The Association of Learning Burnout and Mobile Phone Addiction among Nursing Students in China: The Mediating Role of Negative Emotions

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Objectives: This study aimed to examine the associations between learning burnout and mobile phone addiction among Chinese nursing students. In addition, this study also investigated the moderating effect of negative emotions on the association between learning burnout and mobile phone addiction. Methods: A total of 4792 nursing students (595 male and 4197 female) from 15 universities in China were recruited via online posters. The respondents were asked to complete the following questionnaires: the Mobile Phone Addiction Index (MPAI), Learning Burnout Questionnaire (LBQ), Depression Anxiety Stress Scales-21 (DASS-21), and Family APGAR index. Results: The overall proportion of students with MPA among the nursing students was 50.85%. There were statistically significant differences in nursing students' MPA rates by academic year and family functionality ($p<0.05$). Mobile phone addiction positively correlates with learning burnout and negative emotions and negatively correlates with family functionality. In addition, learning burnout can completely predict mobile phone addiction, and negative emotions partially mediate the relationship between learning burnout and mobile phone addiction. Conclusion: The findings indicated the importance of learning status in preventing mobile phone addiction in nursing students. It is advisable to formulate corresponding management and intervention strategies to alleviate learning burnout, help nursing students develop a positive psychological outlook, and prevent mobile phone addiction.

Keywords: mobile phone addiction; learning burnout; negative emotions; nursing students.

1. Introduction

With the progress of technology and the advancement of digitalization, mobile phones have become an essential part of people's daily lives, especially in today's world with the coronavirus disease 2019 (COVID-19) pandemic, which has significantly disrupted the normal activities of human society globally.[1] According to the 48th report of the China Internet Network Information Center, by June 2021, the number of internet users in China had reached 1.011 billion, among which 1.007 million (99.6%) users used mobile phones to surf the internet.[2]

The multiple functions of mobile phones offer great convenience and benefits for students' daily lives, online studies, social interactions, and entertainment patterns.[3] However, excessive use of mobile phones can damage personal physical, psychological and social functions, which is associated with depression, anxiety, sleep disturbance, and poor academic performance.[4,5] Mobile phone addiction (MPA), also known as problematic mobile phone use[6] or mobile phone dependence,[7] is characterized by uncontrolled mobile phone use that leads to adverse consequences on an individual's physical and mental health and social functioning.[8] Previous studies have shown that MPA is associated with external factors such as school and family environment,[9] interpersonal relationship problems, and internal factors such as mental health, physical exercise,[10] personality,[11] adverse childhood experiences[12] and sleep problems.[13]

1.1 Mobile Phone Addiction and Learning Burnout（L.B.）

According to China's national conditions and the learning characteristics of college students, Lian et al. defined learning burnout (LB) as students' lack of interest in learning or lack of motivation to study and their feelings of fatigue and frustration, resulting in a series of inappropriate behaviors to avoid learning.[14] A systematic review showed that LB is common among medical students and that 25.8-52.1% of medical students in China have a higher burnout level than the average level, which negatively impacts students' learning, life, and physical and mental development.[15]

By the end of 2020, there were 4.71 million registered nurses in China, and the nurse-patient ratio was 3.35 nurses for 1,000 patients (National Bureau of Statistics of China, 2020).[16] Nurses are required to be highly specialized. The learning status of nursing students will affect the quality of nursing talent in the future. Therefore, nursing students need to spend more time and energy acquiring professional knowledge and skills. Song reported that the LB level of nursing undergraduates is relatively high and that the protective factors of academic burnout include low academic year, long study times, high learning initiative, concentration, and independence.[17]

Previous research found that 39.29% of 733 nursing students in a traditional Chinese medicine university presented with burnout syndrome and that psychological capital was negatively correlated with academic burnout.[18] Another longitudinal study followed 1702 nursing students and found that academic burnout increased from 29.7% in the first year to 41% one-year post-graduation.[19] Moreover, MPA can increase laziness among college students, lead to insufficient study time and affect learning efficiency, so students with a high degree of MPA are more likely to have LB.[20,21]

1.2 Mobile Phone Addiction and Negative Emotions（N.E.）

The positive associations between depression, anxiety, stress, and MPA have received more attention in recent years.[22, 23, 24, 25] Because of their versatility and their ability to provide access to virtual spaces, mobile phones have become a way for students to release their emotions and pressure, and individuals with higher levels of social anxiety are more likely to spend time on their phones, which may serve as an avoidance strategy of social interaction and face-to-face communication.[22]

Students who suffer from psychological problems cannot resolve inner conflicts and pressure in a timely manner and thus experience negative emotions such as depression. A 3-year longitudinal study found that mobile phone dependence at year 1 significantly predicted poor mental health status at year 3.[26] Studies also indicate that individuals with positive psychological resources, such as self-esteem and coping style, can alleviate their depression symptoms.[23] Meanwhile, the COVID-19 pandemic and unprecedented control measures have made students face health threats, affected their regular social interaction, and resulted in marked changes in their mental and behavioral health within a short time, which has increased students' perceived stress. Students choose to release their emotions through mobile phones, which increases addictive behavior.[4,27]

However, few studies have explored the relationship between LB and MPA under the mediating effect of NE, especially in global public health emergencies. Therefore, we propose that MPA is related to LB, which further drives students to experience NE. The purposes of this study were as follows: (1) to investigate the MPA status of nursing students and (2) to explore the relationship between LB, NE, family functionality (FF), and MPA, especially the mediating role of NE between LB and MPA. Examining these issues may support recommendations and guidance for the intervention and prevention of nursing students' learning behavior and improve the quality of nursing personnel training.

2. Materials and Methods

2.1 Procedures and Participants

The survey was completed on the Wenjuanxing platform (www.wjx.cn). Everybody involved in this study was informed that they could participate voluntarily. Participants scanned the Q.R. code on the poster through WeChat to participate and could withdraw at any time. The survey was completed anonymously with the guidance of researchers during school classes.

A cross-sectional survey was conducted through convenience cluster sampling in November 2021. A total of 5409 nursing students from 15 studied universities in China were surveyed. The supplementary examination showed that 617 samples were invalid due to incorrect/incomplete answers, and the final sample comprised 4792 participants, for an 88.93% response rate.

2.2 Measures and Instruments

2.2.1 Mobile Phone Addiction

MPA was measured by the Mobile Phone Addiction Index (MPAI),[28] which has been widely applied in Chinese adolescents with good reliability and validity.[29, 30] This scale includes 17 items that measure four addiction symptoms: inability to control craving (items 1-7), feeling anxious and lost (items 8-11), withdrawal or escape (items 12-14), and productivity loss (items 15-17). Items were rated on a 4-point Likert scale ranging from 1 (never) to 5 (always), with high scores indicating a higher degree of MPA. Items 3, 4, 5, 6, 8, 9, 14, and 15 were the MPA screening questions, and if the participants selected five or more of them, they were considered to have MPA.[31] In this study, the Cronbach's alpha coefficient of this scale was 0.904.

2.2.2 Learning Burnout

LB was assessed by the Learning Burnout Questionnaire (LBQ), established by Lian et al.[14] The LBQ comprises 20 items across three dimensions: depression (8 items), improper behavior (6 items), and low personal accomplishment (6 items). Participants answer each item on a 5-point Likert scale ranging from very inconsistent (1) to very consistent (5). The total score can range from 20 to 100,

and a higher score shows a higher level of LB. In this study, the Cronbach's alpha coefficient of this scale was 0.846.

2.2.3 Negative Emotions

NE were evaluated by the Depression Anxiety Stress Scales-21 (DASS-21),[32] which was modified based on Lovibond et al.[33] This scale consists of 21 items measuring an individual's level of NE and has three subscales: depression (7 items), anxiety (7 items), and stress (7 items). Each item is rated on a 4-point Likert scale ranging from 0 (inconsistent) to 3 (always consistent). High sum scores obtained from the DASS indicate a high level of NE. In this study, the Cronbach's alpha coefficients were 0.846 for the total scale, 0.887 for depression, 0.855 for anxiety, and 0.856 for stress.

2.2.4 Family Functionality

FF was assessed by the Family APGAR index,[34] which can test for signs of family dysfunction. This 5-item scale measures five domains of family function: adaptation, partnership, growth, affection, and resolve. Each item is rated as 0 (hardly ever), 1 (some of the time), or 2 (almost always), with higher scores revealing higher levels of satisfaction with FF. Final scores range from 0 to 10 and are then classified into three categories: a score of 7‑10 means functional, a score of 4‑6 means moderately dysfunctional, and a score of 0‑3 means severely dysfunctional. In this study, the Cronbach's alpha coefficient of this scale was 0.904.

2.2.5. Statistical Analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM, New York, USA). Continuous variables are displayed as the means $\pm$ standard deviation (S.D.), and categorical variables are presented as frequencies and percentages (%). For the comparisons between groups, independent sample t tests were used to determine the potential differences between the MPA and non-MPA groups and the gender effects on the associations among MPA, NE, LB, and FF, while the χ^2 test was conducted for categorical variables. Pearson's r correlation analysis was conducted to explore the associations among the continuous data of MPA, NE, LB, and FF. Binary logistic regression was carried out to examine the variance in MPA explained by sociodemographics, NE, LB and FF. Finally, a series of regression analyses were conducted to verify the mediating effect of NE between LB and MPA. A p value of 0.05 was considered statistically significant.

3. Results

A total of 4792 nursing students with a mean age of 19.40 (SD = 1.16) years were enrolled in the study via online posters. The sample consisted of 595 males (12.42%) with a mean age of 19.55 $\pm$ 1.15 years and 4197 females (87.58%) with a mean age of 19.38 $\pm$ 1.16 years. A total of 449 (11.46%) participants were the only children in their families. In terms of residence, 983 students (20.51%) were from urban areas, and 3809 (79.49%) came from rural areas.

3.1 Prevalence of Mobile Phone Addiction

If the participants responded to five or more questions with a rating of three or above, they were considered to have MPA. The overall proportion of students with MPA among the nursing students was 50.85%, including 269 (45.2%) males and 2168 (51.7%) females. A significant difference regarding sex was found between the MPA and non-MPA groups (χ^2 = 8.663, p = 0.003).

3.2 Differences in Demographics, Characteristics of Mobile Phone Usage, NE, and FF between the Two Groups

Table 1 shows that the positive rate of MPA increased significantly from 33.6% to 62.9% with the increase in hours spent on mobile phones per day ($p < 0.001$). There were statistically significant differences in nursing students' MPA rates by academic year and FF ($p < 0.05$). Among them, the positive rate of MPA among second-year students was the highest at 57.1% and that of students with moderate FF was the highest at 56.3%. With the increasing degree of NE, the positive rate of MPA also increased significantly ($p < 0.001$). In the MPA group, the rate of depression showed a gradual increase of 38.4% to 80.0% from normal to very severe levels of depression, the rate of the anxiety showed an increase of 27.2% to 81.3% from normal to very severe levels of anxiety, and the rate of stress showed a gradual increase of 46.1% to 81.8% from normal to severe levels of stress. However, no significant difference was found by ethnicity, residence, only-child status, or father's education between the non-MPA and MPA groups.

Table 1 Differences in demographics, characteristics of mobile phone usage, NE and FF between the MPA and non-MPA groups (N=4792)

	Non-MPA (n=2355) n (%)/M±SD	MPA (n=2437) n (%)/M±SD	t / χ^2	P
Gender			8.663	0.003
Male	326 (54.8)	269 (45.2)		
Female	2029 (48.3)	2168 (51.7)		
Ethnicity			0.109	0.741
Han	2259 (49.2)	2333 (50.8)		
Minority	96 (48.0)	104 (52.0)		
Residence			2.458	0.117
Urban	505 (51.4)	478(48.6)		
Rural	1850 (48.6)	1959(51.4)		
Only-child status			0.000	0.986
Yes	270 (49.2)	279 (50.8)		
No	2085 (49.1)	2158 (50.9)		
Hours spent on the mobile phones per day			129.321	0.000
< 4	363 (66.4)	184 (33.6)		
4–8	1591 (50.3)	1573 (49.7)		
> 8	401 (37.1)	680 (62.9)		
Academic year			16.809	0.001
First	875 (51.5)	825 (48.5)		
Second	1129 (48.9)	1178 (51.1)		
Third	295 (42.9)	392 (57.1)		
Fourth	56 (57.1)	42 (42.9)		
Education level			33.977	0.000
Junior college	851 (44.0)	1082 (56.0)		
Undergraduate	1504 (52.6)	1355 (47.4)		
Father's education			5.594	0.061
Less than high school	1430 (47.9)	1557 (52.1)		
High school graduate	687 (51.7)	641 (48.3)		
College graduate or above	238 (49.9)	239 (50.1)		
Mother's education			11.136	0.004
Less than high school	1569 (47.7)	1721 (52.3)		
High school graduate	609 (53.4)	531 (46.6)		

College graduate or above	177 (48.9)	185 (51.1)		
Depression			328.105	0.000
Normal	1502 (61.6)	938 (38.4)		
Mild depression	535 (39.9)	806 (60.1)		
Moderate depression	300 (32.6)	621 (67.4)		
Severe depression	17 (20.0)	68 (80.0)		
Very severe depression	1 (20.0)	4 (80.0)		
Anxiety			452.658	0.000
Normal	717 (72.8)	268 (27.2)		
Mild	754 (55.6)	601 (44.4)		
Moderate	757 (39.4)	1164 (60.6)		
Severe	109 (25.1)	326 (74.9)		
Very severe	18 (18.8)	78 (81.3)		
Stress				
Normal	2158 (53.9)	1848 (46.1)		
Mild	148 (26.0)	422 (74.0)	218.919	0.000
Moderate	47 (22.9)	158 (77.1)		
Severe	2 (18.2)	9 (81.8)		
Family functionality			29.328	0.000
Functional	1430 (52.2)	1308 (47.8)		
Moderately dysfunctional	692 (43.7)	892 (56.3)		
Severely dysfunctional	233 (49.6)	237 (50.4)		

3.3 Descriptive Statistics

Table 2 shows the means, standard deviations, and Pearson correlation coefficients of the study variables (n = 4792). The total MPA score averaged 45.77 (SD = 11.55). The total LB score averaged 55.76 (SD = 10.24). The total NE score averaged 32.34 (SD = 10.10). The summed depression scores averaged 10.51 (SD = 3.61). The sum of anxiety items averaged 10.48 (SD = 3.35). The sum of stress items averaged 11.35 (SD = 3.73). FF total scores averaged 7.08 (SD = 2.77). LB and NE (including depression, anxiety, and stress) had a significant positive correlation with MPA ($p < 0.001$), while FF had a significant negative correlation with MPA ($p < 0.001$).

Table 2 Descriptive statistics and correlational among MPA, LB, NE, and FF. (N=4792)

	M	SD	1	2	3	4	5	6	7
1. Mobile phone addiction	45.77	11.55	1						
2. Learning burnout	55.76	10.24	0.466***	1					
3. Negative emotions total scores	32.34	10.10	0.465***	0.492***	1				
4. Depression	10.51	3.61	0.414***	0.504***	0.941***	1			
5. Anxiety	10.48	3.35	0.425***	0.428***	0.942***	0.826***	1		
6.Stress	11.35	3.73	0.476***	0.459***	0.951***	0.837***	0.852***	1	
7. Family functionality	7.08	2.77	-0.110***	-0.295***	-0.271***	-0.297***	-0.235***	-0.236***	1

Note: ***p value < 0.001.

3.4 Gender Effects on the Associations among Mobile Phone Addiction, Negative Emotions, Learning Burnout, and Family Functionality

The t tests showed that female students' scores for MPA, feelings of anxiety or loss, withdrawal or escape, and productivity loss were significantly higher than those of male students ($ps < 0.05$). However, male students had a considerably higher NE scores and all dimension scores than female students ($ps < 0.05$). Likewise, male students' FF scores and all dimension scores were lower than those of female students ($ps < 0.01$). No significant differences were revealed in the LB scores between the two groups.

Table 3 Group comparisons of MPA, NE, LB, and FF between males and females (N=4792)

	Male (n=595) M±SD	Female (n=4197) M±SD	t	p
MPA total score	44.57±12.90	45.94±11.34	-2.469	0.014
Inability to control craving	17.37±5.30	17.42±4.55	-0.234	0.815
Feeling anxious and lost	9.96±4.02	10.32±3.86	-2.013	0.044
Withdrawal or escape	8.64±3.11	9.08±2.81	-3.305	0.001
Productivity loss	8.60±2.96	9.12±2.62	-4.112	0.000
NE total score	33.49±11.04	32.17±9.95	2.753	0.006
Depression	10.98±3.97	10.44±3.55	3.114	0.002
Anxiety	10.77±3.55	10.44±3.32	2.174	0.030
Stress	11.74±4.12	11.29±3.67	2.500	0.013
LB total score	55.77±10.56	55.76±10.20	0.025	0.980
Depression	20.30±5.93	20.35±5.71	-0.196	0.845
Improper behavior	17.61±3.97	17.35±3.69	1.606	0.108
Low personal accomplishment	17.85±4.37	18.06±3.77	-1.072	0.284
FF total score	6.57±2.95	7.15±2.74	-4.500	0.000
Adaptation	1.24±0.68	1.32±0.66	-2.706	0.007
Partnership	1.21±0.72	1.30±0.71	-3.061	0.002
Growth	1.34±0.67	1.49±0.62	-5.433	0.000
Affection	1.36±0.69	1.45±0.65	-3.355	0.001
Resolve	1.43±0.66	1.58±0.60	-5.552	0.000

3.5 Binary Logistic Regression Analyses Investigating Factors of MPA

The predictor variables of the MPA of nursing students were shown in binary logistic regression analysis (Table 4). Among the nursing students, the represented model fit the data well (Hosmer-Lemeshow χ^2= 13.247, p = 0.104), and the regression equation was statistically significant (χ^2= 856.453, p < 0.001).

The MPA of nursing students was significantly related to female sex (OR = 1.438, 95% CI: 1.187-1.742), undergraduate status (OR = 0.631, 95% CI: 0.544-0.733), anxiety (OR = 1.111, 95% CI: 1.068-1.156) and LB (OR = 1.052, 95% CI: 1.044-1.061). Sophomores were 1.210 times more likely to become addicted to mobile phones than first-year students. Hours spent on mobile phones per day and FF emerged as significant predictors of MPA. It was found that the more hours students spent on the mobile phone per day (4-8 hours or >8 hours), the higher their risk of having MPA (by 1.592 or 2.064 times, respectively) (ps < 0.001). In particular, nursing students had a 1.475 times (p < 0.001) higher risk of MPA if their FF was severely dysfunctional. The associations with depression and mother's education were not statistically significant and were not included in the final regression model.

Table 4 Binary logistic regression analysis exploring the association between MPA and demographics, NE, FF, and LB (N =4792)

Predictor variables	B	SE	$Wals$	$Exp(B)(95\% CI)$	p
Gender	0.363	0.098	13.805	1.438(1.187-1.742)	0.000
Education level	-0.460	0.076	36.452	0.631(0.544-0.733)	0.000
NE_Anxiety	0.105	0.020	27.021	1.111(1.068-1.156)	0.000
NE_Stress	0.113	0.019	36.381	1.120(1.079-1.162)	0.000
LB	0.051	0.004	163.653	1.052(1.044-1.061)	0.000
Academic year					
First	Reference				
Second	0.190	0.072	6.974	1.210(1.050-1.393)	0.008

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Hours spent on the mobile phone per day.					
< 4	Reference				
4–8	0.465	0.107	18.847	1.592(1.290-1.963)	0.000
> 8	0.725	0.112	35.097	2.064(1.624-2.632)	0.000
FF					
Functional	Reference				
Moderately dysfunctional	0.465	0.107	18.847	1.592(1.290-1.963)	0.000
Severely dysfunctional	0.389	0.116	11.235	1.475(1.175-1.852)	0.001

Note: OR=Odds ratio; 95% CI=95% confidence interval; S.E. = standard error. Nagelkerke[b] R²=0.218; [b] Nagelkerke R² is the variance of the dependent variable (mobile phone addiction) explained by all independent variables included in the regression model.

3.6 Negative Emotions Mediate the Relationship Between Learning Burnout and Mobile Phone Addiction

The results of the mediating role analysis are presented in Table 5 and Figure 1. The LB score was the independent variable, and the MPA score was the dependent variable. The NE scores were mediating variables. The regression analysis of MPA on LB explained 21.7% of the variance in MPA, and the model had an excellent fit ($F = 1330.571$, $p < 0.01$), which means that LB was a significant predictor of MPA ($\beta = 0.466$ (total effect), $p < 0.01$). The regression analysis of LB on NE revealed 24.2% of the variance in NE. The model had a good fit ($F = 1526.955$, $p < 0.001$). This means that LB positively predicted NE ($\beta = 0.492$, $p < 0.001$). The regression analysis of MPA on LB and NE jointly explained 29.1% of the variance in MPA, and the model had an excellent fit ($F = 981.643$, $p < 0.001$); the direct effect was 0.313 ($p < 0.001$). NE had a partial mediating effect on the relationship between LB and MPA.

Table 5 Regression analysis to test the mediating effect of NE between LB and MPD

Variables	Model 1			Model 2			Model 3		
	B(SE)	Beta(β)	t	B(SE)	Beta(β)	t	B(SE)	Beta(β)	t
LB	5.387(0.148)	0.466	36.477***	4.963(0.127)	0.492	39.076***	3.620(0.161)	0.313	22.420***
NE							0.356(0.016)	0.311	-2.805***
R	0.466			0.492			0.539		
R²	0.217			0.242			0.291		
Adjusted R²	0.217			0.242			0.290		
F	1330.571***			1526.955***			981.643***		

Note: B = unstandardized coefficients; SE = standard error; Beta (β) = standardized coefficients; ***p value <0.001; Model 1: LB predicts MPA; Model 2: LB predicts NE; Model 3: LB and NE jointly predict MPA.
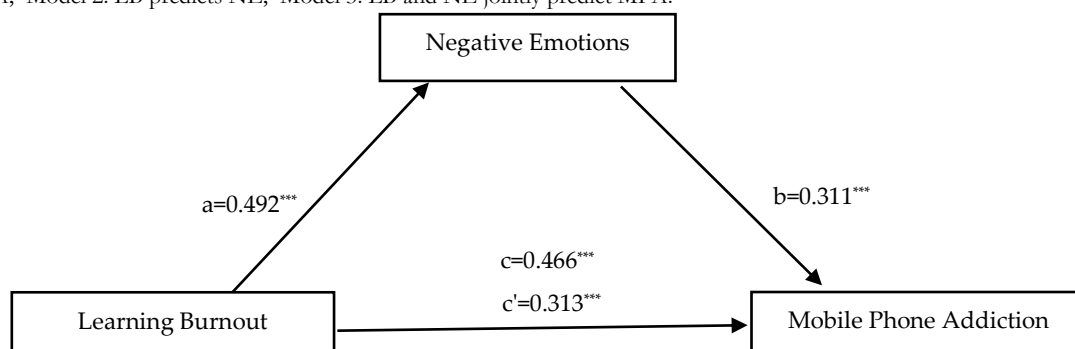

Figure 1 The mediating model of NE in the association between LB and MPA

(Note: ***p value <0.001. Path coefficients are shown in the standardized regression coefficient. a= standardized coefficients of path a; b= standardized coefficients of path b; a*b= indirect effect; c' = direct effect; c= total effect.)

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4. Discussion

In this study, the overall prevalence of MPA among 4792 nursing students was 50.85%, higher than in Lane et al.'s study (38.63%).[11] In contrast, Jafari's survey of 439 Iranian medical students showed that MPA was as high as 71.3%.[35] The different rates of MPA may be caused by the use of different research questionnaires, different research sites and times, and individual differences in participants. Due to the epidemic and the informatization of education and teaching, mobile phones are inseparable from the lives and study of nursing students. Mobile phones are the primary tool for nursing students to obtain information and perform interpersonal communication in daily life. They need to use mobile phones frequently for chatting, eating, shopping, sending and receiving express services, playing mobile games and engaging in COVID-19 prevention and control. In terms of learning, China's number of online education users has reached 325 million, accounting for 32.1% of the total internet users.[2] The information age has led to intelligent teaching and self-learning software. Nursing students need to use "Dingding," "Rain Classroom," "Super Star Learning Tong," and other apps to check in, answer questions and interact with each other in class. They also use mobile phones to participate in online courses and complete their assignments in their spare time. Chernomas showed that nursing students experience heavy academic burdens and anxiety, including heavy course schedules, stringent examinations, and challenges of the clinical environment.[36]

The proportion of depression, anxiety, and stress in the MPA group was higher than that in the non-MPA group, consistent with previous studies,[22, 37] indicating that NE were more serious in the MPA group. The more severe the symptoms of anxiety and stress are, the more urgent the need for mobile phones to relieve NE and the higher the level of MPA.[37] There was no difference in the influence of ethnicity and residence on MPA among nursing students, indicating that the popularity and convenience of the internet make mobile phone use not restricted by geographical conditions. The rate of MPA gradually increased with the increase in the duration of mobile phone use, which is consistent with a previous report that the daily use duration of a smartphone predicted smartphone addiction.[38] In addition, the MPA rate was lowest among nurses with a democratic family atmosphere. The parenting style based on the parent‑child relationship can predict mobile phone dependence behavior, confirming that a harmonious parent‑child relationship can reduce the dependence on mobile phones. This result is consistent with the research of Son, whose findings indicated the importance of parental roles in preventing problematic smartphone use.[39]

Moreover, the correlation analysis results also show that MPA was significantly positively correlated with LB and NE and significantly negatively correlated with FF, implying a possible psychopathology of MPA. Binary logistic regression analysis confirmed that females were more likely to be identified with the MPA group. It may be that females are more sensitive and can meet their interpersonal needs and seek emotional comfort by using mobile phones. Our findings resonate well with previous studies exploring the difference in MPA between males and females.[22] In comparison, other studies found no significant gender differences in MPA.[40, 41] Researchers have also identified gender differences in migratory phone usage patterns.[39, 42] As expected, hours spent on mobile phones per day predicted higher scores on the MPA scale, but FF predicted lower scores.

This study revealed that the LB of nursing students can positively predict MPA and is a significant risk factor. Furthermore, Salmela-Aro et al. suggested that addictive behavioral patterns, such as excessive internet use, can cause LB and contribute to depressive symptoms.[43] Meanwhile, NE partially mediated the relationship between LB and MPA. The path coefficient of the direct effect of LB on MPA was 0.313, which means that LB directly affected MPA and indirectly affected MPA

through NE. The results might provide clues for future interventions to address LB among Chinese nursing students.

The main limitations of this study are the cross-sectional design, convenience sampling, and use of self-reported measurements. The validity of the results may depend on the accuracy of participants' reports, and there is the chance that we could not confirm causal relationships. Fortunately, our sample size was relatively large, and invalid responses were eliminated. A further longitudinal study is warranted to examine the relationships between physical exercise, FF, and MPA. In addition, the number of participants in different gender groups was not equal since the number of females in China's nursing major is significantly higher than that of males, which may limit the generalizability of the results across genders.

5. Conclusions

The MPA of nursing students is at the medium level and is positively correlated with LB, NE, and FF. LB can indirectly affect MPA through NE. It is necessary to explore strategies to alleviate LB, help nursing students develop a positive psychological outlook, and encourage them to use mobile phones rationally and complete academic tasks to prevent MPA. With this, mobile phone may be used as a platform to improve student learning in various nursing concepts. Thus, model of care may be proposed in preventing addiction. Nurse educators may also realize the use of mobile application in teaching professional nursing courses.

Author Contributions

Conceptualization, Ya Meng and Hao Zhang; Methodology, Jian Song and Hao Zhang; Software, Ya Meng, Jian Song and Hao Zhang; Formal Analysis, Ya Meng, Jian Song and Xiao-jing Yu; Investigation, Ya Meng, Hao Zhang, Xiao-jing Yu and Tao Huang; Resources, Tao Huang and Ronnell D. Dela Rosa; Data Curation, Ya Meng and Xiao-jing Yu; Writing – Original Draft Preparation, Ya Meng, Jian Song and Hao Zhang; Writing – Review & Editing, Tao Huang and Ronnell D. Dela Rosa; Visualization, Ronnell D. Dela Rosa; Supervision, Ronnell D. Dela Rosa; Project Administration, Jian Song, Tao Huang; Funding Acquisition, Ya Meng, Hao Zhang and Tao Huang. All authors contributed to developing the study framework, revising successive drafts of the manuscript, and approving the version submitted for publication.

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Conflicts of Interest

There are no conflicts of interest. Informed consent was obtained from all the participants in the study.

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