


Mobile Phone Addiction Mediates the Relationship Between Alexithymia and Learning Burnout in Chinese Medical Students: A Structural Equation Model Analysis

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Background: Learning burnout is a passive mental state among students. It is a common phenomenon that can cause many bad outcomes in Chinese medical students, such as mental disorders and suicide, and its causes are complex.

Purpose: To analyze the relationship between alexithymia and learning burnout, as well as the mediating effect of mobile phone addiction, and provide clues for future interventions to deal with learning burnout among Chinese medical students.

Methods: In this cross-sectional study, convenience cluster sampling was used to produce a sample of 1200 medical universities in Chongqing, China. The Toronto Alexithymia Scale (TAS-20), Mobile Phone Addiction Tendency Scale (MPATS), and Learning Burnout Questionnaire (LBQ) were used to examine participants. Hierarchical regression was used to analyze the effect of alexithymia and mobile phone addiction on learning burnout. A structural equation model (SEM) with maximum likelihood was used to evaluate the mediating effect of mobile phone addiction on the relationship between alexithymia and learning burnout. The bootstrap method was used to confirm the significance of this mediating effect.

Results: The final sample size was 1062, with a valid response rate of 88.5%. The prevalence of learning burnout among Chinese medical students was 39.6%. Results of hierarchical regression revealed that alexithymia ($\Delta R^2=0.198$, $P<0.01$) and mobile phone addiction ($\Delta R^2=0.021$, $P<0.01$) were independent factors of learning burnout; the SEM revealed that the mediating effect of mobile phone addiction between alexithymia and learning burnout accounted for 25.16% of the total effect of alexithymia on learning burnout; the bootstrap method revealed that the bounds of the CI did not contain 0, confirming the significance of this mediating effect.

Conclusion: Of the medical students, 39.6% had learning burnout. Alexithymia can positively predict learning burnout, and this relationship is partially mediated by mobile phone addiction.

Keywords: learning burnout, alexithymia, mobile phone addiction, medical students, mediating effect, interventions

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Introduction

The current cohort of medical students, our future doctors, are a special group; their future work impacts the health of China's 1.4 billion population. However, according to the latest statistics in 2020 in China, the doctor-patient ratio was only 2.77% for 1000 patients,¹ which is substantially lower than that in some developed

countries.² In contrast, the attrition rate of medical graduates in China has been high in the past 10 years.³ Therefore, the cultivation of Chinese medical students has attracted wide attention. Chinese medical students face more academic challenges and pressure for long periods than students in other majors,⁴ leading to numerous problems such as learning burnout.⁵

Learning burnout is a passive mental state of students to the learning, it has been defined as students' emotional exhaustion, depersonalization, and reduced personal sense of achievement caused by course pressure, course burden, or other psychological factors during their educational experience.⁶ It can also be called student burnout or academic burnout and is associated with the phenomenon that students' enthusiasm for learning gradually fades away, attitudes toward learning become increasingly negative and tired.⁵ Existing studies found that female were more prone to learning burnout compared male;⁵ the prevalence of learning burnout was significantly different between vocational students and undergraduates;⁷ as well as different in some demographic characteristics, like residence.⁸ Learning burnout can cause many bad outcomes for students. This includes bad academic performance,⁹ mental disorders such as anxiety, depression, sleep disorders, and loneliness;¹⁰ and even suicide and dropping out of school.¹¹ Studies reveal learning burnout has become a pressing issue among Chinese medical students, with an incidence rate of about 40% and a high-risk rate of about 10%.^{12,13} Therefore, we must pay close attention to the possible causes of learning burnout among Chinese medical students to provide clues for future interventions aimed at diminishing learning burnout in this population.

One person's stable personality trait¹⁴ that might be a factor contributing to burnout among medical students is alexithymia, which has been defined by difficulties in identifying and describing feelings, difficulty in distinguishing between the bodily sensations of emotional arousal and feelings, and restrictions regarding imagination and externally oriented thinking.¹⁵ Many studies confirm that alexithymia is a risk factor for burnout among works,¹⁶ such as in healthcare professionals¹⁷ and nursing assistants,¹⁸ alexithymia was also found to be associated with the components of burnout, such as depersonalization.¹⁹ However, few studies have focused on the relationship between alexithymia and burnout among students. Studies that examine learning burnout are derived from studies on job burnout and only change the subjects from workers to students.²⁰ A study in

Romanian medical students demonstrated that alexithymia might play a significant role in the development of burnout in medical students.²¹ Studies indicate that alexithymia is a personality trait that may make medical students lack in the ability to adjust to the challenging situations met in their learning process.²¹ This is highly likely to cause learning burnout. However, further research is needed. Therefore, in this study, we hypothesized that alexithymia is a risk factor for learning burnout among Chinese medical students.

Alexithymia can not only lead to burnout but also mobile phone addiction.²² Mobile phone addiction, also known as problematic smartphone use or mobile phone dependence, is a non-substance addiction behavior.²³ It has been characterized by a situation when people's behaviors are out of control because of the obsession with mobile phones, and their physical and psychological health and social function are substantially impaired.^{24,25} Studies demonstrate that alexithymia is positively associated with addictive behavior.²⁶ For example, studies have described that alexithymia is a risk factor for craving, the severity of substance and alcohol addiction,²⁷ pathological gambling,²⁸ eating disorders,²⁹ internet addiction.³⁰ According to the theory of compensatory internet use,³¹ medical students with a higher level of alexithymia are more likely to have emotional recognition and expression deficits, mobile phone use may be a coping strategy to escape from real life.^{32,33} A study of 1105 college students suggested that alexithymia is an important correlate of mobile phone addiction.²² Thus, in this study, we also hypothesized that alexithymia was positively associated with mobile phone addiction among Chinese medical students. Mobile phone addiction may positively correlate with learning burnout. Two longitudinal studies found that excessive internet use could be a cause of school burnout among Finnish adolescents.³³ A study of Chinese non-medical college students revealed that mobile phone addiction could positively predict learning burnout.³⁴ For students, excessive mobile phone use leads to inadequate study time and consequently become unable to keep up with their learning progress; this eventually leads to learning burnout. It has been confirmed that mobile phone addiction is negatively related to academic performance and perceived stress of students;³⁵ poor academic performance and high stress are likely to cause learning burnout in students. Therefore, we believe that mobile phone addiction affects learning burnout among medical students. Further research is needed to explore

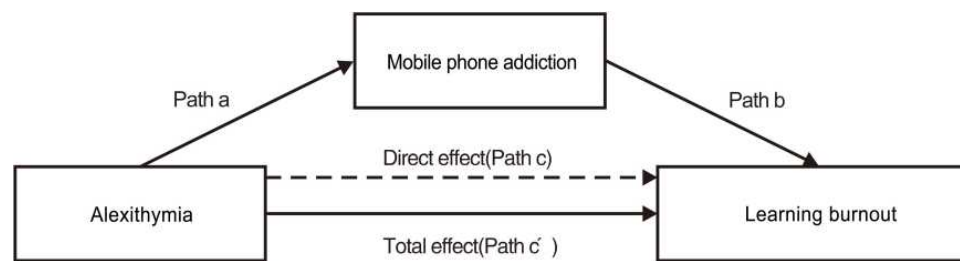


Figure 1 The hypothetical mediation model.

the relationships between the three variables, especially in Chinese medical students.

According to the application of mediation,³⁶ the establishment of the mediation model must meet the following three conditions: the independent variable must have a significant effect on the dependent variable, the independent variable must significantly affect the mediating variables, and the mediating variable must significantly affect the dependent variable. According to the above mentioned, we hypothesized that among Chinese medical students, alexithymia was positively correlated with learning burnout, and their relationship was mediated by mobile phone addiction. A hypothetical theoretical model is presented in Figure 1. Previous studies have confirmed the mediating effect through structural equation models.^{37,38} Thus, this study aimed to analyze the relationship between alexithymia and learning burnout, as well as the mediating effect of mobile phone addiction in this relationship based on the structural equation model. We hope that this study will contribute to providing clues for future interventions on learning burnout among Chinese medical students.

Materials and Methods

Participants and Procedure

Chongqing, one of China's four municipalities directly under the central government, is the most populous city in China, with a population of more than 30 million, and it is known as a "miniature of China."³⁹ Chinese medical students study in medical university or medical-vocational school. Thus, to attain more comprehensive data, this cross-sectional study was conducted in the only one medical university as well as one medical vocational school in Chongqing. The convenience cluster sampling method was used to produce a sample, and we applied the sample size calculation formula $n = \frac{\mu_a^2 \pi (1-\pi)}{\delta^2}$ to calculate the sample size. A relative error of 15% was allowed, so the absolute

error $\delta = 0.15\pi$ with 95% confidence intervals was accepted. Therefore, $\mu_a = 1.96$, according to previous studies, the prevalence of learning burnout among Chinese medical students was 41.6%¹² with $\pi = 41.6\%$. The minimum sample size in this study was $n = [1.96^2 \times 41.6\% (1 - 41.6\%)] / (0.15 \times 41.6\%)^2 \approx 240$. Considering the 10% invalid response, we expanded the minimum sample size to $n = 240 \times (1 + 10\%) \approx 264$.

The study was conducted as follows. First, we communicated with the teacher during the break, and after obtaining their consent, we conducted the investigation in the class they taught. However, in some classes, the teacher thought our investigation would disturb their class, so we did not conduct the investigation in those classes. We excluded students who were not willing to cooperate with the investigation; all participants were willing to cooperate with this investigation and able to complete our questionnaire independently. After obtaining informed consent from participants, they completed a traditional paper-and-pencil questionnaire independently in the classroom with the guidance of well-trained researchers. It took about 30 minutes for each participant to complete the anonymous questionnaire. Finally, we sent out 600 questionnaires to each university respectively and a total of 1200 students were approached. Due to the missing data of our research variables, we excluded 138 individuals and the final sample size was 1062, with a valid response rate of 88.5%, accounting for about 20% of the total students.

Ethical Statements

This study was approved by the ethics committee of Chongqing Medical University (2018015) and was conducted in accordance with the Declaration of Helsinki. All participants voluntarily participated in this study. Participants were fully informed of the survey before participation, such as content and purpose. Completing

and submitting the questionnaire was regarded as their proxy consent to participate. Our questionnaires were anonymous and coded by non-identifying codes, which ensured the confidentiality of the information.

Instruments

Toronto Alexithymia Scale (TAS-20)

The Toronto Alexithymia Scale (TAS-20), developed by Bagby et al^{40,41}, was used to measure alexithymia levels among medical students. TAS-20 consists of 20 items with three factors: difficulty in identifying feelings (seven items; eg, “I am often confused about what emotion I am feeling”), difficulty in describing feelings (five items; eg, “It is difficult for me to find the right words for my feelings”) and externally oriented thinking (eight items; eg, “I’d like to talk with people about their daily activities rather than their feelings”). It was rated on a five-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with a total score ranging from 20 to 100. All items were summed to create a composite score for each participant, with higher scores indicating higher levels of alexithymia. In traditional TAS-20 cutoffs, a total score >60 indicated that the participant had alexithymia.⁴² It has been proven that the TAS-20 is applicable to the Chinese population.⁴³ In this study, Cronbach’s alpha was 0.822.

Mobile Phone Addiction Tendency Scale (MPATS)

The MPATS, made for Chinese college students by Xiong et al⁴⁴, was used to measure mobile addiction among medical students. It consists of 16 items with four dimensions, namely, salience (four items; eg, “Classmates and friends often say that I rely too much on my cell phone”), withdrawal symptoms (six items; eg, “I will feel lonely if the phone is not with me”), social comfort (three items; eg, “I feel more comfortable to communicate with others using my mobile phone (than to talk face to face)”), and mood changes (three items; eg, “When the phone is not connected to the line or receives no signals, I will become anxious and get angry”). It was rated on a five-point scale, ranging from 1 (very inconsistent) to 5 (very consistent), with a total score ranging from 16 to 80. All items were summed to create a composite score for each participant, with a higher score indicating a higher level of mobile phone addiction. In this study, Cronbach’s alpha was 0.898.

Learning Burnout Questionnaire (LBQ)

The Learning Burnout Questionnaire, developed by Lian et al⁴⁵, is widely used to measure learning burnout among Chinese college students. It consists of 20 items with three dimensions, namely, low personal accomplishment (six items; eg, “It is easy for me to master professional knowledge”), depression (eight items; eg, “I feel exhausted after studying all day”), and improper behavior (six items; eg, “I seldom study after class”). It was rated on a five-point scale, ranging from 1 (very inconsistent) to 5 (very consistent), with a total score ranging from 20 to 100. All items were summed to create a composite score for each participant, with a higher score indicating a higher level of learning burnout. In this study, Cronbach’s alpha was 0.859.

Data Analysis

Descriptive analysis was used to describe the demographic characteristics of participants. Enumeration data are described as percentages. The test for normality revealed that the data of alexithymia, mobile phone addiction, learning burnout, and each dimension were all normally distributed, and the continuous data were described as mean \pm standard deviation. The *t*-test was used to analyze differences in alexithymia, mobile phone addiction, and learning burnout between variables. The Pearson correlation coefficient was used to evaluate the correlations among the research variables. Hierarchical regression was used to analyze the effect of alexithymia and mobile phone addiction on learning burnout and the effect of alexithymia on mobile phone addiction. In this study, there was no multicollinearity, and the variance inflation factor (VIF) values were all less than 5. First, we set learning burnout as the dependent variable; in step 1 and significant variables for learning burnout in univariate analysis were entered; in step 2, alexithymia was entered; in step 3, mobile phone addiction was entered. We then set mobile phone addiction as the dependent variable, and in step 1, significant variables for mobile phone addiction in univariate analysis were entered; in step 2, alexithymia was entered. A structural equation model (SEM) with maximum likelihood was used to evaluate the mediating effect of mobile phone addiction on the relationship between alexithymia and learning burnout among Chinese medical students. In this model, we set the subscale scores of alexithymia, mobile phone addiction, and learning

burnout as measurement variables, and their total scores as latent variables. Standardized estimates were conducted for each path, and a standardized path coefficient, which represents the relationship of influence between variables,³⁷ was produced for each path. The model fit was estimated using the root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis index (TLI), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and the Chi-square statistic (χ^2)/degrees of freedom (df) (CMIN/DF).⁴⁶ Models with RMSEAs below 0.08, CFI values above 0.90, TLI values above 0.90, GFI values above 0.95, AGFI above 0.80, and CMIN/DF values below 5 were considered to be a well-fitting model.⁴⁷ The bootstrap method was used to confirm the significance of the mediating effect of mobile phone addiction. We bootstrapped 5000 samples from the data and calculated the 95% bootstrap confidence intervals (CI); if the 95% CI did not contain 0, the mediating effect was considered to be significant.⁵ SPSS20.0 and Amos23.0 were used for statistical analysis, and the level of statistical significance was set at $p < 0.05$.

Results

Demographic Information and Differences in Alexithymia, Mobile Phone Addiction, and Learning Burnout Among Variables

In this study, the average age of participants was 19.52 ± 1.21 years. The average score of learning burnout for participants was 57.43 ± 10.64 . We observed that 39.6% of participants scored higher on learning burnout than they did (60), indicating that 39.6% of participants had learning burnout. Of 1062 participants, 422 were male (39.7%) and 640 were female (60.3%); 522 were from the countryside (49.2%) and 540 were from the city (50.8%); 403 were only children (37.9%), 659 were non-only children (62.1%), 538 were in vocational school (50.7%), and 524 were in university (49.3%). There were significant differences in learning burnout between participants from the countryside and city, only children and non-only children, and students in vocational schools and universities. The detailed results are summarized in Table 1.

Correlations Among Alexithymia, Mobile Phone Addiction, and Learning Burnout

There was a moderate positive correlation between alexithymia and mobile phone addiction ($r=0.397$, $P<0.01$), alexithymia and learning burnout ($r=0.457$, $P<0.01$), and mobile phone addiction and learning burnout ($r=0.368$, $P<0.01$). The detailed results are summarized in Table 2.

Alexithymia and Mobile Phone Addiction are Independent Factors of Learning Burnout

The results of hierarchical regression indicated that after controlling for significant variables in the univariate analysis in step 1, alexithymia positively explained 19.8% of the variance in learning burnout; then, alexithymia was controlled in step 2, mobile phone addiction positively explained 2.1% of the variance in learning burnout. Alexithymia also positively predicted mobile phone addiction by explaining 15.8% of its variance. The detailed results are summarized in Table 3.

Mobile Phone Addiction Mediates the Relationship Between Alexithymia and Learning Burnout

The results of the structural equation model are presented in Figure 2 and Table 4. The fit indices for the hypothetical model were as follows: chi-square statistic (χ^2)/degrees of freedom (df) (CMIN/DF) = 4.026, RMSEA = 0.053, CFI = 0.980, TLI = 0.969, GFI = 0.979, AGFI = 0.961, indicating a good model fit.⁴⁷ A higher standardized path coefficient value represents a stronger correlation between variables; the value over 0.200 was considered as a strong correlation.³⁷ In this model, three latent variables were significantly inter-correlated. The standardized path coefficient of path a (alexithymia \rightarrow mobile phone addiction) was 0.390, which means that if one SD increases in alexithymia, 0.390 SD will increase in mobile phone addiction, indicating that alexithymia was a positive predictor of mobile phone addiction; path b (mobile phone addiction \rightarrow learning burnout) was 0.291; it means that if one SD increases in mobile phone addiction, 0.291 SD will increase in learning burnout, indicating that mobile phone addiction positively predicted learning burnout; path c (alexithymia \rightarrow learning burnout) was 0.366, which means that if one SD increases in alexithymia, 0.366 SD

Table I Demographic Information and Differences in Alexithymia, Mobile Phone Addiction and Learning Burnout

Variables	n (%)	Alexithymia (Mean±SD)	Mobile Phone Addiction (Mean ±SD)	Learning Burnout (Mean ±SD)
Gender				
Male	422 (39.7)	51.95±9.12	40.31±10.77	56.66 ±10.96
Female	640 (60.3)	53.08±8.73	42.17±9.96	57.93 ±10.39
t		-2.027	-2.831	-1.919
P-value		0.043*	0.005**	0.055
Residence				
Countryside	522 (49.2)	53.52±8.32	41.34±10.37	58.25 ±10.73
City	540 (50.8)	51.77±9.35	41.52±10.29	56.64 ±10.49
t		3.219	-0.286	2.473
P-value		0.001**	0.775	0.014*
Only child				
Yes	403 (37.9)	51.68±9.50	41.52±10.62	56.55 ±11.09
No	659 (62.1)	53.21±8.46	41.38±10.15	57.96 ±10.32
t		-2.656	0.209	-2.102
P-value		0.008**	0.834	0.036*
School types				
Vocational school	538 (50.7)	53.17±9.19	40.80±10.50	58.74 ±10.86
University	524 (49.3)	52.08±8.56	42.08±10.11	56.07 ±10.24
t		1.993	-2.018	4.119
P-value		0.047*	0.044*	0.000**

Notes: M±SD refers to mean value standard deviation; *p < 0.05, **p < 0.01.

will increase learning burnout, indicating that alexithymia positively predicted learning burnout. All paths were significant ($P < 0.01$). The results revealed that the mediating effect of mobile phone addiction was also significant ($P < 0.01$), with a path coefficient of 0.113 (path a* path b), accounting for 25.16% (path a*path b/path a*path b + path c) of the total effect. Additionally, the results of the bootstrap method revealed that the lower and upper bounds of the CI did not contain 0, confirming the significance of this mediating effect.

Discussion

This study confirmed the theoretical model we hypothesized, namely, among Chinese medical students, alexithymia can positively predict learning burnout, and their relationship was partially mediated by mobile phone addiction; the partial mediating effect accounted for 25.16%. This means that alexithymia not only directly affects learning burnout but also indirectly affects learning burnout through mobile phone addiction. The results might provide clues for future interventions to deal with learning burnout among Chinese medical students.

In our study, 39.6% of medical students scored higher on learning burnout than the mid-value score (60); therefore, 39.6% of medical students were regarded as having learning burnout problems. This result is highly consistent with previous studies.¹² Learning burnout has become a common phenomenon among Chinese medical students. The findings are as follows:

These results suggest that alexithymia can positively predict learning burnout, consistent with a previous study.²¹ This result is supported by existing studies. First, studies have suggested that personal factors can alleviate and moderate the challenges of adapting to a changing environment.⁴⁸ Alexithymia, one of the personal factors, reflects the individual's response to the surrounding circumstances. Having critical importance on the onset and outcome of burnout,⁴⁹ alexithymia can lead to a lack of adjustment for the challenging situations encountered in studying among medical students, which may lead to learning burnout.⁴⁹ Second, emotional intelligence, the ability to control individual feelings and their expression, can produce a coping mechanism for medical students suffering from academic pressure and bad feelings,⁵⁰ which can protect them from learning burnout.⁵¹ However, emotional intelligence can be impaired by alexithymia, and thus people with alexithymia lack consistent self- and emotional awareness.⁵² Therefore, medical students with alexithymia may have difficulties in coping with challenging and highly stressful learning, contributing to study-related stress and learning burnout. Finally, alexithymia is considered a risk factor contributing to mental disorders, such as depression,²² burnout, and anxiety,⁵³ and psychological factors during the educational experience can also lead to learning burnout.⁶

This study revealed that the relationship between alexithymia and learning burnout was partially mediated by mobile phone addiction. Thus, alexithymia can cause

Table 2 Correlations Among Variables (r , $n = 1062$)

Variables	M±SD	Alexithymia	Mobile Phone Addiction	Learning Burnout
Alexithymia	52.63±8.90	1	0.387**	0.457**
Difficulty in identifying feelings	17.84±4.77	0.904**	0.372**	0.416**
Difficulty in describing feelings	13.65±2.87	0.831**	0.275**	0.324**
Externally oriented thinking	21.14±3.31	0.667**	0.294**	0.347**
Mobile phone addiction	41.43±10.32	0.397**	1	0.368**
Withdrawal symptoms	16.60±4.24	0.298**	0.905**	0.307**
Salience	9.49±3.03	0.346**	0.864**	0.365**
Social comfort	7.84±2.58	0.399**	0.740**	0.270**
Mood changes	7.51±2.32	0.329**	0.845**	0.303**
Learning burnout	57.43±10.64	0.457**	0.368**	1
Depression	22.12±5.36	0.424**	0.386**	0.870**
Improper behavior	18.10±3.99	0.336**	0.302**	0.854**
Low personal accomplishment	17.21±3.73	0.333**	0.174**	0.687**

Notes: M±SD refers to mean value standard deviation; * $p < 0.05$, ** $p < 0.01$.

Table 3 The Effect of Alexithymia and Mobile Phone Addiction on Learning Burnout

Variables	Mobile Phone Addiction			Learning Burnout	
	Block1 (β)	Block2 (β)	Block1 (β)	Block2 (β)	Block3(β)
Gender	1.799**	1.251*			
Residence			-0.861	-0.184	-0.312
Only child			0.978	0.418	0.561
School types	1.194	1.723**	-2.473**	-2.034**	-2.440**
Alexithymia		0.463**		0.536**	0.421**
Mobile phone addiction					0.243**
R ²	0.011	0.169	0.021	0.219	0.265
F	5.936**	71.695**	7.395**	73.896**	76.084**
Adjusted R ²	0.009	0.009	0.018	0.216	0.261
ΔR^2	0.011	0.158	0.021	0.198	0.021

Notes: R², Goodness of Fit; * $p < 0.05$, ** $p < 0.01$.

mobile phone addiction, and mobile phone addiction contributes to learning burnout. This partial mediating effect accounted for 25.16% of variance. The literature indicates that alexithymia can be considered as a common psychological characteristic when someone is suffering from social difficulties, physical, and mental illness.^{54,55} However, people with alexithymia will have difficulties in the process of feelings cognition, distinction, and expression,¹⁵ leading to an inability to release their negative emotions. Alexithymia was found to be significantly correlated with depression, anxiety, and stress.²² Individuals with alexithymia choose to use mobile phones

to escape from reality and to restore their hearts in peace. People with alexithymia are more likely to obtain physiological and psychological satisfaction and meet their unmet social needs in the virtual world built by mobile phones,⁵⁶ and mobile phone addiction is considered a compensatory behavior.⁵⁷ Medical students always encounter difficulties and challenges in their educational experience, which makes them more prone to alexithymia. Thus, they are more likely to choose mobile phones to escape the hardship of reality or to gain the satisfaction that they cannot get in their real life, ultimately leading to mobile phone addiction.

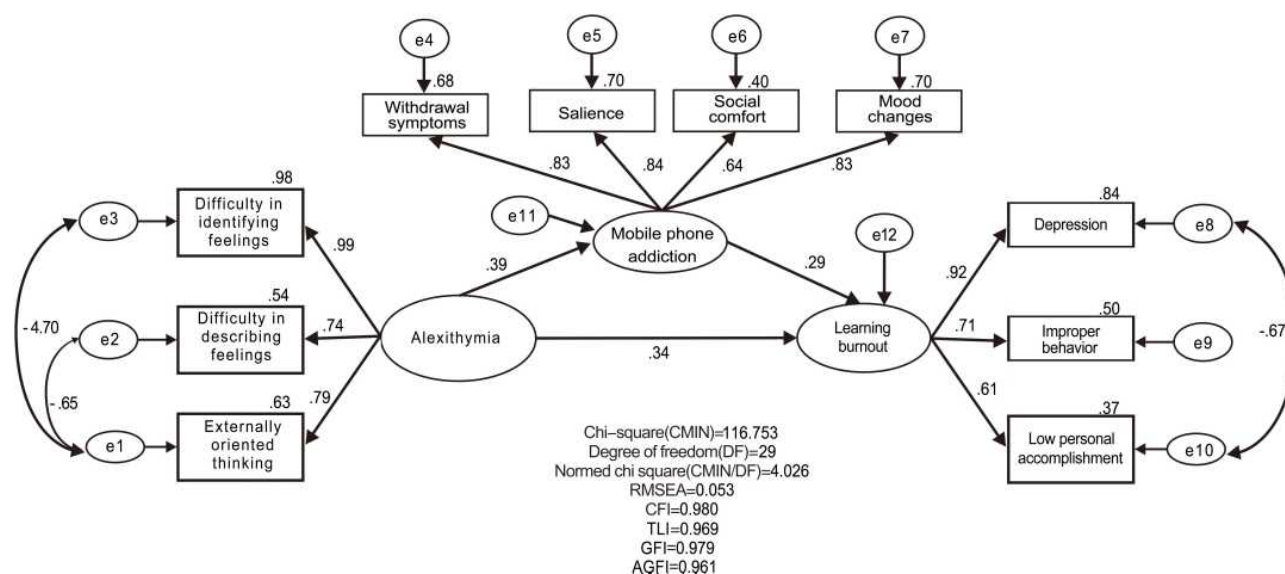


Figure 2 The structural equation modelling for the hypothetical model. RMSEA, root mean square error; CFI, Comparative Fit Index; TLI, Tucker Lewis Index; GFI, Goodness of Fit Index; AGFI, Adjusted Goodness of Fit Index.

Table 4 The Standard Effects in the Hypothetical Model

Effect	Path	Estimate	C.R.	P-value	95% Confidence Intervals	
					Lower Bounds	Upper Bounds
Direct	Alexithymia→MPA	0.390	7.698	<0.001	0.342	0.478
	Alexithymia→LB	0.336	6.882	<0.001	0.283	0.439
	MPA→LB	0.291	8.450	<0.001	0.225	0.380
Indirect	Alexithymia→MPA→LB	0.113	-	<0.001	0.090	0.166
Total	Alexithymia→LB	0.449	-	<0.001	0.423	0.554

Abbreviations: MPA, mobile phone addiction; LB, learning burnout; C.R., critical ratios.

However, mobile phone addiction can have a significant impact on learning burnout. First, medical students need to spend substantial time acquiring professional knowledge, but those with mobile phone addiction spend substantial time on mobile phones, even their class and sleep time,⁵⁸ leading to a decline in their academic performance. In the long term, they have a low sense of accomplishment in learning⁵⁹ and gradually lose interest, which causes learning burnout. Second, studies have confirmed that mobile phone addiction has a negative impact on people's physical and mental health, such as sleep disorders,⁶⁰ ear pain, headache,²² depression, anxiety, interpersonal problems,⁶¹ and suicidal ideation;⁶² these problems can consume so much of the medical student's energy that they cannot devote themselves to learning. When stopping the use of mobile phones, students who are addicted to mobile phones are hard to

disengage from it quickly; thus, medical students cannot concentrate on their studies, leading to learning burnout.

Limitations

This study has several limitations that should be acknowledged. First, this was a cross-sectional study, and any causal relationship should be inferred cautiously based on the association observed in our study. Further study is needed to increase the reliability of the findings, such as cohort studies and intervention trials. We are going to conduct studies in the future based on this cross-sectional study. Second, participants in this study were all recruited in Chongqing. Thus, this sample is not representative of all medical students in China despite Chongqing being known as a "miniature of China."³⁹ Further studies are required to reveal if these inferences can be applied to medical students in other regions of China. Third,

our sampling method (ie, convenience cluster sampling) might have evoked selection bias. However, we remark that we had a large sample that covered almost all subject majors. Studies with random sampling are warranted in the future.

Conclusion

Alexithymia can positively predict learning burnout, and it can also indirectly contribute to learning burnout through mobile phone addiction. Strategies to alleviating alexithymia and control mobile phone use in medical students may provide useful suggestions for future interventions aimed at diminishing learning burnout in medical students.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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