ORIGINAL RESEARCH

The Effect of Self-Esteem on Mobile Phone Addiction Among College Students: Sequential Mediating Effects of Online Upward Social Comparison and Social Anxiety

Peng Zhang [ID][1], Mingliang Wang[1], Lin Ding[1], Jinyang Liu[2], Yuqing Yuan[1], Jianing Zhang[1], Shuyuan Feng[1], Yu Liu[3]

[1]Faculty of Psychology, Tianjin Normal University, Tianjin, 300387, People's Republic of China; [2]College of Arts and Sciences, Indiana University Bloomington, Bloomington, IN, 47405, USA; [3]Department of Psychology, Zhejiang Normal University, Jinhua, 321004, People's Republic of China

Correspondence: Peng Zhang, Faculty of Psychology, Tianjin Normal University, Tianjin, 300387, People's Republic of China, Email psyzhangpeng@163.com

Purpose: Mobile phone addiction threatens individuals' physiological, psychological, and social functions, particularly among college students. While existing theories suggest a strong link between self-esteem and mobile phone addiction, the underlying mechanism remains unclear. This study aims to examine the relationship between self-esteem and mobile phone addiction in Chinese college students, exploring the chain mediation effects of online upward social comparison and social anxiety.

Participants and Methods: A cross-sectional study was conducted using an offline questionnaire survey with 789 Chinese college students, employing convenience sampling in Shaanxi Province, China. Four validated instruments were employed: Self-Esteem Scale, Mobile Phone Addiction Index, Online Upward Social Comparison Scale, and Social Anxiety Scale. Descriptive analysis, correlation analysis, and mediation testing were performed to analyze the data.

Results: The results showed that self-esteem influences mobile phone addiction through three pathways: (1) self-esteem → online upward social comparison → mobile phone addiction, with a 95% confidence interval of [−0.048, −0.010], indicating a significant mediation effect (effect value = −0.027, accounting for 14.86% of the total effect); (2) self-esteem → social anxiety → mobile phone addiction, with a 95% confidence interval of [−0.182, −0.106], indicating a significant mediation effect (effect value = −0.143, accounting for 78.57% of the total effect); (3) self-esteem → online upward social comparison → social anxiety → mobile phone addiction, with a 95% confidence interval of [−0.016, −0.003], suggesting a significant mediation effect (effect value = −0.009, accounting for 4.95% of the total effect).

Conclusion: These findings indicate that online upward social comparison and social anxiety serially mediate the relationship between self-esteem and mobile phone addiction. The study reveals how self-esteem contributes to mobile phone addiction among college students and provides insights for prevention and intervention strategies.

Keywords: self-esteem, online upward social comparison, social anxiety, mobile phone addiction, college students

Introduction

Globally, mobile phones have become an indispensable part of work, knowledge acquisition, entertainment, and social interaction. As of December 2023, China's internet penetration rate reached 75.5%, with the number of internet users totaling 1.092 billion, of which 1.091 billion are mobile phone internet users.[1] It means that the percentage of Internet users using mobile phones to access the Internet is 99.9%. However, mobile phones also bring the risk of addiction due to their accessibility and versatility. This problem is particularly prominent among college students.[2] College students' minds are still developing, and when they enter the university without the supervision of parents and teachers, it is easy to lead to mobile phone addiction. The internet satisfies their curiosity and desire for knowledge. However, without

sufficient self-control and the ability to critically evaluate and filter information, students are prone to falling into the trap of addiction.

An investigative study showed that the prevalence of mobile phone addiction among Chinese college students was 23.0%.[3] Mobile phone addiction refers to a behavioral addiction characterized by an individual's uncontrollable use of mobile phones, leading to significant impairment in physiological, psychological, and social functions.[4] It not only threatens interpersonal communication, family relationships, academic performance, sleep quality, and attention but also trigger a range of negative emotions, including alienation, anxiety, and depression.[5–8] Exploring the mechanisms of mobile phone addiction in college students is crucial for promoting more rational use of mobile phones and plays a significant role in preventing addiction among this population.

Self-Esteem and Mobile Phone Addiction

Self-esteem refers to an individual's judgment of self-worth, perception of self-competence, and recognition of the overall self.[9] According to the theory of problem behavior, the emergence of problem behavior is the result of a combination of multidimensional factors in which personality, social environment, and behavior all play an important role.[10] Self-esteem, an important personality variable, is a major predictor of behavioral addiction and likewise significantly predicts mobile phone addiction.[11] According to resource conservation theory, individuals cope with stressors and social threats by protecting and preserving psychological resources.[12] Within this framework, self-esteem is considered an important psychological resource. Individuals with low self-esteem may experience heightened social threats and evaluation anxiety, leading them to avoid social interactions and excessively rely on their phones to escape negative evaluations. This behavior can be seen as a form of resource protection, aimed at reducing potential social risks by minimizing direct contact with others. As Joinson's empirical study found, people with lower self-esteem are more likely to use indirect communication methods such as e-mail when facing interpersonal risks, which may be an avoidance strategy to cope with potential social risks.[13] Additionally, college students with lower self-esteem tend to exhibit greater impulsivity and weaker self-control,[14,15] which makes them more susceptible to maladaptive behaviors, such as mobile phone addiction.[16–18] Furthermore, a study confirmed a significant negative correlation between self-esteem and mobile phone addiction among college students, indicating that lower self-esteem is associated with higher levels of mobile phone addiction.[19] Given this, this study proposed H1: Self-esteem is a significant negative predictor of mobile phone addiction.

Although theories and research have established a link between self-esteem and mobile phone addiction, the underlying mechanisms have not been clarified. Some researchers suggest that the impact of self-esteem on mobile phone addiction may involve additional underlying psychological processes.[4,20] To deepen our understanding of the mechanisms through which self-esteem influences mobile phone addiction, it is necessary to introduce additional potential mediators. This approach not only enhances our comprehension of the underlying processes of mobile phone addiction but also provides crucial insights for developing effective intervention strategies.

Social media are thriving currently, and online upward social comparison offers a valuable perspective for understanding the complex relationship between self-esteem and mobile phone addiction. In today's world, social comparison is a prevalent cognitive process existing in people's minds, and also a collective phenomenon in social life.[21] A large number of studies have also confirmed that social comparison is an important factor in influencing and shaping human behavior,[22,23] and the role of this process is more prominent in the context of the widespread popularity of the Internet. What's more, impression management theory suggests that individuals tend to present a retouched, embellished, or even exaggerated image of their "perfect self" online.[24] This results in an increased frequency of individuals comparing themselves to others they perceive as superior when viewing social media posts, making the phenomenon of upward social comparison more prevalent and spontaneous online. As Lee's study found, the use of social media increases the frequency of upward social comparisons.[25] However, frequent upward social comparisons can damage an individual's mental health and induce negative emotions such as depression, jealousy, and stress.[26,27] According to the contrast effect of social comparisons and cognitive models of social anxiety, frequent upward social comparisons may result in lower self-appraisal and a heightened tendency to develop negative self-interpretation biases in social situations, thereby increasing the risk of social anxiety.[28,29] Based on the aforementioned research, we propose that online upward social

comparison and social anxiety may serve as important psychological mechanisms in the relationship between self-esteem and mobile phone addiction. Therefore, we aim to investigate the mediating role of online upward social comparison and social anxiety in this relationship.

The Mediating Effect of Online Upward Social Comparison

Online upward social comparison refers to the process of social comparison between an individual and a better person with positive characteristics in terms of ability, achievement, appearance, emotion, physical health, and popularity by browsing others' posts on social media.[22,30] A meta-analysis revealed that self-esteem is a significant negative predictor of online upward social comparison.[31] According to social comparison theory, individuals have a need for self-evaluation and use others as a source of self-evaluation in the absence of objective evaluation criteria.[29] Self-esteem, a core component of an individual's self-concept, influences their self-evaluation and the processing of social comparison information.[32] A study involving 798 participants using a combination of real-time social media browsing, experimenter-generated comparisons, and comparisons across different contexts (eg, text messages and face-to-face interactions) found that more frequent and extreme upward social comparisons on social media led to significant declines in self-evaluations, state self-esteem, mood, and life satisfaction. Additionally, individuals with low self-esteem were particularly vulnerable to making more frequent and extreme upward comparisons, which further threatened their already-lower self-evaluations.[33]

In addition, online social comparison has a negative effect on mobile phone use behavior. Some college students report that one of their motivations for using social media is to make social comparisons, especially when viewing posts and photos shared by others.[25] Since individuals often present an idealized version of themselves on social media, it inherently provides ample opportunities for upward social comparison.[21] A study involving 145 undergraduate participants from a university in the United States, using correlational analysis, found that college students with higher tendencies for upward social comparison spent more time and energy on social media, which could potentially lead to social media addiction.[34] According to the theory of compensatory internet use, individuals tend to turn to the internet to alleviate negative emotions or psychological distress following a stressful event, thereby fulfilling unmet psychological needs.[35] While using the internet to alleviate negative emotions can be somewhat adaptive, excessive reliance on it may lead to negative outcomes, such as social network addiction.[36] As He's study confirm the idea that individuals who make upward social comparisons are more likely to recognize gaps between themselves and others, magnify their deficiencies, perceive more stress, and thus lead to mobile phone addiction.[37] Given that mobile phones serve as accessible tools for social comparison, individuals with lower self-esteem may engage in upward social comparisons online, thereby increasing their risk of mobile phone addiction. Based on the above analyses, this study proposes H2: Online upward social comparison mediates the relationship between self-esteem and mobile phone addiction.

The Mediating Effect of Social Anxiety

Social anxiety, a common form of anxiety, arises from an individual's fear of negative evaluations by others in social situations, leading to feelings of nervousness and unease during interactions or social gatherings.[38] On the one hand, the inducement of social anxiety is strongly influenced by intrinsic personal factors. Negative self-perceptions and evaluations as well as fear of negative evaluations are risk factors for inducing social anxiety.[28,39] Individuals with lower levels of self-esteem tend to have negative thoughts on themselves, and are prone to believe that others will do the same. So, they are more sensitive to others' evaluations. Fear management theory emphasizes that self-esteem, a psychological protective mechanism, plays an important role in reducing anxiety through its self-regulatory function.[40] For example, individuals with high self-esteem are better equipped to withstand social anxiety and exhibit greater resilience in reducing anxiety.[41] This indicates that self-esteem plays a critical role in the formation and maintenance of social anxiety.

On the other hand, social anxiety is also an important factor in triggering mobile phone addiction. According to the cognitive-behavioral model of pathological internet use, social anxiety is viewed as a significant psychopathological factor that plays a crucial role in triggering internet addiction.[42] The association between social anxiety and mobile phone addiction is further reinforced by the fact that mobile phone addiction is widely regarded as a form of addiction similar to internet addiction, exhibiting consistent psycho-behavioral patterns.[43] Specifically, individuals with higher levels of

social anxiety are more sensitive to interpersonal relationships and tend to rely more on their mobile phones to connect with others rather than engaging in face-to-face interactions.[19] Meta-analysis also further confirmed that social anxiety is a significant positive predictor of mobile phone addiction.[44] Based on the above analyses, this study proposes H3: Social anxiety mediates the relationship between self-esteem and mobile phone addiction.

The Serial Mediating Role of Online Upward Social Comparison and Social Anxiety

Compared to offline socialization, the interpersonal interactions and information-sharing environment created by social media offer individuals a richer foundation for social comparison, but also pose a threat to their emotional well-being.[45] The contrast effect of social comparison refers to the phenomenon that an individual's self-evaluation level deviates from the competitor when facing social comparison information.[46] In other words, when the individual's expectation for the future is not as good as that of the competitor's, the individual's self-evaluation level will decline. According to the cognitive model of social anxiety, when individuals hold negative beliefs about themselves, these beliefs are activated during social interactions, leading them to interpret neutral social cues negatively, which in turn triggers social anxiety.[28] Jiang and Ngien's study further confirmed that online upward social comparisons are a trigger for social anxiety.[47] To conclude the previous studies, upward social comparison can predict social anxiety.

Overall, individuals with lower self-esteem often have unclear self-perceptions and diminished self-confidence, leading them to rely on social comparison information to gain a clearer understanding of themselves.[48] Consequently, they are highly susceptible to frequent and intense upward social comparisons, which in turn trigger their social anxiety.[49] This anxiety may cause them to avoid in-person interactions, thereby increasing the risk of mobile phone addiction. Thus, the present study incorporates both online upward social comparison and social anxiety into the relationship between self-esteem and college students' mobile phone addiction, aiming to explore their interrelationships and the underlying mechanism through which self-esteem influences mobile phone addiction. Based on the above reasons, this study proposes H4: Online upward social comparison and social anxiety act as serial mediators in the relationship between self-esteem and mobile phone addiction.

In general, this study proposes to establish a serial mediation model (as shown in Figure 1) to explore the influence of self-esteem on college students' mobile phone addiction. It will examine both the independent and sequential mediating roles of online upward social comparison and social anxiety. The study aims to offer insights for the prevention and intervention of mobile phone addiction among college students.

Methods
Participants
This study employed a cross-sectional design, with data collected through convenience sampling in Shaanxi Province, China. To enhance sample representativeness and minimize biases, participants were college students who voluntarily completed the survey. Informed consent was obtained from all respondents, who were assured of the confidentiality of their responses. To ensure data accuracy, lie detection questions were included. The survey was administered online via
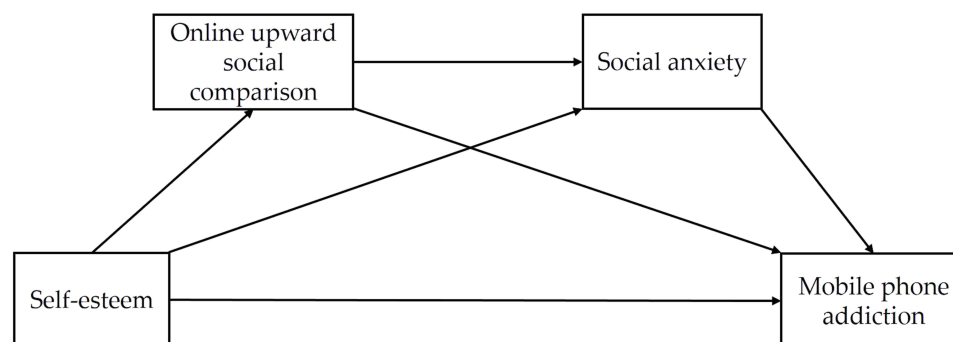
Figure 1 Hypothetical model.

"Survey Star", with participants accessing it through QR codes or website links on their mobile phones. This research adhered to ethical guidelines outlined in the Declaration of Helsinki and received approval from the Ethics Committee of Tianjin Normal University (2024012458). A total of 810 questionnaires were distributed, and 789 valid responses were collected, resulting in a response rate of 97.4%. The mean age of participants was 19.63 years (SD = 1.20), consisting of 467 male students (59.2%) and 322 female students (40.8%). Among the participants, 410 were freshmen, 309 sophomores, 49 juniors, and 21 seniors.

Measures
Self-Esteem Scale
The Self-Esteem Scale developed by Rosenberg[9] and revised by Wang et al[50] was used in this study. The scale consists of 10 items, with five reverse-scored. Each item is rated on a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). The total score ranges from 10 to 40 points, with higher scores indicating higher levels of self-esteem. The scale has shown high reliability among Chinese college students.[19] In this study, the Cronbach's α coefficient of the scale was 0.88.

Online Upward Social Comparison Scale
The Online Upward Social Comparison Scale developed by Gibbons & Buunk[51] and revised by Lian et al[52] was used in this study. This scale consists of 6 items, which are rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 6 to 30, with higher scores indicating a higher frequency of online upward social comparison. The scale has demonstrated high reliability in previous studies, including among Chinese college students.[52] In this study, the Cronbach's α coefficient of the scale was 0.91.

Social Anxiety Scale
The social anxiety subscale for the Self-Consciousness Scale developed by Fenigstein et al[53] and revised by Wang et al[50] was used in this study. This scale consists of 6 items, which are rated on a 5-point Likert scale, ranging from 0 (strongly disagree) to 4 (strongly agree). The total score ranges from 0 to 24 points, with higher scores indicating higher levels of social anxiety. The scale has high reliability among Chinese college students,[19] and the Cronbach's α coefficient of the scale in this study was 0.84.

Mobile Phone Addiction Index
The mobile phone addiction index developed by Leung et al[54] and translated by Huang et al[55] was used in this study. This scale consists of 17 items, which are rated on a 5-point Likert scale, ranging from 1 (almost never) to 5 (always). The total score ranges from 17 to 85 points, with higher scores indicating higher levels of mobile phone addiction.The scale has high reliability among Chinese college students,[56] and the Cronbach's α coefficient of the scale in this study was 0.90.

Analytical Method
This study utilized SPSS 26.0 for data processing and analysis. Data were collected through a questionnaire survey, and the analysis methods included descriptive statistics, correlation analysis, and regression analysis. Additionally, the PROCESS 4.1 macro (Model 6) for SPSS was employed to examine the mediating roles of online upward social comparison and social anxiety in the relationship between self-esteem and mobile phone addiction.

Firstly, since this study employed a questionnaire survey, common method bias may be a concern. To assess the reliability of the data and ensure the accuracy of the findings, Harman's single-factor test was conducted to examine potential common method bias. If the variance explained by the first factor is below the critical threshold of 40%, it indicates that common method bias does not significantly affect the results.

Secondly, to investigate the relationships among the main variables, descriptive statistics and correlation analysis were conducted. Significant correlations indicated that the statistical requirements for mediation analysis were met. All variables were standardized, and regression analysis was performed using the confidence interval method in Model 6 of the PROCESS macro. A chain mediation model was established with self-esteem as the independent variable, mobile

phone addiction as the dependent variable, and online upward social comparison and social anxiety as mediating variables. The analysis was based on 5000 bootstrap samples, with gender and age controlled for.

The data analysis results included reporting key parameters such as the confidence interval, effect size, significance level, path coefficient, and the amount of effect to provide a comprehensive presentation of the findings.

Common Method Bias Test

All questionnaires in this study were completed anonymously, with some items reverse-scored. Common method bias was assessed using Harman's single-factor test.[57] The results indicated that eight factors had eigenvalues greater than 1, and the first factor explained 23.29% of the variance, which is below the 40% threshold, suggesting no significant common method bias.

Results

Descriptive Statistics and Correlation Analysis

The results of the correlation analysis (Table 1) show that self-esteem is significantly negatively correlated with gender, online upward social comparison, social anxiety, and mobile phone addiction. Online upward social comparison shows significant positive correlations with gender, age, social anxiety, and mobile phone addiction. Social anxiety is significantly positively correlated with mobile phone addiction. Finally, mobile phone addiction exhibits significant negative correlations with gender and significant positive correlations with age.

Mediating Effect Test

The results of the correlation analysis meet the statistical requirements to further conduct a mediated effects test on the relationship between self-esteem and mobile phone addiction among college students. Therefore, Bootstrap's mediated effects test is performed using Model 6 in the PROCESS program. Controlling for college students' gender and age, a serial mediation model is established with self-esteem as the independent variable, mobile phone addiction as the dependent variable, and online upward social comparison and social anxiety as the mediating variables.

The results of regression analysis are shown in Table 2. College students' self-esteem significantly negatively predicts mobile phone addiction ($\beta = -0.18$, $p < 0.001$) and online upward social comparison ($\beta = -0.13$, $p < 0.001$). Self-esteem

Table 1 Mean, Standard Deviation, and the Correlation Matrix of Each Variable (n = 789)

	M	SD	1	2	3	4	5	6
1.Gender	–	–	1					
2.Age	19.63	1.20	0.07	1				
3.Self-Esteem	2.96	0.48	−0.14**	0.03	1			
4.Online Upward Social Comparison	2.96	0.86	0.11**	0.09*	−0.14**	1		
5.Social Anxiety	3.16	0.84	−0.03	0.01	−0.37**	0.21**	1	
6.Mobile Phone Addiction	2.57	0.72	−0.08*	0.12**	−0.16**	0.29**	0.45**	1

Notes: Gender is a dummy variable, female=0, male=1; *$p < 0.05$, ** $p < 0.01$.

Table 2 Regression Analysis of Variable Relationships in the Serial Mediation Model

Outcome Variable	Predictor Variable	R	R²	F	β	t
Mobile Phone Addiction	Self-Esteem	0.23	0.05	14.44***	−0.18	−5.17***
Online Upward Social Comparison	Self-Esteem	0.18	0.03	9.11***	−0.13	−3.65***
Social Anxiety	Self-Esteem	0.41	0.17	40.26***	−0.36	−10.81***

(*Continued*)

Table 2 (Continued).

Outcome Variable	Predictor Variable	R	R²	F	β	t
	Online Upward Social Comparison				0.17	5.08***
Mobile Phone Addiction	Self-Esteem	0.51	0.26	54.25***	−0.003	−0.10
	Online Upward Social Comparison				0.21	6.59***
	Social Anxiety				0.40	11.76***

Notes: The variables in the model are standardized and then brought into the regression equation, *** $p < 0.001$.

also significantly negatively predicts social anxiety (β = −0.36, $p < 0.001$), while online upward social comparison significantly positively predicts social anxiety (β = 0.17, $p < 0.001$). When self-esteem, online upward social comparison, and social anxiety are simultaneously included in the regression equation, online upward social comparison (β = 0.21, $p < 0.001$) and social anxiety (β = 0.40, $p < 0.001$) significantly positively predict mobile phone addiction, whereas self-esteem (β = −0.003, $p > 0.05$) fails to significantly negatively predict mobile phone addiction.

The mediating path is further tested, and the results are shown in Table 3. The mediating effect of online upward social comparison and social anxiety between college students' self-esteem and mobile phone addiction is significant (95% confidence interval not including 0), with a total mediating effect value of −0.178, accounting for 98.38% of the total effect. Self-esteem affects college students' mobile phone addiction through the following three paths: (1) self-esteem → online upward social comparison → mobile phone addiction, with a 95% confidence interval of [−0.048, −0.010] not including 0, indicating that the mediation effect of this path is significant (effect value = −0.027, accounting for 14.86% of the total effect); (2) self-esteem → social anxiety → mobile phone addiction. The 95% confidence interval is [−0.182, −0.106], not including 0, indicating a significant mediating effect of this path (effect value = −0.143, accounting for 78.57% of the total effect); (3) self-esteem → online upward social comparison → social anxiety → mobile phone addiction, with a 95% confidence interval of [−0.016, −0.003], not including 0, suggesting that the mediating effect of this path is significant (effect value = −0.009, accounting for 4.95% of the total effect). The specific model plot with the path coefficients of each variable is shown in Figure 2.

Table 3 Intermediary Effect Value and Effect Size

	Effect	Ratio of Total Effects	Boot LLCI	Boot ULCI
Direct Effect			−0.069	0.063
Path 1: Self-Esteem→Mobile Phone Addiction	−0.003			
Indirect Effect		14.86%	−0.048	−0.010
Path 2: Self-Esteem→Online Upward Social Comparison→Mobile Phone Addiction	−0.027			
Path 3: Self-Esteem→Social Anxiety→Mobile Phone Addiction	−0.143	78.57%	−0.182	−0.106
Path 4: Self-Esteem→Online Upward Social Comparison→Social Anxiety→Mobile Phone Addiction	−0.009	4.95%	−0.016	−0.003
Total Mediation Effect	−0.178	98.38%	−0.220	−0.138
Total Effect	−0.182		−0.251	−0.113
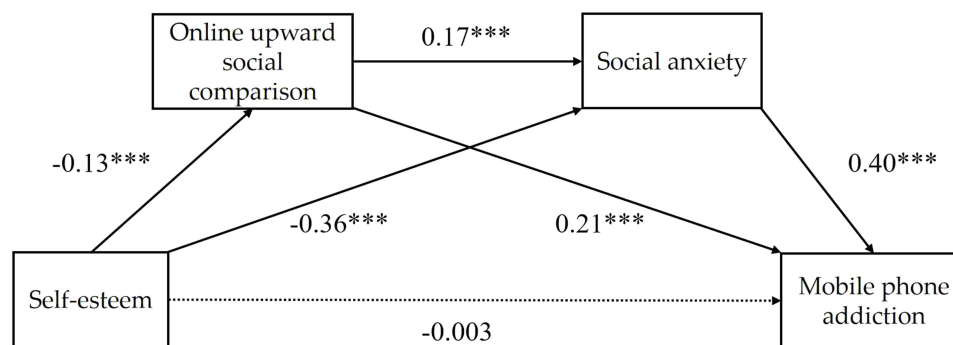
Figure 2 Sequence mediated effects model.
Notes: Dashed lines indicate paths that are not significant (*p*>0.05) and all path coefficients are standardized, ***p<0.001.

Discussion

This study explored the underlying mechanism by which self-esteem influences mobile phone addiction in college students through a serial mediation model involving online upward social comparison and social anxiety. The findings demonstrate that self-esteem can impact mobile phone addiction through both the independent mediating roles of online upward social comparison and social anxiety, as well as through their sequential mediation. These results provide valuable insights into the psychological processes linking self-esteem and mobile phone addiction, contributing to theoretical advancements in the field. Practically, these findings offer multiple angles for proactive prevention and intervention, supporting efforts to reduce mobile phone addiction among college students.

The Impact of Self-Esteem on Mobile Phone Addiction

This study showed that self-esteem negatively predicts mobile phone addiction and the results confirmed H1, which is consistent with the results of previous studies.[19] Based on resource conservation theory and compensatory Internet use theory, people tend to protect and keep valuable resources to cope with stress and psychological distress.[12,35] Individuals with lower self-esteem often experience anxiety and helplessness due to a lack of internal resources, such as self-confidence and self-worth. As a result, they are more likely to seek external resources to compensate for these deficiencies. Individuals with lower self-esteem tend to avoid in-person communication, and the reduction of audiovisual cues in the online environment facilitates the overcoming of timid and anxious thoughts. As a result, they are more likely to seek the resources they need through the Internet.[13] Mobile phones, as a convenient tool for online socialization, are often viewed by individuals with low self-esteem as an important means of compensating for resource deficits. However, as dependence on mobile phones gradually increases, this behavior may eventually escalate into mobile phone addiction.

When mediating variables were introduced into the model for a more in-depth analysis, the direct effect of self-esteem on mobile phone addiction became insignificant. This suggests that the relationship between self-esteem and mobile phone addiction may not be direct and simple. Some researchers have argued that self-esteem is strongly influenced by the feedback from those around an individual, especially when one's self-worth depends on the approval of others,[20] while mobile phones are essentially just a medium for information exchange, although they can provide feedback from others.[4] Thus, the relationship between self-esteem and mobile phone use behaviors (including mobile phone addiction) may not be direct, but instead involves a complex interaction of psychological processes. This finding further emphasizes the importance of incorporating mediating variables to better understand the complex psychological mechanisms through which self-esteem influences mobile phone addiction.

The Role of Online Upward Social Comparison as a Mediator

This study confirmed that online upward social comparison mediated the relationship between self-esteem and mobile phone addiction among college students, and H2 was validated. Firstly, self-esteem was a negative predictor of online upward social comparison, which is similar to previous findings.[33] Social comparison theory posits that when individuals

experience uncertainty about their abilities and worth, they are inclined to evaluate themselves by comparing themselves to others.[29] In other words, individuals with low self-esteem often lack a sense of self-worth. They tend to have negative or doubtful perceptions of their abilities, appearance, and achievements, and are more likely to seek validation or confirmation of their value through external evaluations and social comparisons. Secondly, this study found that online upward social comparison positively predicts mobile phone addiction, which is consistent with previous research and extends the compensatory internet use theory.[35,37] It suggests that the negative effects of an individual's online upward social comparisons may be mitigated by seeking positive stimuli through mobile phones, allowing individuals to either restore a sense of well-being or escape negative emotions via entertainment. Specifically, when social media is used as a tool for frequent and repeated comparisons in terms of interpersonal relationships, career success, wealth accumulation, quality of life, or social status, persistent negative comparisons may undermine an individual's emotional well-being and self-identity. This can lead to depression, negative self-perception, and a diminished sense of well-being,[58,59] which individuals may attempt to cope with through maladaptive or deviant behaviors, such as excessive mobile phone use.[60] Over time, this can escalate into uncontrollable addictive behaviors. In conclusion, online upward social comparisons serve as a means for individuals with low self-esteem to seek self-worth and identity. One of the motivations behind mobile phone use for these individuals is to alleviate or compensate for the negative effects resulting from such comparisons.

The Role of Social Anxiety as a Mediator

The present study found that social anxiety mediated the relationship between self-esteem and mobile phone addiction among college students and validated H3. Firstly, self-esteem was a negative predictor of social anxiety, which is consistent with Iancu's finding that lower levels of self-esteem are associated with higher levels of social anxiety.[61] The reasons may stem from the negative self-evaluative beliefs that individuals with low self-esteem hold in their cognitive schemas. These beliefs become activated in social contexts, leading to a biased interpretation of situations or others' behaviors, which subsequently triggers the experience of social anxiety. Secondly, social anxiety positively predicts mobile phone addiction, supporting the cognitive-behavioral model of pathological Internet use[42] and consistent with Liu's finding.[62] When it comes to in-person interactions, people with social anxiety experience unnecessary tension and fear and are overly sensitive to criticism and rejection from others. This high level of interpersonal sensitivity leads them to be particularly vulnerable in establishing or maintaining interpersonal relationships, which in turn creates a psychological tendency to avoid real-life social interactions.[19] The anonymity and non-immediacy provided by the Internet can effectively alleviate the fear of being evaluated by individuals with social anxiety, and encourage them to use mobile phones to make up for the lack of offline interpersonal communication and seek emotional support. However, if the self-control ability is insufficient, mobile phone addiction can be easily induced.[63] In conclusion, low self-esteem may serve as a trigger for social anxiety, which is a key emotional factor contributing to mobile phone addiction. Self-esteem can provide a foundational personality trait for the development of mobile phone addiction, while social anxiety acts as an important emotional mechanism through which low self-esteem leads to online problematic behaviors, such as mobile phone addiction and Internet addiction.

The Sequential Mediation Effect of Online Upward Social Comparison and Social Anxiety

The present study reveals how self-esteem influences mobile phone addiction through the sequential mediating role of online upward social comparison and social anxiety, confirming H4. It was found that upward social comparisons are common in mobile phone use, significantly intensifying an individual's level of social anxiety. This result supports the contrast effect of upward social comparisons, whereby exposure to positive information from others highlights the disparity between oneself and others, often resulting in lower self-assessment and negative self-feelings, which subsequently diminish emotional well-being.[46] Upward social comparisons can make individuals susceptible to interpersonal pressure from their peers, resulting in negative self-evaluations and a heightened sense of gap between themselves and others.[64] If an individual perceives this gap to be large and difficult to bridge, it may trigger doubt and denial of their

abilities, leading to lower self-evaluation and negative emotions such as anxiety.[47] Therefore, during online upward social comparisons, people are prone to exhibit typical social anxiety symptoms, such as fear of negative evaluations and worry about how to interact with others.

Overall, people with low self-esteem are more likely to make upward social comparisons on social media in an attempt to stabilize or confirm their self-concept.[65] However, when seeing positive information displayed by others, they are more likely to feel the inferiority, which increases their psychological burden in in-person social interactions, and experience negative emotions such as social anxiety.[66] To escape from the pressure and anxiety in in-person interactions, these people often turn to communications online to seek comfort. This is because online communication provides them with a way to avoid direct confrontation with the judgment of others, allowing them to express themselves freely in an environment without immediate feedback and judgment.[67] This behavioral pattern of relying on online communication further increases the risk of mobile phone addiction. Therefore, understanding and coping with online upward social comparison and social anxiety is crucial for the prevention of mobile phone addiction.

Implications and Limitations

The study holds significant theoretical value and offers profound practical implications. Theoretically, this study examined the mechanisms of the role of online upward social comparison and social anxiety in the influence of self-esteem on mobile phone addiction based on the social comparison theory and the cognitive model of social anxiety. The findings indicate that self-esteem influences mobile phone addiction through three main pathways: the independent mediating roles of online upward social comparison and social anxiety, as well as the sequential mediating role of online upward social comparison and social anxiety. This finding offers a more comprehensive and in-depth theoretical framework for understanding and explaining the psychological mechanisms behind mobile phone addiction. Additionally, it opens new avenues for research on mobile phone addiction, providing solid theoretical support for further exploration of its underlying mechanisms and the development of effective interventions.

From a practical perspective, this study offers valuable guidance for preventing and intervening in mobile phone addiction among college students. First, enhancing self-esteem proves to be an effective preventive strategy. Universities can promote self-esteem through psychological health education programs, group activities, and self-awareness training. These initiatives can help students develop a healthy self-identity and positive self-evaluation, reducing their dependence on mobile phones. For instance, psychological counseling and behavioral correction can assist students in recognizing and modifying negative self-concepts, which, in turn, may help reduce the likelihood of mobile phone addiction. Second, for students already experiencing mobile phone addiction, research suggests that reducing online upward social comparison and managing social anxiety are effective intervention strategies. University counseling centers can offer personalized psychological support by utilizing cognitive behavioral therapy (CBT) and mindfulness-based techniques to help students adjust maladaptive social comparison habits and regulate anxiety. Additionally, fostering a healthy online social environment and encouraging increased participation in offline activities can reduce excessive reliance on mobile phones for virtual communication, alleviating both social anxiety and mobile phone addiction. This approach not only addresses mental health concerns but also improves students' overall quality of life and social adaptability.

Additionally, this study has some limitations that should be addressed in future research. First, the serial mediation model used in this cross-sectional study limits the ability to establish causal relationships between self-esteem and mobile phone addiction. Future research should incorporate longitudinal tracking studies to explore the dynamic relationships between variables over time. Second, this study primarily focused on college students, which limits its generalizability. Future studies should employ more representative sampling methods to include a broader demographic. Finally, the relationship between self-esteem and mobile phone addiction is complex and influenced by multiple factors. This study focused on two key mediating mechanisms, but there may be other important mechanisms that warrant further investigation.

Conclusions

The results of this study indicated that self-esteem is a significant contributing factor to mobile phone addiction among college students, with the relationship being mediated by online upward social comparison and social anxiety. Guiding

college students to reduce unnecessary comparisons and manage anxiety is beneficial in reducing mobile phone addiction.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

All procedures performed in studies involving human participants were in accordance with the Ethics Committee of Tianjin Normal University. The ethical approval number is 2024012458, and the approval date is 24 January 2024. Informed consent was obtained from all subjects involved in the study.

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Disclosure

The authors report no conflicts of interest in this work.

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