprehensive psychiatry, 55*(6), 1377-1384. [CrossRef]

[34] Wang, H., Ji, M., Tu, H., Qi, Y., Wu, S., & Wang, X. (2025). College students' loneliness and mobile phone addiction: mediating role of mobile phone anthropomorphism and moderating role of interpersonal relationship quality. *Frontiers in Psychiatry, 16*, 1581421. [CrossRef]

[35] Bi, T., Kou, H., Xie, Q., & Dong, J. (2022). Mediating roles of social anxiety and interpersonal distress in the relationship between mobile phone addiction and loneliness. *Journal of Psychology in Africa, 32*(5), 487-493. [CrossRef]

[36] Saeb, S., Zhang, M., Karr, C. J., Schueller, S. M., Corden, M. E., Kording, K. P., & Mohr, D. C. (2015). Mobile phone sensor correlates of depressive symptom severity in daily-life behavior: an exploratory study. *Journal of medical Internet research, 17*(7), e4273. [CrossRef]

[37] Thomée, S., Härenstam, A., & Hagberg, M. (2011). Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults-a prospective cohort study. *BMC public health, 11*(1), 66. [CrossRef]

[38] Nyer, M., Farabaugh, A., Fehling, K., Soskin, D., Holt, D., Papakostas, G. I., ... & Mischoulon, D. (2013). Relationship between sleep disturbance and depression, anxiety, and functioning in college students. *Depression and anxiety, 30*(9), 873-880. [CrossRef]

[39] Demirci, K., Akgönül, M., & Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of behavioral addictions, 4*(2), 85-92. [CrossRef]

[40] Ernst, C., Olson, A. K., Pinel, J. P., Lam, R. W., & Christie, B. R. (2006). Antidepressant effects of exercise: evidence for an adult-neurogenesis hypothesis?. *Journal of Psychiatry and Neuroscience, 31*(2), 84-92. [CrossRef]

[41] Meng, S., Qi, K., Shen, P., Zhang, M., Zhang, Y., Onyebuchi, N., ... & Ge, X. (2025). The effects of mobile phone addiction on learning engagement of Chinese college students-the mediating role of physical activity and academic self-efficacy. *BMC Public Health, 25*(1), 110. [CrossRef]

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