

Original Research

The Mediating Role of Psychological Capital in the Relationship Between Childhood Trauma and Mobile Phone Addiction Among Chinese Nursing Students: A Cross-Sectional Questionnaire Survey

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Abstract

Background: Nursing students, as future clinical professionals, face an increasing risk of mobile phone addiction (MPA), which can compromise their academic performance, mental health, and clinical competence. Therefore, understanding the prevalence and underlying mechanisms of MPA is crucial for protecting mental health, promoting academic success, and strengthening professional development in this population. This study examined the relationship between childhood trauma and MPA and evaluated the mediating role of psychological capital, offering a theoretical foundation for improving mental health and fostering healthy smartphone use among nursing students. **Methods:** This cross-sectional, descriptive, correlational study was conducted between November 2023 and April 2024. An online survey was administered to 1249 undergraduate nursing students (majority female). Standardized instruments, including the Childhood Trauma Questionnaire, the Psychological Capital Questionnaire, and the Mobile Phone Addiction Tendency Scale, were used to assess childhood trauma, psychological capital, and MPA, respectively. Data analysis comprised multiple statistical approaches, including descriptive statistics, testing for common method bias, independent-sample t-tests, one-way analysis of variance (ANOVA), and Pearson correlation analyses. Mediation analysis was performed using Hayes' PROCESS macro (Model 4) with bootstrap resampling (5000 iterations) to generate bias-corrected confidence intervals, thereby strengthening the robustness of the mediation estimates. **Results:** Among the 1249 nursing students, 456 (36.5%) exhibited MPA symptoms. Correlation analyses revealed that MPA was positively correlated with childhood trauma ($r = 0.237, p < 0.001$) and negatively associated with psychological capital ($r = -0.298, p < 0.001$). Additionally, childhood trauma was negatively associated with psychological capital ($r = -0.276, p < 0.001$). Mediation analysis demonstrated that psychological capital partially mediated the association between childhood trauma and MPA. The total effect of childhood trauma on MPA was 0.245, consisting of an indirect effect of 0.072 (29.4%) and a direct effect of 0.173 (70.6%). **Conclusions:** These findings demonstrate that MPA is highly prevalent among nursing students, that childhood trauma positively predicts MPA, and that psychological capital partially mediates this association. These findings suggest that strengthening psychological capital may attenuate the adverse effects of childhood trauma on MPA, thereby supporting learning efficiency, protecting mental health, and promoting professional development among nursing students.

Keywords: childhood trauma; psychological capital; mobile phone addiction; nursing students

1. Introduction

Mobile phone addiction (MPA) is a form of behavioral addiction characterized by excessive reliance on mobile devices and impaired self-control, which can disrupt social functioning and lead to psychological and behavioral problems (Billieux, 2012; Liu et al., 2017). With the widespread adoption of smartphones, MPA has become an increasing public health concern, particularly among university students, who are consistently identified as a high-risk population for compulsive and uncontrolled smartphone use (Alosaimi et al., 2016). The prevalence of MPA among Asian

medical students is estimated to be 41.9% (Zhong et al., 2022), whereas it ranges from 22.0% to 53.8% among nursing students, showing a persistent upward trend (Osorio-Molina et al., 2021; Uzunçakmak et al., 2022; ; Yan et al., 2024; Zheng et al., 2024; Zhou et al., 2024).

Evidence suggests that MPA has a wide range of adverse effects on academic performance, mental and physical health, and social functioning. MPA is associated with reduced learning engagement and poorer achievement academically (Adelantado-Renau et al., 2019; Ibrahim et al., 2018; Kates et al., 2018); heightened risks of anxiety and



depression psychologically (Li et al., 2020); visual strain, musculoskeletal pain, and sleep disturbances physiologically (Acharya et al., 2013; Elhai et al., 2016; Osorio-Molina et al., 2021; Zhang et al., 2022; Zhou et al., 2024); and cognitive failures, irrational procrastination, poor time management, and diminished executive attention socially. These consequences threaten not only individual well-being but also educational quality and social development (Cui et al., 2025; Hong et al., 2020; Yan et al., 2024; Yuan et al., 2023; Zhou et al., 2024).

Nursing students, as an integral part of medical education and the future backbone of clinical nursing, face the dual pressures of intensive theoretical study and demanding skill acquisition, alongside heightened role expectations during clinical training. MPA may impair their learning efficiency, hinder their clinical skill mastery, and compromise their communication and professional competence, thereby posing potential risks to the quality and safety of future healthcare delivery (Li et al., 2025; Zheng et al., 2024; Zhou et al., 2024). Therefore, investigating the prevalence and psychosocial mechanisms of MPA among nursing students is of theoretical and practical importance. Recently, parental and familial influences on the development of and intervention in Internet-related addictions have received increasing attention (Bussone et al., 2020; Lo et al., 2021; Tang et al., 2024; Liu et al., 2025). Among these, childhood trauma has emerged as a particularly salient factor because early adverse experiences can deplete psychological resources and increase susceptibility to addictive behaviors (Tang et al., 2024).

1.1 Influence of Childhood Trauma on MPA

Approximately one-third of individuals worldwide have experienced childhood trauma, which generally refers to adverse life events occurring before the age of 18 years, including emotional and physical neglect and emotional, physical, and sexual abuse (Lai et al., 2023; Tang et al., 2024). This issue has been recognized as a major global public health challenge, particularly in developing countries (Tang et al., 2024). Childhood trauma is widely recognized as a significant risk factor for diverse mental health outcomes, notably anxiety and depressive symptoms, as well as externalizing manifestations, such as impulsivity and aggression (McLaughlin et al., 2012; Teicher et al., 2016). The underlying mechanisms involve disruptions in normal brain development, leading to negative short- and long-term outcomes (McLaughlin et al., 2012; Teicher et al., 2016).

Previous research has consistently shown that childhood trauma is strongly associated with addictive behaviors, including problematic Internet use and MPA (Worsley et al., 2018). Among the various forms of childhood trauma, emotional abuse and neglect are highly prevalent and have been linked to alterations in the development of prefrontal–limbic networks, which may compromise emo-

tional regulation capacities and promote maladaptive coping behaviors, including excessive mobile phone use (Hao et al., 2024). Neurobiological evidence further indicates that childhood trauma may result in persistent dysregulation of the hypothalamic–pituitary–adrenal axis, along with structural and functional alterations in key brain regions, such as the hippocampus, amygdala, and cerebellum (Yang et al., 2021). These changes increase stress reactivity and amplify vulnerability to behavioral addictions. Accordingly, individuals with higher perceived stress are more likely to develop MPA, whereas those with lower perceived stress tend to maintain healthier usage patterns (Samaha and Hawi, 2016). Thus, early identification and intervention targeting childhood trauma may be pivotal in mitigating the development of MPA and associated maladaptive behaviors (Hao et al., 2024; Leenarts et al., 2013; McLaughlin et al., 2012).

1.2 Psychological Capital as a Potential Mediating Factor

In 2004, Luthans and Youssef introduced the concept of positive psychological capital in the context of positive psychology and organizational behavior (Luthans et al., 2004; Luthans and Youssef, 2004). Psychological capital is a positive psychological state of development characterized by four core components: self-efficacy, optimism, resilience, and hope (Luthans et al., 2004). Notably, psychological capital is measurable and malleable and has been shown to enhance individuals' capacity to cope with challenges and achieve goals (Luthans et al., 2004). Empirical evidence suggests that parental support positively predicts psychological capital (Wang, 2018), whereas early maladjustment (Afshar-Jalili and Khamseh, 2019, 2020) and childhood trauma (Yang et al., 2022; Zhang et al., 2020) can undermine it, largely through disruptions in stress regulation and reductions in self-efficacy (Cohrdes and Mauz, 2020). Furthermore, psychological capital is inversely associated with MPA, with lower levels of psychological capital predisposing individuals to maladaptive phone use (Li et al., 2025; Wang et al., 2021; Yan et al., 2024). Notably, Wang et al. (2021) demonstrated that higher psychological capital can buffer the impact of perceived stress and negative emotions on MPA. Collectively, these findings suggest that psychological capital may play a pivotal mediating role in the relationship between childhood trauma and MPA.

1.3 Theoretical Framework

This study was guided by the Interaction of Person–Affect–Cognition–Execution (I-PACE) model, which provides a theoretical framework for understanding behavioral addictions (Brand et al., 2019; Brand et al., 2016). The I-PACE model posits that Internet-related addictive behaviors emerge from dynamic interactions between distal individual vulnerabilities and affective-cognitive processing. Within this framework, childhood trauma, as a critical early life risk factor, may deplete individuals' psychological re-

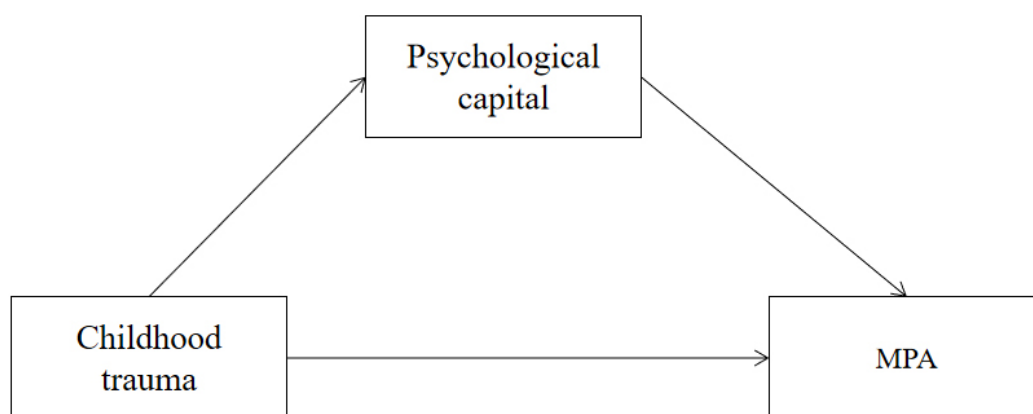


Fig. 1. Hypothetical conceptual model illustrating the proposed mediating role of psychological capital in the relationship between childhood trauma and mobile phone addiction (MPA).

sources, thereby diminishing their capacity to cope with stress and regulate negative emotions and increasing their tendency to use mobile phones for emotional regulation. Drawing on conservation of resources theory, individuals' psychological resources, such as psychological capital, can buffer the adverse effects of stress and negative emotions on behavior (Hobfoll, 1989). Therefore, psychological capital, as a key positive psychological resource, may mediate the relationship between childhood trauma and MPA, thus providing a theoretical basis for understanding addictive behaviors.

1.4 Study Purpose

Previous studies have demonstrated that childhood trauma is negatively associated with psychological capital and positively associated with MPA, whereas psychological capital is inversely associated with MPA. However, empirical evidence elucidating the underlying mechanisms linking these three constructs is scarce, particularly among nursing students. Nursing students constitute a critical component of medical education and represent the future backbone of clinical nursing. Their mental well-being is pivotal not only to their academic and professional development but also to quality of clinical care and patient safety. Thus, examining the interrelations among childhood trauma, psychological capital, and MPA has considerable theoretical and practical significance. This may deepen the understanding of the mechanisms through which adverse childhood experiences shape subsequent psychological and behavioral problems. Furthermore, it can offer evidence-based guidance for universities to promote mental health education and foster professional competence.

This study focused on nursing students and proposed a mediation model in which childhood trauma served as the independent variable, psychological capital as the mediator, and MPA as the dependent variable to delineate the pathways underlying MPA in this population. This study may provide valuable insights for the early identification of and

interventions for at-risk nursing students, as well as practical strategies for fostering positive psychological qualities and promoting healthy patterns of Internet use. Accordingly, this study tested the following hypotheses: (1) childhood trauma positively predicts MPA and (2) psychological capital mediates the relationship between childhood trauma and MPA. The proposed theoretical model is presented in Fig. 1.

2. Materials and Methods

2.1 Study Design and Sample Characteristics

This cross-sectional descriptive correlational study was conducted with undergraduate nursing students in Xi'an, Shaanxi Province, China, from November 2023 to April 2024. Participants were recruited using a multistage sampling procedure in which five nursing schools were randomly selected from a list of ten accredited institutions in Xi'an through a computer-generated randomization process.

The inclusion criteria were as follows: (1) full-time undergraduate nursing students in years 1–4, (2) the ability to independently comprehend and complete the questionnaire, and (3) voluntary participation with signed informed consent. Participants were excluded if they (1) were absent during the survey period because of illness, personal reasons, or military service; (2) had severe physical conditions or diagnosed psychiatric disorders (e.g., schizophrenia or bipolar disorder) that could affect the accuracy of psychological assessments; (3) were simultaneously enrolled in other psychological intervention studies that might interfere with the study outcomes; or (4) submitted incomplete or invalid questionnaires (e.g., unusually short completion times or highly homogeneous response patterns).

The required sample size was determined using the standard formula: $N = Z^2 \times [P \times (1 - P)] / E^2$, where N denotes the required sample size, Z corresponds to the Z -score for the selected confidence level, P is the estimated prevalence, and E represents the permissible margin of error. In

this study, a 95% confidence level ($Z = 1.96$) and 4% margin of error were applied. Using a previously reported MPA prevalence of 53.84% among nursing students (Xie, 2019) as P , the initial sample size was calculated to be 597. The estimated sample size was increased by 20% to accommodate potential non-responses and incomplete data, resulting in a minimum sample size of 720 participants.

Data reliability and validity were assured by applying the following rigorous quality control measures: (1) each IP address was restricted to a single submission to prevent duplication, (2) the expected completion time for the questionnaire was 15–20 minutes, and (3) questionnaires that were incomplete, exhibited identical response patterns, or were completed in less than 5 minutes were excluded. A total of 1325 questionnaires were collected, of which 76 were deemed invalid (23 with missing responses, 18 with highly homogeneous responses, and 35 completed in under 3 minutes). Consequently, 1249 valid questionnaires were retained, resulting in a validity rate of 94.26%.

2.2 Measurements

2.2.1 Demographic Characteristics

A demographic questionnaire was administered to collect information on participants' characteristics, including age (in years), gender (male or female), class year (freshman, sophomore, junior, or senior), only child in the family (yes or no), type of residence (urban, suburban, or rural), and single-parent family status (yes or no).

2.2.2 Measurement of Childhood Trauma

This study assessed the extent of childhood trauma in nursing students using the Childhood Trauma Questionnaire (CTQ), originally designed by Bernstein (1998) and subsequently translated and validated in Chinese by Zhao et al. (2005). The CTQ comprises 28 items covering five dimensions: emotional neglect, emotional abuse, physical neglect, physical abuse, and sexual abuse. Each item is rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). Total scores range from 28 to 140, with higher scores indicating more severe childhood trauma. The original scale demonstrated a Cronbach's α coefficient of 0.77 (Zhao et al., 2005), while Zhang et al. (2022) reported a coefficient of 0.87 among college students, indicating satisfactory reliability. In this study, the Cronbach's α coefficient of the CTQ was 0.91, suggesting excellent internal consistency. Furthermore, the construct reliability (CR) and average variance extracted (AVE) of the CTQ were 0.976 and 0.676, respectively, indicating acceptable convergent validity.

2.2.3 Measurement of Psychological Capital

This study assessed the psychological capital of nursing students using the Positive Psychological Capital Questionnaire (PPCQ), revised by Zhang et al. (2010), based on the Psychological Capital Scale developed by Luthans et al.

(2004). The PPCQ comprises 26 items encompassing four dimensions: optimism, hope, self-efficacy, and resilience. Each item is rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree), yielding total scores between 26 and 182. Higher scores indicate greater psychological capital. The original scale demonstrated a Cronbach's α of 0.90 (Zhang et al., 2010), and Feng et al. (2024) reported a Cronbach's α of 0.93 among college students, both suggesting high reliability. In this study, the PPCQ achieved a Cronbach's α of 0.91, indicating strong internal consistency. Furthermore, the CR and AVE of the PPCQ were 0.960 and 0.546, respectively, indicating acceptable convergent validity.

2.2.4 Measurement of Mobile Phone Addiction

This study assessed MPA tendencies among nursing students using the Mobile Phone Addiction Tendency Scale (MPATS), originally developed by Xiong et al. (2012). The MPATS comprises 16 items categorized into four dimensions: withdrawal symptoms, salience, social comfort, and mood modification. Each item is rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Total scores range from 16 to 80, with a threshold of ≥ 48 indicating MPA (Xiong et al., 2012). In this study, students scoring ≥ 48 were classified as exhibiting MPA. Higher scores reflect more severe tendencies toward MPA. The original scale demonstrated a Cronbach's α of 0.83 (Xiong et al., 2012), and Wang et al. (2024) reported a Cronbach's α of 0.88 among college students, indicating good reliability. In this study, the MPATS achieved a Cronbach's α of 0.93, demonstrating excellent internal consistency. Furthermore, the CR and AVE of the MPA were 0.943 and 0.526, respectively, indicating acceptable convergent validity.

2.3 Statistical Methods

Statistical analyses were conducted using SPSS version 27.0 (IBM SPSS Statistics, Chicago, IL, USA), supplemented with the PROCESS macro. The normality of the data was assessed using skewness and kurtosis statistics, as well as visual inspection of Q–Q plots. The results indicated that all variables approximately conformed to a normal distribution, satisfying the assumptions for subsequent analyses. All variables were measured based on self-reports; therefore, common method bias was evaluated using Harman's single-factor test. The first extracted factor accounted for 22.52% of the total variance, which was below the 40% threshold, indicating that common method bias was unlikely to substantially affect the results (Podsakoff et al., 2003). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were computed. Independent-samples t -tests and one-way analysis of variance (ANOVA) were used to compare the scores for childhood trauma, psychological capital, and MPA across demographic characteristics. Pearson correlation analyses were

conducted to examine the associations among childhood trauma, psychological capital, and MPA. For the mediation analysis, childhood trauma was specified as the independent variable, psychological capital as the mediator, and MPA as the dependent variable. A single mediation model was constructed using Hayes' PROCESS macro (Model 4), with age, gender, class year, only child in the family, type of residence, and single-parent family status included as covariates to control for potential confounding factors (Hayes, 2013). Path coefficients were estimated based on ordinary least squares (OLS) regression, and bias-corrected bootstrap confidence intervals (95% CI) were generated with 5000 resamples to estimate indirect effects. The indirect effects were considered statistically significant if the bootstrap confidence intervals did not include zero, thereby confirming the mediating role of psychological capital in the relationship between childhood trauma and MPA.

3. Results

3.1 Preliminary Analyses

This study included 1249 nursing students. Their demographic characteristics are summarized below. The participants had a mean age of 20.68 years ($SD = 1.68$), with ages ranging from 17 to 32 years. Regarding gender distribution, women comprised 82.4% of the sample ($n = 1029$), whereas men accounted for 17.6% ($n = 220$). The grade distribution was relatively balanced, with freshmen, sophomores, juniors, and seniors accounting for 25.2% ($n = 315$), 23.7% ($n = 296$), 25.6% ($n = 320$), and 25.5% ($n = 318$) of the sample, respectively. Regarding family composition, 80.5% of the participants were not the only child in their families ($n = 1005$), whereas 19.5% were only children ($n = 244$). Regarding residence type, 53.9% of the participants resided in rural areas ($n = 673$), 23.3% in suburban areas ($n = 291$), and 22.8% in urban areas ($n = 285$). In terms of family structure, most participants were from intact families (90.6%, $n = 1132$), whereas 9.4% were from single-parent families ($n = 117$). Among 1249 nursing students, the mean MPA score was 42.53 ± 10.26 , with 456 students scoring 48 or above, resulting in an MPA prevalence of 36.5%.

Descriptive statistics indicated that the skewness and kurtosis values for the main variables were within acceptable ranges: childhood trauma, skewness = 1.381, kurtosis = 1.041; psychological capital, skewness = 0.626, kurtosis = 1.762; MPATS, skewness = -0.148, kurtosis = 0.725. Visual inspection of the Q-Q plots confirmed that the data points were approximately aligned along the reference diagonal, suggesting that the distributions were approximately normal.

An independent samples t -test revealed a significant difference in PPCQ scores between male and female students ($t = 2.909$, $p = 0.004$), with male students exhibiting higher psychological capital than their female counterparts. A one-way ANOVA indicated that academic year was significantly associated with scores on both the CTQ ($F =$

25.937 , $p < 0.001$) and MPATS ($F = 9.787$, $p < 0.001$). Post hoc tests revealed that juniors reported the highest levels of childhood trauma, followed by freshmen, sophomores, and seniors, whereas MPATS scores exhibited a decreasing trend from freshmen to seniors. No significant differences were observed in the scale scores for other demographic variables. Detailed information is presented in Table 1.

3.2 Preliminary Correlation Analyses

Pearson correlation analysis revealed that MPA was significantly positively correlated with childhood trauma ($r = 0.237$, $p < 0.001$) and negatively correlated with psychological capital ($r = -0.298$, $p < 0.001$). In addition, childhood trauma was negatively correlated with psychological capital ($r = -0.276$, $p < 0.001$). Additional details are presented in Table 2.

3.3 Mediation Analyses

All variables were standardized before the mediation analysis. In line with the hypotheses, childhood trauma was specified as the independent variable, psychological capital as the mediator, and MPA as the dependent variable. A mediation model was constructed using Model 4 of Hayes' PROCESS macro in SPSS, with age, gender, class year, only child in the family, type of residence, and single-parent family status included as covariates to control for potential confounding factors. The analytical results are presented in Table 3.

Regression analysis revealed that childhood trauma significantly and positively predicted MPA ($c = 0.245$, $SE = 0.030$, $t = 8.236$, $p < 0.001$). Further analysis demonstrated that childhood trauma significantly and negatively predicted psychological capital ($a = -0.303$, $SE = 0.030$, $t = -9.959$, $p < 0.001$). When both childhood trauma and psychological capital were entered into the regression model, the predictive effect of childhood trauma on MPA remained significant ($c' = 0.173$, $SE = 0.030$, $t = 5.751$, $p < 0.001$), and psychological capital significantly predicted MPA ($b = -0.240$, $SE = 0.027$, $t = -8.896$, $p < 0.001$).

A bias-corrected percentile bootstrap method was applied with 5000 resamples used to generate 95% confidence intervals to further examine the mediating effect. The results indicated that the indirect effect of psychological capital on the relationship between childhood trauma and MPA was significant ($ab = 0.072$, $Boot SE = 0.014$, 95% CI: 0.047, 0.103). The confidence interval did not include zero, thereby supporting the presence of a mediating effect. The mediating effect accounted for 29.4% of the total effect, whereas the direct effect accounted for 70.6%. Thus, psychological capital partially mediated the association between childhood trauma and MPA (Table 4 and Fig. 2).

4. Discussion

This study focused on nursing students, exploring the mechanisms linking childhood trauma to MPA and con-

Table 1. Demographic characteristics and comparison of childhood trauma, psychological capital, and MPA among nursing students.

Variables	N (%)	CTQ	PPCQ	MPATS
Gender				
Male	220 (17.6)	49.45 ± 14.10	113.83 ± 10.26	42.32 ± 10.33
Female	1029 (82.4)	50.78 ± 14.18	111.50 ± 10.89	42.57 ± 10.26
<i>t</i>		-1.268	2.909	-0.333
<i>p</i>		0.205	0.004	0.739
Cohen's <i>d</i>		-0.094	0.216	-0.025
95% CI		-0.240 to 0.051	0.070 to 0.362	-0.170 to 0.121
Class year				
①Freshmen	315 (25.2)	52.28 ± 15.43	111.69 ± 10.10	44.47 ± 10.76
②Sophomores	296 (23.7)	50.12 ± 13.83	111.30 ± 10.23	43.32 ± 8.65
③Juniors	320 (25.6)	54.45 ± 15.78	111.30 ± 11.06	42.10 ± 11.01
④Senior	318 (25.5)	45.26 ± 8.93	113.33 ± 11.65	40.29 ± 9.94
<i>F</i>		25.937	2.532	9.787
<i>p</i>		<0.001	0.056	<0.001
η^2		0.059	0.006	0.023
95% CI		0.035 to 0.084	0.000 to 0.015	0.008 to 0.040
Post hoc test		Freshmen < Juniors		Freshmen > Juniors
		<i>p</i> = 0.047		<i>p</i> = 0.003
		Freshmen > Senior		Freshmen > Senior
		<i>p</i> < 0.001		<i>p</i> < 0.001
		Sophomores < Junior		Sophomores > Senior
		<i>p</i> < 0.001		<i>p</i> < 0.001
		Sophomores > Senior		Juniors > Senior
		<i>p</i> < 0.001		<i>p</i> = 0.024
Only child in the family				
Yes	244 (19.5)	49.33 ± 13.80	112.41 ± 12.41	41.74 ± 10.33
No	1005 (80.5)	50.84 ± 14.25	111.79 ± 10.39	42.72 ± 10.25
<i>t</i>		-1.496	0.807	-1.341
<i>p</i>		0.135	0.420	0.180
Cohen's <i>d</i>		-0.107	0.058	-0.096
95% CI		-0.247 to 0.033	-0.082 to 0.197	-0.236 to 0.044
Type of Residence				
①Downtown	285 (22.8)	48.94 ± 13.33	113.06 ± 10.45	42.82 ± 10.83
②Suburb	291 (23.3)	51.75 ± 15.08	112.03 ± 11.59	42.37 ± 10.92
③Rural areas	673 (53.9)	50.70 ± 14.07	111.38 ± 10.59	42.47 ± 9.73
<i>F</i>		2.920	2.465	0.159
<i>p</i>		0.054	0.085	0.853
η^2		0.005	0.004	0.000
95% CI		0.000 to 0.014	0.000 to 0.013	0.000 to 0.003
Single-parent family				
Yes	117 (9.4)	51.43 ± 14.45	112.56 ± 11.67	43.03 ± 9.64
No	1132 (90.6)	50.45 ± 14.15	111.85 ± 10.72	42.48 ± 10.33
<i>t</i>		0.708	0.684	0.551
<i>p</i>		0.479	0.524	0.582
Cohen's <i>d</i>		0.069	0.066	0.054
95% CI		-0.122 to 0.259	-0.124 to 0.257	-0.137 to 0.244

Notes: CTQ, Childhood Trauma Questionnaire; PPCQ, Positive Psychological Capital Questionnaire; MPATS, Mobile Phone Addiction Tendency Scale; N, number of samples.

firming the mediating role of psychological capital. The findings revealed that childhood trauma exerts a significant

but relatively small direct effect on MPA. Most of its influence occurs through an indirect pathway via psycholog-

Table 2. Descriptive statistics and correlation analysis of each variable.

Variables	Mean	SD	1	2	3
1. Childhood trauma	50.54	14.17	1		
2. Psychological capital	111.91	10.81	-0.276***	1	
3. MPA	42.53	10.26	0.237***	-0.298***	1

Notes: *** $p < 0.001$.

Table 3. Mediating effect of psychological capital in the relationship between childhood trauma and MPA.

Regression model		Overall fit index			Significance of regression coefficients				
Variable	Independent variable	<i>R</i>	<i>R</i> ²	<i>F</i>	β	<i>SE</i>	<i>t</i>	<i>p</i>	95% CI
Psychological capital		0.289	0.084	16.174					
	Childhood trauma				-0.303	0.030	-9.959	<0.001	-0.363 to -0.244
	Age (years)				0.070	0.039	1.801	0.072	-0.006 to 0.145
	Gender				0.036	0.027	1.343	0.179	-0.017 to 0.089
	Class year				-0.031	0.039	-0.803	0.422	-0.108 to 0.045
	One child in the family				0.004	0.028	0.143	0.887	-0.051 to 0.059
	Type of Residence				-0.056	0.028	-2.014	0.044	-0.110 to -0.001
	Single-parent family				-0.023	0.027	-0.849	0.396	-0.077 to 0.030
MPA		0.377	0.142	25.643					
	Childhood trauma				0.173	0.030	5.751	<0.001	0.114 to 0.232
	Psychological capital				-0.240	0.027	-8.896	<0.001	-0.293 to -0.187
	Age (years)				-0.125	0.037	-3.416	<0.001	-0.197 to -0.053
	Gender				-0.059	0.026	-2.317	0.021	-0.109 to -0.009
	Class year				-0.019	0.037	-0.500	0.617	-0.091 to 0.054
	One child in the family				0.040	0.027	1.506	0.132	-0.012 to 0.092
	Type of Residence				-0.022	0.026	-0.846	0.398	-0.074 to 0.029
MPA		0.295	0.087	16.936					
	Childhood trauma				0.245	0.030	8.236	<0.001	0.187 to 0.304
	Age (years)				-0.142	0.038	-3.759	<0.001	-0.216 to -0.068
	Gender				-0.068	0.026	-2.578	0.010	-0.119 to -0.016
	Class year				-0.011	0.038	-0.289	0.773	-0.086 to 0.064
	One child in the family				0.039	0.027	1.425	0.154	-0.015 to 0.093
	Type of Residence				-0.009	0.027	-0.329	0.742	-0.062 to 0.044
	Single-parent family				-0.017	0.027	-0.649	0.517	-0.070 to 0.035

Table 4. Total, direct, and indirect effects of childhood trauma on MPA.

Paths	Effect	Boot SE	Bootstrap 95% (CI)		Proportion of mediation effect
			BootLL CI	BootUL CI	
Total effect of X on Y	0.245	0.030	0.187	0.304	
Direct effect of X on Y	0.173	0.030	0.114	0.232	70.6%
Indirect effects (X→M→Y)	0.072	0.014	0.047	0.103	29.4%

Note: The bias-corrected bootstrap confidence intervals were computed using 5000 bootstrap samples, with a 95% confidence level. Variables are defined as follows: X, Childhood trauma; M, Psychological capital; Y, MPA. BootLL CI, Bootstrap Lower Limit Confidence Interval; BootUL CI, Bootstrap Upper Limit Confidence Interval.

ical capital. This pattern reflects partial mediation, with psychological capital accounting for 29.4% of the total effect. As a crucial reserve force for the future clinical nursing workforce, nursing students experience substantial academic burdens, considerable clinical training pressure, and high professional role expectations. During their education and professional development, they carry heavier psycho-

logical and emotional burdens than their peers in other disciplines, while remaining at a stage of incomplete psychological maturity. Consequently, they are more prone to using mobile phones for emotional regulation and stress alleviation, thereby increasing their risk of MPA (Majeed et al., 2018; Yam et al., 2019).

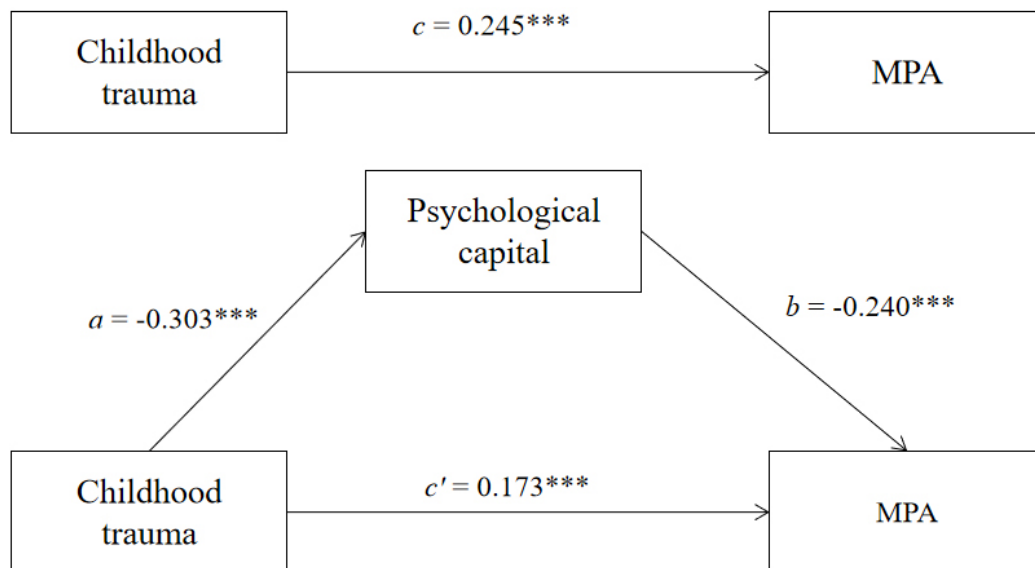


Fig. 2. The mediating role of psychological capital in the relationship between childhood trauma and MPA with standardized beta values. Notes: *** $p < 0.001$.

This study found a 36.5% prevalence of MPA among nursing students, which, although lower than the rate (53.84%) used for the sample size calculation (Xie, 2019), is higher than that reported in many previous studies. Osorio-Molina et al. (2021) reported a prevalence of 22.0% among 2780 nursing students, while Yan et al. (2024) reported a prevalence of 34.9% among 900 nursing students. The discrepancy between the estimated and observed prevalence may be partly explained by differences in study populations, as well as variations in assessment instruments and classification criteria used across studies. Nevertheless, compared to these findings, our results suggest an even higher prevalence of MPA among nursing students, underscoring a risk that warrants serious attention.

The high prevalence of MPA among nursing students has important implications for educators and administrators. Therefore, psychological health assessments and interventions in nursing education should be strengthened, particularly for students with a history of childhood trauma. Furthermore, fostering positive psychological capital by enhancing self-efficacy, optimism, hope, and resilience can facilitate healthy coping strategies and mitigate reliance on maladaptive behaviors, such as excessive mobile phone use. Ultimately, such efforts may not only enhance nursing students' academic performance and quality of life but also ensure the quality of clinical nursing and safeguard patient safety in the future.

4.1 Direct Effect of Childhood Trauma on MPA

This study found that childhood trauma exerted a significant positive predictive effect on MPA, suggesting that more severe traumatic experiences during childhood increased the likelihood of developing MPA in adulthood among nursing students. These results support Hypothe-

sis 1 and align with prior empirical evidence (Tang et al., 2024; Worsley et al., 2018; Xie et al., 2023). These underlying mechanisms can be interpreted from psychological and neurobiological perspectives. From a psychological perspective, traumatic childhood experiences may impair secure attachment and emotional regulation, predisposing individuals to adopt avoidant coping strategies and seek immediate gratification. During university education and clinical training, nursing students are frequently confronted with intensive academic demands, rigorous clinical skill requirements, interpersonal challenges, and uncertainties about future career trajectories. In this context, the Internet and smartphones may provide a seemingly safe and convenient "refuge", enabling individuals to immerse themselves in online games, short videos, or social media to temporarily alleviate anxiety and avoid painful memories, which in turn elevates the risk of MPA (Majeed et al., 2018; Yam et al., 2019). From a neurobiological perspective, childhood trauma may induce persistent dysregulation of the hypothalamic–pituitary–adrenal axis and modify the structure and function of the prefrontal cortex, amygdala, and reward-related neural circuits (Brand et al., 2016; Teicher et al., 2016). Such neurobiological alterations may enhance individuals' sensitivity to immediate rewards and weaken their ability to delay gratification, thereby rendering them more vulnerable to smartphone addiction (Brand et al., 2016).

The observation that childhood trauma significantly predicts MPA has important implications for nursing education and clinical management. Nursing educators and clinical administrators should prioritize the assessment of adverse childhood experiences by implementing regular mental health screenings and evaluations, thereby facilitating the early identification of high-risk individuals.

Furthermore, tailored support measures should be implemented, including (1) accessible psychological counseling and therapeutic services, as well as (2) interventions targeting stress management, including mindfulness-based approaches, cognitive-behavioral techniques, and programs designed to enhance resilience (Dong and Potenza, 2014; Mehmood et al., 2021). These strategies can foster the development of adaptive coping mechanisms, enable students to appraise academic stressors with greater objectivity, reduce their dependence on smartphones, and ultimately enhance their psychological well-being.

4.2 Analysis of the Mediating Effect of Psychological Capital Between Childhood Trauma and MPA

A central finding of this study is that psychological capital significantly mediates the association between childhood trauma and MPA, thereby confirming Hypothesis 2. Specifically, childhood trauma not only directly elevates the risk of MPA but also indirectly exacerbates it by eroding psychological capital. This finding highlights psychological capital as a pivotal psychological mechanism bridging childhood trauma and addictive behaviors. Consistent with previous research, this study found that childhood trauma significantly and negatively predicted psychological capital (Zhang et al., 2020; Qin et al., 2018). Adverse childhood experiences may erode individuals' positive psychological resources, rendering them more vulnerable to negative self-perceptions and diminished self-evaluations (Li et al., 2018). This depletion of psychological resources undermines individuals' ability to cope with environmental stress and heightens their propensity to adopt maladaptive coping strategies. Prior studies have demonstrated that elevated levels of psychological capital act as crucial protective factors against MPA. Li et al. (2025) reported that psychological capital not only directly mitigates the risk of MPA but also buffers the impact of high perceived stress on addictive behaviors via diminished self-control. Thus, individuals with greater psychological capital are more capable of sustaining positive cognition and emotional regulation under stress, thereby enhancing their environmental adaptability and reducing their reliance on smartphones for emotional relief (Li et al., 2014; Li et al., 2025; Yan et al., 2024; Jesús et al., 2024). These findings further provide indirect support for the theoretical framework of the I-PACE model. According to this model, childhood trauma is a predisposing vulnerability that influences individuals' affective-cognitive processing, whereas psychological capital modulates their stress-coping strategies and emotional regulation, thereby indirectly mitigating the risk of MPA.

The findings of this study indicate that strengthening psychological capital among nursing students may represent a key pathway for MPA prevention and intervention. Notably, psychological capital was found to partially mediate the association between childhood trauma and MPA, suggesting that other mechanisms, such as emotion regu-

lation and social support, may also influence this relationship. Nursing educators and administrators can adopt several strategies: (1) strengthening students' emotional regulation and stress-management skills through interventions such as mindfulness training and cognitive-behavioral therapy; (2) embedding positive psychology principles into curricula and clinical practice to foster hope, optimism, self-efficacy, and resilience (Fazia et al., 2023; Lemay et al., 2019; Regehr et al., 2013; Zheng et al., 2024); (3) establishing supportive academic and clinical environments that ensure access to psychological support and resources; and (4) implementing early screening for childhood trauma to identify students at higher risk for MPA, thereby enabling timely and targeted support. Collectively, these measures may mitigate the adverse effects of childhood trauma, foster psychological capital, and ultimately reduce the risk of MPA.

4.3 Limitations

This study objectively investigated the influence of childhood trauma on MPA and the mediating role of psychological capital. However, several limitations warrant consideration. First, the sample consisted of nursing students, a population characterized by substantial academic demands and distinctive clinical training experiences. This may constrain the generalizability of the findings to students from other disciplines or the wider youth population, thus reducing external validity. Future research should include participants from various academic disciplines and extend across different regions and cultural contexts to strengthen the robustness and generalizability of the findings. Nonetheless, the present findings have valuable implications for nursing education and management in local contexts. Second, owing to the cross-sectional nature of this study, causal relationships among the variables cannot be established. Future research should address this limitation by employing longitudinal or experimental designs and integrating mixed methods or multi-source data, such as peer reports, behavioral metrics, and physiological indicators, to more rigorously examine the long-term mechanisms linking childhood trauma to MPA. Third, the mechanisms through which childhood trauma contributes to MPA are highly complex. This study focused only on the mediating role of psychological capital, which cannot fully capture the multifactorial pathways underlying addictive tendencies. Future research should incorporate additional variables to develop a more systematic and comprehensive explanatory model. Fourth, this study used an online questionnaire survey, which enhanced data collection efficiency but may have introduced self-selection and reporting biases. Future research should integrate offline assessments with more objective measurement approaches to evaluate MPA, childhood trauma, and psychological capital, thereby further validating the present findings. Furthermore, the sample was predominantly female, reflecting

the gender composition of undergraduate nursing education in China. Although gender was controlled for as a covariate in the analyses, gender-stratified or moderation analyses were not conducted. Future studies should consider more gender-balanced samples and incorporate a gender-sensitive perspective to further examine these relationships. In this study, the measurement model fit of some scales did not fully meet the stringent criteria, which may limit the interpretation of the findings to some extent. Therefore, further validation is warranted.

5. Conclusions

This study demonstrated that childhood trauma exerts a significant direct effect on MPA among nursing students, although this effect was relatively small. Most of its influence operates indirectly through the reduction of psychological capital, reflecting a partial mediation pattern, with psychological capital accounting for 29.4% of the total effect. These findings highlight psychological capital as a critical mechanism linking early adverse experiences to addictive tendencies. These findings expand the theoretical framework of MPA research and provide novel evidence explaining individual differences in responses to early life adversity. Notably, this study underscores the protective role of positive psychological resources in addiction prevention, suggesting that interventions targeting psychological capital may constitute an effective strategy for preventing and mitigating MPA among nursing students.

Abbreviations

MPA, Mobile Phone Addiction; I-PACE, Interaction of Person–Affect–Cognition–Execution; CTQ, Childhood Trauma Questionnaire; PPCQ, Positive Psychological Capital Questionnaire; MPATS, Mobile Phone Addiction Tendency Scale; CR, construct reliability; AVE, average variance extracted; ANOVA, one-way analysis of variance; OLS, ordinary least squares; BootLL CI, Bootstrap Lower Limit Confidence Interval; BootUL CI, Bootstrap Upper Limit Confidence Interval.

Availability of Data and Materials

De-identified textual data can be made available upon reasonable request to the corresponding author.

Author Contributions

Conceived and designed the research: WKZ, WJS, CDW, and HD. Performed the research: ZKL, FW, KRW, LLW, ZYZ, CNH, and MFW. Data analyses: WKZ and MFW. Writing-original draft: WKZ and WJS. Writing-review and editing: WKZ and WJS. Supervision: MFW, CDW and HD. All authors contributed to critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The present study was approved by the Ethics Committee of Tangdu Hospital (Approval ID: TDLL-202311-17) and complied with the Declaration of Helsinki. All participants were fully informed about the study aims prior to data collection. Informed consent was obtained from every participant; dual consent from participants and their legal guardians was secured for minors aged 17.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-assisted Technologies in the Writing Process

During manuscript preparation, ChatGPT-5 was used for grammar and spelling revision. All content was carefully reviewed and revised by the authors, who take full responsibility for this article.

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