


Life Events, Boredom Proneness and Mobile Phone Addiction Tendency: A Longitudinal Mediation Analysis Based on Latent Growth Modeling (LGM)

Yuntong Yang , Yanhong Luo, Ming Chen, Jie Zhai 

Department of Applied Psychology, Hunan University of Chinese Medicine, Changsha, Hunan, People's Republic of China

Correspondence: Yanhong Luo, Department of Applied Psychology, Hunan University of Chinese Medicine, Changsha, Hunan, People's Republic of China, Tel +86-1868 486 0548, Email luoyanhong2006@126.com

Purpose: Mobile phone addiction has motivated a widespread concern in recent years. From a developmental perspective, this study explored the predictive relations between life events, boredom proneness (BP), and mobile phone addiction tendency (MPAT) among undergraduate students. It also tested the longitudinal mediation of BP between life events and MPAT.

Methods: Five hundred and eighty-four undergraduate students completed the Mobile Phone Addiction Tendency Scale, the Adolescent Self-Rating Life Events Checklist, and the Boredom Proneness Scale-Short Form. A longitudinal mediation analysis based on latent growth modeling was conducted to test the hypothesized relationships among life events, BP and MPAT.

Results: Latent growth modeling (LGM) showed that the BP and MPAT of undergraduate students both increased linearly. A longitudinal model based on LGM showed that negative life events both directly and indirectly affected the initial level and the growth rate of the MPAT through the mediating effect of the initial level of BP.

Conclusion: These results reveal that negative life events are an indicator of the development of MPAT. It has practical implications for calling for adopting health coping styles when facing negative life events. Supported for reducing college students' boredom proneness in order to lessen the tendency towards mobile phone addiction to improve their mental health.

Keywords: mobile phone addiction, life events, boredom proneness

Introduction

The number of mobile Internet users worldwide continues to grow. Mobile phones become a ubiquitous part of our daily lives through their accessibility, providing users with many benefits.^{1,2} In particular, mobile phones provide students with immediate access to a wide variety of features and functions that support motivation, engagement, learning and instruction from different points.^{3,4} However, this accessibility may also increase one's tendency towards mobile phone addiction (MPA).⁵ MPA is defined as a behavioral addiction characterized by excessive mobile phone use which leads to behavioral discomfort.^{2,5} But mobile phone "addiction" used to diagnose is still a debated concept, and the existing instruments do not use a cut-off point for MPA. From MPAT to MPA, it is more reflected as a continuous spectrum that higher scores indicate more serious problem.⁶ An increasing body of research has shown that mobile phone addiction and the tendency towards it can lead to both physical and psychological disturbances, including sleep disturbance^{7,8} and depression,⁹ as well as being extensively associated with learning burnout,¹⁰ irrational procrastination,¹¹ peer victimization,² and poor quality of life.¹² It is therefore important to explore both risk of and protective factors against tendency towards MPA, as well as MPA itself, in order to proactively prevent it.

Young adults are at risk of MPA as nowhere is this fascination with mobile phone technology quicker and more intense than in them – college students in particular.¹³ Moreover, university students lead a life with full of stress and obscurity adding the fact of living away from families and having to cope with economic and social issues. An increase in the use of mobile phone can be commonly observed among the university students.¹⁴ Numerous studies

have also shown that college students have a high incidence of mobile phone addiction tendency (MPAT).^{15,16} A study of South African university students found that 65% send over 21 text messages a day.¹⁷ 78.3% of Chinese university students reported possible mobile phone dependence.¹⁸ The American college student cell phone survey revealed that 93% students used mobile phone often or sometimes while a passenger during their commute, 92% use during idle time at work or school, 57% check their phone during class.¹⁹ MPAT in group of university students deserves attention.

Previous studies have suggested that gender and residence may play a role in MPAT. Differences exist in how males and females use mobile phones. Men use phone instrumental oriented, such as problem solving, relaxation and entertainment, whereas women utilize it social maintenance oriented, including emotional expression, interpersonal communication.¹⁶ Female students reported more frequent possible MPAT compared to male students.¹⁸ Previous study found that rural students had significantly less screen time than urban counterparts. Infrastructure challenges in rural communities as well as various options for leisure activities in different context might explain the differences in mobile usage.²⁰ A British online survey conducted in pandemic showed that urban participants were more vulnerable to mobile phone continuous use and addiction compared to rural participants. And a higher increase in spending hours on mobile phone was self-reported among urban participants.²¹ Therefore, gender and residence should take into account as control variables.

Life Events and Mobile Phone Addiction Tendency

It has been suggested that mobile phone served as a stress-coping tool which included wishful thinking and behavioral efforts to escape or avoid problem.²² Addictive behaviors can be considered as maladaptive coping strategies of responding to life stressors.²³ Negative life events are important sources of durative pressure which can have a substantial impact on those who experience them, leaving people tense, confused and withdrawn.²⁴ Therefore, negative life events can be a salient vulnerability factor for mobile phone addiction tendency. Previous studies have also demonstrated that university students' life stresses positively influence smart mobile phone addiction,^{25,26} while negative life events correlate positively and significantly with Internet addiction.²⁷ Moreover, research has confirmed mobile phone addiction tendency is not a temporary problem but instead persists long term.²⁸ Although existing studies have revealed the relationship between life events and the level of mobile phone addiction, the influence of life events on the development trend and speed as an important indicator of mobile phone addiction tendency has not been discussed. Therefore, it is necessary to take life events as predictive variables to systematically investigate the effects of life events on the initial level and growth rate of mobile phone addiction tendency.

Boredom Proneness as Mediator

According to the revised Interaction of Person-Affect Cognition-Execution (I-PACE) model, response to personal factors has been proposed as an influencing factor that can explain excessive internet use. There may be other indirect ways for life events to activate undergraduates' mobile phone addiction tendency, with boredom proneness as a personal trait perhaps playing an important role in this.²⁹ Boredom proneness refers to one's chronic characteristic tendencies towards constraint, restlessness, or lethargy, and the attribution of the aversive state to a monotonous or overly difficult environment.^{30,31} Firstly, stressful life events may have increased boredom proneness, resulting in experiencing feelings of unpleasantness, slow passage of time, and trapped feelings.³² Yan, L.³³ has pointed out that boredom proneness played a mediating role between perceived life stress and emotional distress during the COVID-19 outbreak. Secondly, person with higher boredom proneness often feel the push-to-action more intensely, and exhibit lower levels of self-control.³⁴ Given that the boredom prone tend to experience the being-prevented state more frequently, many may have resorted to smartphone games to relieve boredom.³¹ Cross-lagged studies have proved that there is a longitudinal relationship between boredom proneness and mobile phone addiction.³⁵

The Present Study

Due to the basis of most research are cross-sectional data. Studies only reveal the direct action of life events and boredom proneness on mobile phone addiction tendency. It is unknown how these variables change and whether the factors can explain variations in the development of mobile phone addiction tendency during undergraduate period. In addition, the mean value of boredom proneness at a single or several time points was often used to represent its status of development when discussing the mediating role of boredom proneness,³⁵ leading to an incomplete explanation of its longitudinal effect. It highlights the need to clarify the initial level and growth rate of the mediating variable, and specifically answer which part plays the mediating role, or both. For the current study, we explored the trajectory of variables according to the three waves data. On the basis of LGM we tested the longitudinal mediation of boredom proneness initial level and growth rate on the association between life events and mobile phone addiction tendency. The core hypotheses of this study are as follows:

H1: life events directly affect the initial level and growth rate of MPAT among undergraduate student.

H2: life events indirectly affect the development of MPAT by influencing the initial level and growth rate of BP.

Materials and Methods

Procedures and Participants

This study was conducted using online survey and completed follow-up tracking according to the contact information left by the participants. Data were collected from multiple provinces through the Questionnaire Star website, with important information such as the nature and purpose of the research, as well as the requirements and rights of participants marked clearly. Each wave is separated by six months. For the first wave, the data collection was carried out in October 2021 (T1), Wave 2 data were obtained in April 2022 (T2), Wave 3 data were obtained in October 2022 (T3). Tencent QQ numbers served as unique identifiers to match responses across the three waves. A total of 734 Chinese college students participated in the investigation. The analyzed data comprised 584 valid cases with an effective recovery rate of 79.6%. There were 265 (45.4%) males and 319 (54.6%) females, 286 (49%) urban students and 298 (51%) rural students. The mean age of the sample at baseline (T1) was 18.89 years ($SD = 1.21$). Of the undergraduate students at wave 1 assessment, 278 were freshmen, 148 sophomores, 144 juniors, and 14 seniors.

Ethics Approval

This study was conducted in accordance with the Declaration of Helsinki. Ethics approval of this study was granted by the Ethics Committee of Hunan University of Chinese Medicine. Each participant first participated with written informed consent prior to start the research. Participants were informed that their participation was voluntary and that they had the right to withdraw from the study at any point without adverse consequences. Participants were assured that the data collected would be kept confidential, and would only be used for research purposes.

Instrument

Mobile Phone Addiction Tendency Scale (MPATS)

Developed by Xiong Jie et al, the scale contains 16 items covering four factors: withdrawal symptoms, salience, social comfort, and mood changes. Respondents rated each item using a 5-point scale from 1 (totally inconsistent) to 5 (totally consistent). The scale's score distribution ranges from 16 to 80. When the total score is high, the tendency to become addicted to mobile phones is more likely to be severe. For this sample, Cronbach's Alphas ($T1 = 0.84$, $T2 = 0.87$, $T3 = 0.84$) showed good internal consistency.

Adolescent Self-Rating Life Events Checklist (ASLEC)

Developed by Liu Xianchen et al, the scale uses 27 items depicting negative life events that have the potential to bring about psychological and physical effects. Respondents rated each item using a 6-point scale from 1 (never happened) to 6 (happened and seriously affected). The higher the score, the more negative life events the respondent has encountered in

their life, and the more they have been impacted by these negative life events. Cronbach's Alphas for this sample ($T1 = 0.95$, $T2 = 0.96$, $T3 = 0.95$) showed that the scale had good internal consistency across the 3 times.

Boredom Proneness Scale-Short Form (BPS-SF)

Revised by Li Xiaomin et al, this scale has 12 items, among which questions 1, 2, 4, 7, 8, and 12 are scored in reverse. Items are rated using a 7-point Likert scale, from 1 (totally disagree) to 7 (totally agree). The higher the score, the higher the respondent's likelihood to develop proneness to boredom. The Cronbach's Alphas is acceptable: $T1 = 0.67$, $T2 = 0.68$, $T3 = 0.68$.

Statistical Analysis

SPSS 23.0 was employed to generate descriptive statistics, and Pearson correlation analysis was used to understand the correlations between study variables. Then we used Mplus8.0 to evaluate a longitudinal structural mode: First, unconditional latent growth modeling (LGM) was estimated for each variable to evaluate its growth pattern by extracting its intercept and slope. All factor loadings of the intercepts were fixed at one. We set the factor loadings of the slopes at zero, one, and two to fit a linear trajectory. Second, conditional LGM was established to test the direct effect of life events on the intercept and slope of mobile phone addiction tendency which was used to test hypothesis 1. Third, longitudinal mediation analysis (from life events to mobile phone addiction tendency via boredom proneness) based on LGM was conducted which was used to test hypothesis 2. Robust maximum likelihood estimator (MLR) within all models was done.

Results

Preliminary results

The results of independent sample *T*-test showed that for mobile phone addiction tendency, the first two waves of male students were significantly lower than female students ($T1: t=-3.53, p<0.001$; $T2: t=-2.05, p=0.04$; $T3: t=-1.25, p=0.21$), and there was no significant difference between urban students and rural students ($T1: t=-1.53, p=0.13$; $T2: t=-0.92, p=0.36$; $T3: t=-0.75, p=0.46$). For boredom proneness, there was no difference in gender ($T1: t=0.92, p=0.36$; $T2: t=1.23, p=0.22$; $T3: t=1.34, p=0.18$), and the latter two waves of urban students were significantly lower than rural students ($T1: t=-1.50, p=0.14$; $T2: t=-2.77, p<0.01$; $T3: t=-2.29, p=0.02$). In view of this, both gender and residence were included into the model as covariates.

Means and standard deviations of the key variables are listed in Table 1. Their mobile phone addiction tendency and boredom proneness showed an increasing trend over time.

Unconditional LGM

Intercepts and slopes of unconditional growth models are shown in Table 2. Results showed that the model fit indices of MPAT and BP were acceptable ($CFI, TLI > 0.9$; $RMSEA < 0.08$), and the mean slope was positive, indicating that student's mobile phone addiction tendency and boredom proneness level increased with time. However, the partial correlation coefficients of MPAT were negative, showing that the higher the initial level of the mobile phone addiction tendency, the slower the growth rate. The results of life events suggested poor fit. The mean of life events of three waves was represented as a manifest variable in the subsequent structural equation model analysis.

Table 1 Means and Standard Deviations of Variables Over Time

	MPAT		LE		BP	
	Mean	SD	Mean	SD	Mean	SD
Wave 1	41.81	9.61	47.08	19.92	42.81	8.16
Wave 2	44.79	10.12	50.42	23.00	44.23	7.39
Wave 3	45.24	9.18	46.82	19.51	44.24	7.86

Abbreviations: LE, life events; MPAT, mobile phone addiction tendency; BP, boredom proneness.

Table 2 LGM Fitting Indicators, Intercepts, and Slopes of Key Variables

Variables	χ^2	df	RMSEA	CFI	TLI	Mean		Partial Correlation
						Intercept	Slope	
MPAT	4.14	1	0.07	0.99	0.97	41.88***	1.39***	-12.03**
BP	0.71	1	<0.001	1.00	1.01	42.86***	0.69**	1.34
LE	10.41	1	0.13	0.79	0.36			

Notes: *** $p < 0.001$. ** $p < 0.01$.

Abbreviations: LE, life events; MPAT, mobile phone addiction tendency; BP, boredom proneness.

Direct Effect of Life Events on the Initial Level and Growth Rate of MPAT

A conditional LGM was estimated with Life events as the independent variable and MPAT as the dependent variable, controlling for gender and residence, to examine whether Life events can affect the initial level and growth rate of MPAT. The model was well fitted ($\chi^2/df = 7.59/4$, CFI = 0.99, TLI = 0.97, RMSEA = 0.04). Life events significantly and positively influenced the MPAT intercept ($\beta = 0.26$, $p < 0.001$) and slope ($\beta = 0.25$, $p < 0.01$), indicating that the higher the level of life events, the higher the initial level of the MPAT, and the faster the growth rate of the MPAT.

Longitudinal Mediation of BP Between Life Events and MPAT

A longitudinal model was estimated based on LGM to examine the mediating role of boredom proneness (Figure 1). The results revealed that the model had a good fit ($\chi^2/df = 21.57/13$, CFI = 0.99, TLI = 0.97, RMSEA = 0.04). The direct paths between life events, BP, and MPAT were presented in Table 3, indicating that life events significantly impacted the initial level of BP ($\beta = 0.33$, $p < 0.001$), but had little effect on its growth rate. In addition, the intercept of BP had a positive effect both on the intercept of MPAT ($\beta = 0.40$, $p < 0.001$) and the slope of MPAT ($\beta = 0.22$, $p < 0.05$). Furthermore, the slope of BP predicted the slope of MPAT ($\beta = 0.38$, $p < 0.05$), signifying that a growing BP promoted the MPAT growth rate.

In order to explore the longitudinal effect of BP in the association between life events and MPAT further, bootstrapping (1000 re-samples) was used to verify the mediating effect of BP intercept and slope, respectively. The model included three indirect paths: (1) life events \rightarrow BP intercept \rightarrow MPAT intercept, the indirect path was significant. (2) life events \rightarrow BP intercept \rightarrow MPAT slope, the indirect path was marginal significant. (3) life events \rightarrow BP slope \rightarrow MPAT slope, the indirect effect was not significant (Table 4). In general, negative life events could affect the development of mobile phone addiction tendency indirectly, such effects were partially due to the mediating role of baseline boredom proneness level, but not the rate of increase in boredom proneness.

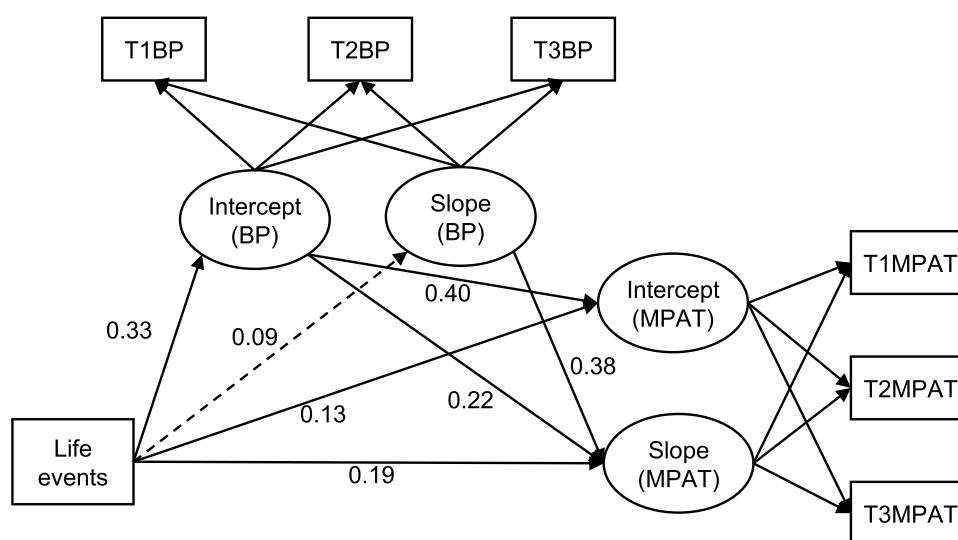


Figure 1 The longitudinal mediation model.

Table 3 Direct Paths in the Longitudinal Mediation Model

Path Coefficient	β	B	SE	p
LE→BP intercept	0.33	0.11	7.17	<0.001
LE→BP slope	0.09	0.01	0.69	0.49
LE→MPAT intercept	0.13	0.06	2.52	0.01
LE→MPAT slope	0.19	0.05	2.75	0.01
BP intercept→MPAT intercept	0.40	0.56	4.52	<0.001
BP intercept→MPAT slope	0.22	0.12	2.16	0.03
BP slope→MPAT slope	0.38	0.46	2.37	0.02

Abbreviations: B, unstandardized coefficient; β , standardized coefficient; SE, standard error. LE, life events; MPAT, mobile phone addiction tendency; BP, boredom proneness.

Table 4 Indirect Paths in the Longitudinal Mediation Model

Indirect Paths	Indirect Effect	p	95% Bootstrap	
LE→BP intercept→MPAT intercept	0.13	0.01	0.03	0.17
LE→BP intercept→MPAT slope	0.07	0.05	-0.14	-0.01
LE→BP slope→MPAT slope	0.03	0.45	-0.10	0.058

Abbreviations: LE, life events; MPAT, mobile phone addiction tendency; BP, boredom proneness.

Discussion

Trajectories of Life Events, BP, and MPAT

Firstly, the LGM on life events did not meet the fitting standard, indicating that there is no linear development trend of life events. This is because most life events occur at random. For college students in particular, they are basically affected by little individual differences in environmental circumstances, and mostly can access to support from family and school. So that salient factors such as the socioeconomic status do not contribute to college students' sustained exposure to stressful events.³⁶

Secondly, boredom proneness was on the increase. This is consistent with the conclusions of previous studies,³⁷ indicating that BP continues to develop during undergraduate years. As the increased demands for independence and novelty may create mismatches with limited novel opportunities and inadequate stimulation provided in the social context.³⁸ Besides, the data were collected during the pandemic period. Due to the COVID-19 pandemic causing a lack of autonomy in one's external environment, many have repeatedly failed to attain sufficient attentional engagement and have instead been stuck in an unchanging cycle for prolonged periods of time, resulting in becoming chronically bored.³²

Finally, the MPAT continued to increase, which coincided with the rise trend of mobile phone addiction around the world.³⁹ A global survey estimated that total Internet traffic has increased by about 60% following the COVID-19 outbreak.²¹ Previous longitudinal study has also manifested that once MPAT appear, it can easily continue or even worsen.²⁸ Because the smartphone applications are designed to attract users, introducing technology into every activity of people's life. Eventually, mobile phone tends to become ones extended self that causes increasing attachment.⁴⁰ For MPAT, the higher the initial level, the slower the growth rate. There is an upper limit to the ultimate level of MPAT. It means that students with lower level have greater deterioration space while students with high level remain a relatively stable growth in subsequent development.

Direct Effect of Life Events on MPAT

The current study found that life events directly affected the initial level and growth rate of MPAT, which supported H1.

According to the Transactional Model of Stress and Coping, personal resources are taxed or exceeded during negative life events.⁴¹ That is, the more negative events an individual encounters, the more pressure they feel, and the more likely they are to adopt problematical coping responses. Stress, avoidance-oriented coping styles increased and over 48% reported high and extremely high stress in a longitudinal survey of Polish university students.⁴² During the COVID-19

pandemic, measures have been implemented such as home quarantine, travel restrictions, and closed or substantially restricted school environments, all of which have reduced social interactions and disrupted everyone's daily life.⁴³ Exposure to such a social environment has likely made college students feel a kind of diffuse pressure that has resulted in increased stress, prompting them to turn to mobile phones for comfort and compensation. Individuals have been shown to use mobile phones to seek virtual psychological support.⁴⁴ The main motivation of addictive behavior is to escape from feelings of pain, anxiety, or other negative emotions.⁴⁵ Once the feeling of happiness was created by mobile phone use, the neural system excited the reward system via activation of dopamine.⁴⁶ Then, this experience becomes continuous and consistent habitual, causing further increases in one's MPAT, trapping them in a vicious cycle growth.⁷

Longitudinal Mediation Effect of ST

Before further investigating the longitudinal mediating role of BP, this study examined the possible direct paths between the trajectories of life events, BP and MPAT. The result showed that life events can significantly affect the initial level of BP. It supports the traditional view that boredom has been viewed as externally driven, as a state-like affective reaction to a monotony or an overload situation.³⁷ Previous research has also found that perceived life boredom was the most important detail in relating BP to frequency of boredom, intensity of boredom, and perceived life boredom as three separate characterizations.⁴⁷ Hence, the more an individual is affected by negative life events, a higher level of BP. BP's initial level positively affected the initial level and growth rate of MPAT. It is in line with the arousal theory. A high level of BP students would instinctively choose some interesting and challenging stimuli.³⁵ When they feel unengaged, smartphones can provide a simple, direct route to interrupt the monotonous cycle, offering bored users an alternative experience.⁴⁸ The relationship between levels of BP and levels of MPAT has been clearly established. Meanwhile, BP reflects poor self-regulation and an inability to correct such a state.⁴⁹ The failure of self-regulation could increase the sense of immersion in using mobile phones, and such sustainable and effortless attention and engagement³¹ may bring about a growth in MPAT. Namely, the higher the level of BP, the steeper the MPAT will increase. The study also displayed that the slope of BP positively affected the slope of MPAT. Previous study pointed out that people who frequently feel bored for long periods, and then the experience of boredom becomes more intense and aversive. The cumulative effect may gradually result in increased BP.⁵⁰ In order to get rid of the detestable feeling, increasing the duration of smartphone usage is needed. It further drives them away from reality and drown in virtual world.⁵¹ This leads to the rapid growth of MPA.

Bootstrap method was used to further test the indirect paths in the model. As a result, we found two indirect paths, which indicated that the initial level of BP played a positive longitudinal mediating role between life events and the development of MPAT, not the slope of BP, thereby supporting H2 partly. According to a school of thought of BP integrating state, trait, and person-environment fit models.³⁷ It adds a developmental perspective and explicitly relates the BP to characteristics of life period, prompting that the development of BP has a complex social context and is not simply affected by life events. Dang and Lench⁵⁰ have pointed out that BP actually captured two separate constructs: an external stimuli factor, which represent the requirement for environmental change and excitement, and an internal stimuli factor, which represent the ability to remain interested and engaged. Evidence suggests that the internal stimulation factor of BP predicted boredom frequency, which in turn predicted the intensity of boredom. Therefore, the BP slope is less amenable to life events influence, but instead the internal environment of a lack of response. In this study, it indicates the existence of trait-like stable components of BP. The growth rate of BP may be more caused by the internal. Life events indirectly affect the development of MPAT by influencing the initial level of BP simply.

Limitations and Future Direction

The current study does have several limitations. First, we used negative life event checklists based on the assumption that events are cumulative.³⁶ A more convincing method in this regard is that to identify the threat of events using information garnered from a structured interview. Second, due to the limit of tracking times, this study only plotted primary linear growth. Future studies could use LGM curve model to explore the possible quadratic growth trend on the basis of multiple tracking. Third, previous studies have emphasized the bidirectional dynamic effect of BP and MPAT. Study only investigated the unidirectional predictive relationship between variables, and a cross-lagged model could be used to explore the interaction in future studies.

Conclusion

This study has demonstrated that (1) during the study period, there is no linear development trend of life events, but the development of BP and MPAT of undergraduate students showed an increasing linear trend, and MPAT's initial level significantly negative correlated with its growth rate. (2) life events could directly and indirectly predict the development of MPAT, which exerted indirect influence via the mediating effect of the initial level of BP, but not the growth rate of BP. This indicates the need to pay attention to the problematic behavior of mobile phone addiction among college students. It allows us to develop accurate-targeted intervention measures that can reduce the negative impacts of life events and BP on the physical and mental health of college students.

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Disclosure

The authors report no conflicts of interest in this work.

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