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Original Article

Effect of an Intervention Based on the Health Action Process Approach Model on Mobile Phone Addiction in Adolescents

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Abstract

Background: Mobile phone addiction in adolescents is a serious social problem that not only negatively affects physical and mental health but also hinders social stability and development. However, studies on interventions for mobile phone addiction in adolescents are still few. Therefore, exploring interventions for mobile phone addiction in adolescents and scrutinizing the corresponding mechanism of action are crucial.

Methods: A questionnaire survey was conducted on 800 adolescents who were recruited using random sampling from communities in Hubei Province, China in 2023, and 232 of them were identified to have mobile phone addiction. Then, they were randomly divided into the experiment group, comprising 119 members, and the control group, composed of 113 members. The experiment group was given a 3-month intervention under the Health Action Process Approach (HAPA) model, whereas the control group was given no intervention.

Results: This intervention significantly reduced the level of mobile phone addiction in adolescents ($P<0.05$). It also significantly improved self-efficacy in adolescents with mobile phone addiction ($P<0.05$). The intervention can significantly improved life satisfaction in adolescents with mobile phone addiction ($P<0.05$). Self-efficacy and life satisfaction had a chain mediating effect ($P<0.001$).

Conclusion: The HAPA model is conducive to alleviating mobile phone addiction. It further enhances the intervention effect by improving self-efficacy and life satisfaction in adolescents.

Keywords: Mobile phone addiction; Health action process approach (HAPA) model; Self-efficacy; Life satisfaction

Introduction

Mobile phone addiction in adolescents has become a focus of concern in the society. According to a survey by China Internet Network Information Center in 2022, the proportion of minors using mobile phones in China was as high as 96.8% (1), and the incidence of mobile phone addiction in adolescents in the world was as high as 25.7% (2). Mobile phone addiction poses a huge threat to adolescents' physical and mental health. Long-term use of a mobile phone with a lowered head may cause pain in the neck and eyes and increase muscle tension in the neck (3). Moreover, it may lead to psychological problems, such as anxiety and depression (4). Diverse intervention schemes have been proposed in many studies to address these issues, but the effects are

insignificant; moreover, the intervention measures from the perspective of improving addicts' self-management and support from others are few (5-6).

The HAPA model is used to explain and predict individuals' healthy behaviors and is suitable for investigating addictive behaviors because it can explain and predict changes in healthy behaviors (7). The HAPA model covers the stages of motivation formation and execution (8-9). It emphasizes the interaction between motivation formation and behavior execution in adopting and maintaining healthy behaviors and provides a systematic framework to explain and predict the adoption and maintenance of healthy behaviors (10). The issue of mobile phone addiction in adolescents has attracted widespread attention from academia and society. The HAPA model has been widely applied in the medical and healthcare field, with functions including promoting exercise and rehabilitation among chronic disease patients, improving food safety behaviors, and increasing the influenza vaccination rate of susceptible populations. However, reports on the effectiveness of intervention methods based on this model in alleviating adolescents' mobile phone addiction behavior are few. Accordingly, the following hypothesis, H1, was proposed in this study. H1: An intervention based on the HAPA model negatively predicts mobile phone addiction in adolescents.

Among the core concepts of social cognitive theory, self-efficacy refers to individuals' confidence and belief in their abilities to complete specific tasks or achieve specific goals successfully by evaluating their abilities, including cognitive, emotional, and behavioral evaluations (11). According to a study, an intervention based on the HAPA model can further reduce adolescents' addictive behaviors, such as smoking addiction, through the mediating effect of self-efficacy (8). Nonetheless, no relevant study on mobile phone addiction from the self-efficacy perspective currently exists, particularly the role of self-efficacy in the mechanism of the intervention based on the HAPA model affecting adolescents' mobile phone addiction behavior. Given that mobile phone addiction is one of the addictive behaviors, the following hypothesis, H2, was proposed in this study. H2: Self-efficacy plays a mediating role in the mechanism of intervention based on the HAPA model affecting adolescents' mobile phone addiction behavior.

Life satisfaction refers to individuals' subjective evaluation and perception of their overall living conditions, including satisfaction with various aspects of life, such as family, work, social relationships, and health; these perception and evaluation reflect their quality of life (12). As an important indicator of one's quality of life, life satisfaction can be improved through some intervention experiments (13). For example, group psychological counseling intervention can boost individuals' overall life satisfaction by improving their healthy behaviors and quality of life (14). Experiment results indicate that life satisfaction and individuals' mental health and emotional well-being have a significant positive correlation (13). Mobile phone addiction in adolescents is often negatively correlated with mental health problems (15). Adolescents with mobile phone addiction may be trying to escape realities or alleviate negative emotions by using mobile phones, thereby leading to a decrease in life satisfaction (16). Individuals who consistently experience low levels of life satisfaction tend to engage in negative behaviors, such as gambling and mobile phone addiction. Although the decrease in life satisfaction may be an important predictor of adolescents' mobile phone addiction behavior, no relevant research currently exists to support this conclusion. This gap limits the research on intervention for mobile phone addiction to some extent. Accordingly, the following hypothesis, H3, was proposed in this study. H3: Life satisfaction plays a mediating role in the mechanism of the intervention based on the HAPA model affecting adolescents' mobile phone addiction behavior. Self-efficacy may play a mediating role in the mechanism of the intervention based on the HAPA model affecting adolescents' mobile phone addiction behavior.

In summary, close relationships may exist among the four variables, including the intervention

based on the HAPA model, mobile phone addiction in adolescents, self-efficacy, and life satisfaction. These four variables interact with one another and jointly form a complex network of relationships. An in-depth understanding of the connections among them is conducive to designing targeted intervention measures that are highly effective in preventing and reducing the occurrence of mobile phone addiction behavior among adolescents.

A chain mediating model was constructed in this study to examine the relationships among the intervention based on the HAPA model, self-efficacy, life satisfaction, and mobile phone addiction in adolescents. This study can provide a new perspective and a pathway for intervening in mobile phone addiction in adolescents.

Materials and Methods

From June 2023 to September 2023, a mobile phone addiction screening was conducted on 823 adolescent volunteers recruited from three communities selected in Honghu City, Hubei Province. A total of 232 adolescents, including 102 girls and 130 boys, were identified by the Smartphone Addiction Scale to have mobile phone addiction. These 232 adolescents were divided into the experiment group and the control group using a random number table, with 119 members in the experiment group (67 boys and 52 girls) and 113 members in the control group (63 boys and 50 girls). This study was approved by the ethics committee.

Research tools

Smartphone Addiction Scale–Short Version (SAS-SV): SAS-SV, developed by Min Kwon, was used (17). This scale has 10 items, and each item is rated from 1 to 6 points. The total score ranges from 10 to 60 points. A high score indicates severe symptoms of mobile phone addiction. Boys with a score exceeding 31 are identified to be mobile phone addicts, whereas girls with a score exceeding 33 are identified to be mobile phone addicts. This scale has good reliability and validity (18). The internal consistency reliability of this scale is 0.83.

General Self-Efficacy Scale (GSES): GSES, developed by Ralf Schwarzer and revised by Wang (19), was used. It consists of 10 items. Each item is rated using 5-point scoring. A high score indicates high self-efficacy in the individual. This scale has good reliability and validity. The internal consistency reliability of this scale is 0.79.

Chinese Adolescent Student Life Satisfaction Scale (CASLSS): CASLSS, developed by Zhang et al. (20), was used. It includes 36 items, and each item is rated using 5-point scoring. Four reverse items exist. A high score indicates that the individual has high satisfaction with his/her life. This scale has good reliability and validity. The internal consistency reliability of this scale is 0.85.

Intervention method

A design experiment of before and after intervention measurements of the experiment group and the control group was adopted in this study. The intervention period lasted for 3 months from June 2023 to September 2023. Both groups of participants were measured in terms of mobile phone addiction, self-efficacy, and life satisfaction before and after the intervention.

The experiment group was treated with an intervention scheme based on the HAPA model. This intervention scheme involves a 12-session group counseling, given once a week. The intervention scheme was formulated with reference to previous designs based on the HAPA model to deal with addictive behaviors. In the first three sessions, the intervention mainly focused on the establishment of trust relationships among members. The fourth to sixth sessions focused on changing the self-efficacy cognition of adolescents with mobile phone addiction, with an attempt to help them form motivation for behavioral change and promote their behavioral change through changing their motivation. In the 7th to 12th sessions, group members were guided to begin execution, where their behavioral change was continuously promoted through a gradual

and progressive approach. The control group was given no intervention.

Statistical methods

Statistical analysis was conducted using SPSS 26.0 (IBM Corp., Armonk, NY, USA). First, independent and paired sample t-tests were performed to examine the changes in the scores of the experiment group and the control group in mobile phone addiction, self-efficacy, and life satisfaction before and after the intervention. Second, process 3.4 was used for mediating and chain mediating analysis.

Results

Changes in the experiment group and the control group in terms of mobile phone addiction

Table 1 shows that the experiment group and the control group had no significant difference in mobile phone addiction before the intervention. However, the score of the experiment group showed a significant decrease after the intervention, whereas that of the control group showed no significant change. Moreover, the score of the experiment group after the intervention was significantly lower than that of the control group, indicating that the intervention was effective.

Table 1: Changes in the experiment group and the control group in terms of mobile phone addiction before and after the intervention

Variable	*Before intervention*	*After intervention*	t	P
Experiment group	46.45±6.22	36.37±6.89	11.23	0.001
Control group	47.13±7.01	46.78±6.14	1.13	0.76
t	1.34	-12.27		
P	0.68	0.001		

Changes in the experiment group and the control group in terms of self-efficacy

Table 2 shows that the experiment group and the control group had no significant difference in self-efficacy before the intervention. However, the score of the experiment group showed a significant increase after the intervention, whereas that of the control group showed no significant change. Moreover, the score of the experiment group after the intervention was significantly higher than that of the control group, indicating that the intervention was effective.

Table 2: Changes in the experiment group and the control group in terms of self-efficacy before and after the intervention

Variable	*Before intervention*	*After intervention*	*t*	*P*
Experiment group	20.36±3.82	33.45±4.13	-13.36	0.001
Control group	20.98±3.98	19.32±3.44	0.97	0.93
t	-0.76	14.12		
P	0.87	0.001		

Changes in the experiment group and the control group in terms of life satisfaction

Table 3 shows that the experiment group and the control group had no significant difference in life satisfaction before the intervention. However, the score of the experiment group showed a significant increase after the intervention, whereas that of the control group showed no significant change. Moreover, the score of the experiment group after the intervention was significantly higher than that of the control group, indicating that the intervention was effective.

Table 3: Changes in the experiment group and the control group in terms of life satisfaction before and after the intervention

Variable	*Before intervention*	*After intervention*	*t*	*P*
Experiment group	73.46±11.87	107.89±12.92	-27.76	0.001
Control group	73.01±12.19	74.35±12.34	1.32	0.83
t	0.83	26.55		
P	0.28	0.001		

Mediating effect analysis

Process 3.0 was used to analyze the mediating effect, with intervention as the independent variable, mobile phone addiction as the dependent variable, and self-efficacy and life satisfaction as the mediating variables. The results obtained are shown in Table 4 and Fig.1. Model 1 shows that when intervention was the independent variable and mobile phone addiction was the dependent variable, intervention had a significant direct predictive effect on mobile phone addiction, with a value of 0.54 and $P<0.001$. Model 2 shows that when self-efficacy was the dependent variable and intervention was the independent variable, intervention had a significant predictive effect on self-efficacy, with a value of 0.46 and $P<0.001$. Model 3 shows that when life satisfaction was the dependent variable and intervention and self-efficacy were the independent variables, intervention had a significant predictive effect on life satisfaction, with a value of 0.46 and $P<0.001$, and self-efficacy had a significant predictive effect on life satisfaction, with a value of 0.47 and $P<0.001$. Model 4 shows that when mobile phone addiction was the dependent variable and intervention, self-efficacy, and life satisfaction were the independent variables, intervention had a significant predictive effect on mobile phone addiction, with a value of 0.21 and $P<0.001$; self-efficacy had a significant predictive effect on mobile phone addiction, with a value of 0.45 and $P<0.001$; life satisfaction had a significant predictive effect on mobile phone addiction, with a value of 0.52 and $P<0.001$. The results of the mediating effect analysis (Table 4) indicate that self-efficacy had a significant mediating effect, life satisfaction had a significant mediating effect, and self-efficacy and life satisfaction had a significant chain mediating effect.

Table 4: Mediating effect results

Variable	*Model 1: mobile phone addiction*	*Model 2: Self-efficacy*	*Model 3: Life satisfaction*	*Model 4: mobile phone addiction*
Intervention	0.54**	0.46**	0.43**	0.21**
Self-efficacy			0.47**	0.45**
Life satisfaction				0.52**

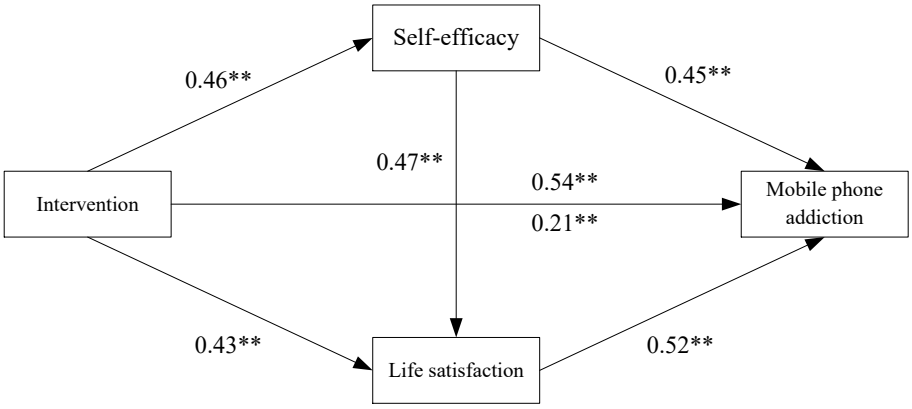

Fig. 1: Mediating Model Diagram

Discussion

Intervention based on the HAPA model has a direct predictive effect on mobile phone addiction in adolescents

This study shows that the intervention based on the HAPA model has a significant negative predictive effect on adolescents' mobile phone addiction behavior, indicating that adolescents accepting a high level of intervention based on the HAPA model are slightly likely to have mobile phone addiction behavior. This finding is consistent with existing research results (21). The following reasons may explain why the intervention based on the HAPA model has a direct predictive effect on mobile phone addiction in adolescents. First, the HAPA model emphasizes individuals' transformation into healthy behaviors, including cognitive, emotional, and behavioral changes. One's transformation into healthy behaviors is a gradual process that involves stages, such as becoming aware of the problem, deciding to take action, taking action, and maintaining action. Therefore, the intervention measures designed based on this model typically target key stages in this process. They seek to promote the adoption and maintenance of healthy behaviors and the removal of unhealthy behaviors by enhancing individuals' health awareness, emotional control, and behavioral control (22). Second, the intervention based on the HAPA model is usually designed according to individuals' specific needs and behavioral characteristics, enabling such intervention to bring ideal results. Intervention measures targeted at enhancing self-control ability and cultivating healthy coping strategies can effectively reduce the occurrence of Internet addiction (23). Similarly, the intervention for mobile phone addiction in adolescents may involve enhancing their awareness of the potential negative effects of mobile phone use, improving their self-control, and cultivating healthy coping strategies (24).

Self-efficacy plays a mediating role

First, the intervention based on the HAPA model can significantly negatively predict adolescents' mobile phone addiction behavior partly because of the mediating role of self-efficacy. A high level of self-efficacy leads to a low level of mobile phone addiction in adolescents. This finding supports the results of previous studies on self-efficacy, the HAPA model, and mobile phone addiction in adolescents (23). Self-efficacy plays an important role in predicting individuals' behaviors (25). Self-efficacy is one of the key factors driving behavioral change. Individuals with high self-efficacy tend to participate in activities where they believe they can succeed, including ensuring their self-discipline in using mobile phones. Therefore, a strong sense of self-efficacy may reduce the incidence of mobile phone addiction in adolescents. Second, the HAPA model is a framework commonly used to explain individuals' behavioral change in three dimensions, in-

cluding cognition, emotions, and behaviors. According to this model, individuals decide whether to adopt a certain behavior through cognitive and emotional processing, and self-efficacy plays an important role in this process (7). In short, the intervention based on the HAPA model often focuses on enhancing individuals' self-efficacy, thereby promoting the formation of healthy behaviors and reducing the occurrence of negative behaviors.

Life satisfaction plays a mediating role

The results of this study indicate that the significant negative predictive effect of this intervention on adolescents' mobile phone addiction behavior is, to some extent, mediated by life satisfaction. A high level of life satisfaction leads to a low level of mobile phone addiction in adolescents. This finding is consistent with previous research results (16). On the one hand, the HAPA model highlights individuals' behavioral change in three dimensions, including cognition, emotions, and behaviors. As an emotional experience, life satisfaction takes an important role in this model. On the other hand, individuals' perception of life satisfaction affects their attitude toward and acceptance of healthy behavior intervention, thereby affecting the effectiveness of the intervention (26). Therefore, life satisfaction can be seen as a protective factor that reduces the risk of mobile phone addiction in adolescents.

Self-efficacy and life satisfaction play a chain mediating role

This study shows that self-efficacy and life satisfaction play a chain mediating role in the impact of the intervention based on the HAPA model on mobile phone addiction in adolescents. This finding indicates that the intervention based on the HAPA model can significantly negatively predict mobile phone addiction in adolescents through the separate mediating effects of self-efficacy and life satisfaction. It may also jointly affect mobile phone addiction in adolescents through the chain mediating effect of self-efficacy and life satisfaction. This finding is consistent with previous research results (27). On the basis of these conclusions, this study indicates that the effectiveness of the intervention based on the HAPA model, to some extent, depends on whether these factors can enhance self-efficacy and life satisfaction in adolescents. In this study, mobile phone addiction in adolescents is reduced by connecting the intervention based on the HAPA model, self-efficacy, and life satisfaction.

Conclusion

The HAPA model was adopted in this study to intervene in adolescents' mobile phone addiction behavior. The experiment group and the control group, which were completely randomly divided, were repeatedly measured. Thus, the following results were obtained. The score of the experiment group in mobile phone addiction after the intervention is significantly lower than that before the intervention. Moreover, their scores in self-efficacy and life satisfaction after the intervention are significantly higher than those before the intervention. By contrast, no significant changes exist in the scores of the control group in mobile phone addiction, self-efficacy, and life satisfaction. Moreover, the control group has a significantly higher score in mobile phone addiction than the experiment group and significantly lower scores in self-efficacy and life satisfaction than the experiment group after the intervention. These results indicate that the intervention based on the HAPA model has a significant effect in alleviating mobile phone addiction in adolescents and improving their self-efficacy and life satisfaction. Therefore, the results of this study have significant implications, particularly in providing empirical support and practical guidance for the formulation and implementation of intervention methods for addressing adolescents' mobile phone addiction behavior.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submis-

sion, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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