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Original Article

Physical Exercise and Behavioral Addiction: How Self-Control and Subjective Emptiness Jointly Mediate the Reduction of Short-Video Addiction in Adolescents

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Abstract

Background: Short-video addiction is prevalent among adolescents and threatens their development. This study aimed to examine the relationships among physical exercise, self-control, subjective emptiness, and short-video addiction in adolescents and the underlying mechanisms.

Methods: A total of 889 adolescents were recruited from 3 middle schools in Zhejiang Province, China. Data collection was conducted from April to June 2025 using a questionnaire.

Results: The mean score of short-video addiction in adolescents was 3.01; physical exercise was negatively correlated with short-video addiction ($r=-0.626$, $P<0.001$); self-control (effect=−0.106, 95% CI [−0.175, −0.047]) and subjective emptiness (effect=−0.360, 95% CI [−0.492, −0.260]) mediated the relationship between physical exercise and short-video addiction; and the chain mediation model shaped by self-control and subjective emptiness had a statistically significant effect (effect=−0.064, 95% CI [−0.115, −0.025]).

Conclusion: Physical exercise contributes to mitigating short-video addiction in adolescents by enhancing self-control and alleviating psychological emptiness. Relevant interventions should integrate physical activities to improve adolescents' self-management abilities, satisfy their psychological needs, and lay a foundation for the prevention and treatment of this addictive behavior.

Keywords: Short-video addiction; Adolescent; Physical exercise; Mediation effect

Introduction

Short videos have rapidly gained prevalence with the development of mobile internet and new media technologies. These videos, typically under 5 minutes, are characterized by fragmentation, interactivity, diversity, and embeddedness (1), providing users accessible entertainment and social connectivity. According to the 5th National Survey Report on Internet Use Among Minors, over 100 million adolescents in China use short videos, of which 11.9% watch short videos for over 2 hours daily on weekdays and 7.2% watch for over 5 hours daily during holidays (2). These data indicate a growing prevalence of short-video addiction, particularly among adolescents, which significantly affects their physical and mental health.

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Short-video addiction refers to a compulsive urge to watch short videos, which leads to behavioral dyscontrol, difficulties in concentrating, and adaptive challenges in social, academic, and occupational domains (1, 3). Although short-video use may positively contribute to socialization in adolescents, addiction to such content is detrimental to their healthy development. First, short-video addiction impairs psychological well-being by exacerbating emotional problems, such as depression and anxiety, and undermines self-control and resilience (4). Prolonged immersion in short videos may also blur the boundary between reality and the virtual world, resulting in cognitive dissonance and dyshormia (1). Second, it compromises physical health, causing severe consequences including vision deterioration, spinal deformities, and impaired brain function (5). Moreover, excessive short-video engagement consumes time, reduces academic and work efficiency, and significantly undermines adolescents' intrinsic and extrinsic learning motivation, as well as academic performance (6). These findings underscore the critical research value of investigating short-video addiction in adolescents.

In view of the adverse effects of short-video addiction, researchers have started to explore effective interventions, among which physical exercise has emerged as a promising candidate. Evidence indicates that regular engagement in physical activities not only enhances physical fitness but also alleviates behavioral dependencies, including short-video addiction. Physical exercise exerts dual regulatory effects on the brain's reward system. It promotes the release of endogenous endorphins and dopamine, offering healthy pleasurable experiences that can replace the abnormal neural excitation induced by short videos (7). In addition, long-term physical exercise strengthens the inhibitory function of the prefrontal cortex (PFC), thereby reducing over-responsiveness to stimuli from short videos (8). Empirical studies have confirmed that the frequency and intensity of physical exercise directly predict lower levels of short-video addiction in adolescents. However, the underlying mechanisms mediating this relationship remain underexplored.

The enhancement of self-control is a key outcome of physical exercise. Self-control refers to the ability to suppress dominant responses and regulate impulsive emotions to achieve long-term goals (8). Its core mechanism involves inhibitory regulation of the limbic system by the PFC, a process particularly critical during adolescence (9). During this development stage, incomplete myelination of the PFC leads to an imbalance between cognitive control and emotional impulsivity (9), rendering adolescents more susceptible to the instant gratification offered by short videos. Self-control in adolescents is fundamental for their academic achievement, peer relationship maintenance, and moral internalization, verified to be negatively correlated with adolescents' aggressive behaviors (10). The resource limitation model posits that self-control is a depletable psychological resource. Short-video addiction leads to self-depletion through sustained consumption of cognitive resources (10). Therefore, self-control is significantly negatively correlated with short-video addiction in adolescents. Based on this reasoning, the following hypothesis is proposed: H1: Self-control mediates the relationship between physical exercise and short-video addiction in adolescents.

The mechanisms underlying short-video addiction in adolescents, particularly regarding subjective emptiness, have not been systematically explored. Subjective emptiness is defined as a persistent psychological state of vacuity in individuals arising from insufficient perception of meanings, weak social connections, or ambiguous goal orientation (11). Adolescents are at high risk of subjective emptiness due to self-identity crises and pressures associated with social role transitions (12). When adolescents fail to satisfy their needs for relatedness, competence, and autonomy in real-world environments, they turn to short videos, from which they can gain virtual social feedback and instant achievement to fill their psychological gaps. Subjective emptiness has a stronger association with short-video addiction than other psychological variables (13). As an intervention incorporating physiological activation and psychological adjustment, physical exer-

cise may alleviate subjective emptiness and its associated addictive behaviors through dual pathways. First, physical exercise satisfies psychological needs: team sports (e.g., basketball, soccer) enhance belonging via collaboration and role division; skill-based sports (e.g., dancing, rock climbing) boost competence through completing challenging tasks; and autonomous sport selection promotes autonomy in decision making (14). Second, physical exercise facilitates neurofunctional remodeling. Regular physical exercise increases gray matter density in the PFC, restoring the inhibitory control of the PFC over the limbic system, and it promotes the release of endogenous endorphins to provide sustainable pleasure, thereby reducing reliance on rewards from short videos (15). Based on this logic, the following hypothesis is proposed: H2: Subjective emptiness mediates the relationship between physical exercise and short-video addiction in adolescents.

In summary, prior studies have confirmed the multiple negative effects of short-video addiction on adolescents' health and preliminarily discussed the intervention potential of physical exercise. However, systematic investigations into the mediation mechanisms remain limited. By examining the chain mediation effect of self-control and subjective emptiness, this study aimed to elucidate the internal mechanisms through which physical exercise affects short-video addiction in adolescents, providing a robust theoretical foundation for the formulation of targeted interventions.

Materials and Methods

The research protocol for this study received approval from the Zhijiang College of Zhejiang University of Technology Ethics Committee (Approval number: 20250601).

Participants were recruited from three middle schools in Zhejiang Province: the Experimental Middle School of Keqiao, Jinhua Middle School, and Qianqing Middle School, all located in Shaoxing, Zhejiang Province. The target population included students in Grades 7 and 8. The estimation of sample size was based on 10-20 times the number of questions (16), taking into account the complexity of structural equation modeling (SEM) and the high demand for statistical power. In addition, there was room for estimating possible invalid questionnaires. Using convenience sampling, 920 questionnaires were distributed. Of these, 905 were retrieved, and after rigorous screening, 889 valid questionnaires were retained, yielding an effective response rate of 98.15%. The participants' ages ranged from 12 to 15 years (mean age=13.52±1.04 years). Data collection was successfully completed from April to June 2025. The final sample size (n=889) met the statistical power requirement for the study. Among the valid participants, 50.84% (452 participants) were male, and 49.16% (437 participants) were female, rendering the gender distribution of this study relatively balanced. Prior to questionnaire distribution, detailed information about the purpose, significance, and voluntary participation principle of the study was provided to students and their legal guardians. The questionnaire were distributed only after obtaining informed consent from all students and their guardians.

Research tools

Subjective Emptiness Scale (17)**:** Developed by Price et al., (18) this scale contains five items (e.g., "I feel empty inside" and "I feel disconnected from my own life") and uses four-point Likert scoring (1=completely disagree, 4=completely agree). Fu et al. (17) translated and validated the scale for Chinese populations, reporting a Cronbach's alpha coefficient of 0.90, split-half reliability of 0.84, and test–retest reliability (over a 2-week interval) of 0.82. These results indicate that this scale has good reliability and validity for assessing subjective emptiness in Chinese adolescents.

Physical Activity Rating Scale (19)**:** This three-item scale measures exercise intensity, duration, and frequency using five-point Likert scoring. Physical activity level is calculated as: (intensity score)×(duration score−1)×(frequency score). The final score reflects the extent to which a stu-

dent participated in physical exercise in the past month. The cut-offs for the final score are defined as: ≤19 points (low physical activity level), 20–42 points (moderate physical activity level), and >42 points (high physical activity level). In this study, the Cronbach's alpha coefficient of this scale was 0.766 (19).

Dual-mode Self-control Scale (20)**:** Revised by Xie et al., this scale (appropriate for ages 8–26) assesses levels of self-control in Chinese adolescents. It includes two subscales (i.e., impulse and control system) with 21 items. Five-point Likert scoring is used, with higher scores indicating stronger impulse control or self-control. In this study, the Cronbach's alpha coefficients of the two subscales were 0.854 (impulse system) and 0.803 (control system) (20).

Short-video Social Media Dependency Scale (SVSMD-S) (21)**:** Adapted by Hu et al. from a social media dependency scale, this scale replaces "social website" with "short-video social website" in each item. It contains six items (e.g., "Since I started using short-video social websites, my academic performance has declined") and uses five-point Likert scoring. In this study, the Cronbach's alpha coefficient of this scale was 0.732.

Statistical methods

The data were analyzed using SPSS 26.0. Descriptive statistics, t-tests, one-way ANOVA and correlation analysis were conducted to examine the relationships among the variables and demographic differences. Mediation effects were analyzed using PROCESS 3.4.6 macro in SPSS, with confidence intervals estimated using bias-corrected nonparametric percentile bootstrap. Models 4, 6, and 7 were used to test the mediation effects of self-control and subjective emptiness, as well as their chain mediation effect. Regression analysis was performed to test the predictive relationships among the variables. All statistical tests used a two-tailed test, for which the significance level was set to 0.05.

Results

General Descriptive Statistics

The descriptive statistical results of the core variables in this study are presented in Table 1. The physical exercise score was 27.20±26.61 (maximum score=100), indicating a relatively low overall level of physical exercise among adolescents. The subjective emptiness score was 2.73±1.08, reflecting a moderately high tendency toward emptiness in this population. The short-video addiction score was 3.01±1.19, close to the theoretical median 3 points, thereby suggesting a moderate level of addiction risk. The self-control score was 2.74±0.61, significantly lower than the median of 3, thereby reflecting generally weak self-control abilities among adolescents.

Table 1: General descriptive statistics (N=153)

	Min Value	Max Value	M	SD
Physical exercise	0.00	100.00	27.20	26.61
Subjective emptiness	1.00	4.00	2.73	1.08
Short-video addiction	1.00	5.00	3.01	1.19
self-control	1.81	5.00	2.74	0.61

As shown in Table 2, no significant gender difference was observed in short-video addiction between the male and female participants. However, rural adolescents exhibited a significantly higher short-video addiction level than urban adolescents. Grade 8 students showed a higher addiction level than Grade 7 students. No significant difference was found between only children and non-only children.

Table 2: Test of differences in short-video addiction (N=324)

Variable	Group	M	SD	T
Gender	Male	2.967	1.289	-0.319
	Female	3.028	1.100	
urban or rural	Town	2.839	1.157	-3.241**
	Rural	3.545	1.139	
Grade	First grade of junior high school	2.722	1.160	-4.198**
	Second year of junior high school	3.521	1.070	
The only child	Y	3.042	1.237	0.240
	N	2.994	1.169	

Correlation Analysis

According to the correlation analysis results (Table 3), physical exercise was significantly negatively correlated with short-video addiction (r=−0.626, *P*<0.001). Self-control was significantly negatively correlated with short-video addiction (r=−0.584, *P*<0.001). Subjective emptiness was significantly positively correlated with short-video addiction (r=0.793, *P*<0.001). Moreover, self-control was significantly negatively correlated with subjective emptiness (r=−0.501, *P*<0.001).

Table 3: Correlation analysis of physical exercise, self-control, subjective emptiness, and short-video addiction in adolescents

Variable	Physical exercise	self-control	Subjective emptiness	Short-video addiction
Physical exercise	1			
self-control	0.449***	1		
Subjective emptiness	-0.698***	-0.501***	1	
Short-video addiction	-0.626***	-0.584***	0.793***	1

Note: *P<0.05, **P<0.01, ***P<0.001.

Mediation Analysis

The mediation and chain mediation effects of self-control and subjective emptiness were tested using PROCESS 3.4.6 macro in SPSS 26.0. As shown in Table 4, physical exercise had a significantly positive effect on self-control (β=0.449, *P*<0.001) and a significantly negative effect on subjective emptiness (β=−0.592, *P*<0.001). Self-control had a significantly negative effect on subjective emptiness (β=−0.235, *P*<0.001) and short-video addiction (β=−0.236, *P*<0.001). Subjective emptiness had a significantly positive effect on short-video addiction (β=0.608, *P*<0.001). Physical exercise had no significant direct effect on short-video addiction (β=−0.095, *P*>0.05) but indirectly affected short-video addiction through the meditation roles of self-control and subjective emptiness.

Table 4: Mediation effect analysis

Dependent variable	Independent variable	β	t	LLCI	ULCI
Self-control	Physical exercise	0.449	6.17***	0.306	0.593
Subjective emptiness	Physical exercise	-0.592	-9.468***	-0.715	-0.468
	self-control	-0.235	-3.763***	-0.359	-0.112
Short-video addiction	Physical exercise	-0.095	-1.457***	-0.225	0.034
	Self-control	-0.236	-4.343***	-0.342	-0.128
	Subjective emptiness	0.608	8.989***	0.475	0.742

Table 5 shows that the total effect of physical exercise on short-video addiction was −0.626 (95% CI [−0.751, −0.501]). Specifically, the mediation effect of self-control was −0.106 (95% CI [−0.175, −0.047]); the mediation effect of subjective emptiness was −0.360 (95% CI [−0.492, −0.260]); and the chain mediation effect of self-control and subjective emptiness (physical exercise→self-control→subjective emptiness→short-video addiction) was −0.064 (95% CI [−0.115, −0.025]). These results indicate that physical exercise affects short-video addiction not only directly but also indirectly through self-control, subjective emptiness, and their chain mediation pathway.

Table 5: Chain mediation effect analysis

Effect	Path	Effect Value	LLCI	ULCU
Total effect	Physical exercise - Short-video addiction	-0.626	-0.751	-0.501
Indirect effect 1	Mediation effect of self-control	-0.106	-0.175	-0.047
Indirect effect 2	Mediation effect of subjective emptiness	-0.360	-0.492	-0.260
Chain mediation effect	Self-control - Subjective emptiness	-0.064	-0.115	-0.025

Discussion

Analysis of the Current Status of Short-video Addiction, Physical Exercise, Subjective Emptiness and Self-control in Adolescents

In this study, the mean score of short-video addiction in adolescents was 3.01, at a moderately high level, reflecting a common behavioral risk that requires more attention. Moreover, rural adolescents exhibited a significantly higher addiction level than their urban peers, which is consistent with prior findings (22). The absence of parental supervision was considered a critical contributing factor; the proportion of left-behind children in rural areas reached 23.1%. These children, due to the lack of daily companionship and emotional support from parents, might fail to meet their emotional needs, thereby turning to seek emotional compensation through virtual means, such as short videos (23). Regarding grade differences, Grade 8 students showed a significantly higher addiction level than Grade 7 students. No significant differences were observed between genders and between only children and non-only children, suggesting that addiction is a universally prevalent risk across groups and necessitates systematic intervention.

In this study, the mean score of subjective emptiness in adolescents was 2.73, which is significantly higher than the median of 2.5, aligning with the findings of Fu et al. (11). Adolescents are prone to existential confusion due to delayed self-identity, leading to their insufficient perception of meanings, manifested as emotional emptiness and vague goals. This psychological state drives adolescents to engage in avoidant behaviors, such as short-video dependency. Chen et al. (24) revealed in their longitudinal study that 34.7% of Chinese adolescents experienced identity delay due to exam-oriented education that limits self-exploration time. These individuals who value goals are susceptible to meaninglessness. In addition, the mean score of physical exercise was 27.20, indicating a low overall level of participation in physical exercise among adolescents, potentially attributed to the "time deprivation" effect of academic burdens. High academic pressure in junior high school further reduces the time for adolescents to engage in physical exercise.

The mean score of self-control was 2.74, at a relatively low level, possibly linked to the underdevelopment of the PFC in adolescents, which weakens inhibitory functions (23). Moreover, adolescents exhibit hyperactivity in the limbic system, with the nucleus accumbens showing a 40% stronger response to instant rewards than adults, such that their impulsive decision-making style is exacerbated (25). This biological foundation con-

tributes to lower self-control abilities in adolescents.

Correlational Relationships between Short-video Addiction and Physical Exercise, Subjective Emptiness, and Self-control

In this study, short-video addiction was significantly negatively correlated with physical exercise, consistent with Ferdowsi et al. (26) research findings regarding media use by adolescents, which demonstrate that physical activity reduces digital dependency. The time displacement hypothesis posits that physical exercise reduces the time used for watching short videos, whereas exercise-induced dopamine release alleviates the need for immediate gratification (27). These findings further validate physical exercise as an intervention tool for short-video addiction, providing empirical support for constructing an adolescent-targeted digital health intervention framework.

A significantly positive correlation was observed in this study between subjective emptiness and short-video addiction, indicating that higher subjective emptiness leads to stronger short-video addiction tendencies. This finding aligns with the survey data obtained by Ding et al. (13). Individuals with subjective emptiness are more prone to short-video addiction, given that immediate gratification and fast-paced content available from short videos exactly meet their psychological needs. A significantly negative correlation was found between self-control and short-video addiction, indicating that stronger self-control leads to lower short-video addiction tendencies. Two possible reasons are as follows. First, self-control affects the balance between immediate gratification and achievement of long-term goals. Short videos, characterized by algorithmic recommendations and fragmented content, inherently reduce cognitive resources (28). Second, with sufficient self-control resources, individuals are more likely to resist immediate gratification from short videos and activate the cognitive control network of the PFC to inhibit impulsive behaviors. This capacity to resist immediate gratification and inhibit impulsive behaviors underscores the importance of enhancing self-control in adolescent-targeted education in preventing short-video addiction.

Mediation Effect Analysis

In this study, self-control partially mediated the relationship between physical exercise and short-video addiction, suggesting that physical exercise indirectly suppresses short-video addiction by enhancing self-control. Self-control is a limited psychological resource; adequate resources enable individuals to resist temptations during behavioral choices. Short videos, featured with diverse content and instant feedback, are highly addictive (2). Physical exercise requires willpower and planning, thereby strengthening self-control. After acquiring enhanced self-control resources, individuals are more likely to resist short-video temptations, reduce the use of short videos, and lower the risk of short-video addiction (29). Furthermore, physical exercise promotes the development of the PFC, a region in the brain closely linked to self-control. Furthermore, overcoming challenges and following exercise plans, which are necessary during physical exercise, contribute greatly to the cultivation of resilience and self-regulation skills. Improved self-control enables individuals to rationally manage their behaviors when tempted by short videos, empowering them to resist immediate gratification and reduce addiction likelihood.

The results of mediation effect analysis demonstrate that subjective emptiness partially mediated the relationship between physical exercise and short-video addiction, indicating that physical exercise indirectly reduces short-video addiction by alleviating subjective emptiness. Psychological discomfort arising from subjective emptiness drives individuals to seek instant entertainment and emotional satisfaction from short videos (11). Nevertheless, long-term reliance on this kind of relief, which is transient, leads to addiction. From the perspective of social support theory, individuals with subjective emptiness often fail to obtain sufficient real-life social support. Physical exercise, particularly team sports, provide a platform for individuals to engage in socialization, increase their interaction with others,

and expand their social networks. It allows individuals to acquire emotional support and relatedness, thereby alleviating subjective emptiness.

Analysis of the Chain Mediation Effect of Subjective Emptiness and Self-control

The results of chain mediation effect analysis reveal that subjective emptiness and self-control exerted a chain mediation effect on the relationship between physical exercise and short-video addiction. Specifically, physical exercise alleviates subjective emptiness, enhances self-control, and thus reduces short-video addiction risk. Subjective emptiness is a negative emotional state. Insufficient or depleted self-control resources trigger negative emotions and aggravate subjective emptiness. By contrast, physical exercise brings positive emotions, alleviates subjective emptiness, conserves psychological resources, and enhances self-control (30). Furthermore, physical exercise boosts the secretion of neurotransmitters (e.g., dopamine and endorphins), which not only optimize mood but also reinforce the executive functions of the brain, including self-control. Long-term adherence to physical exercise is conducive to cultivating positive attitudes toward life and strong psychological resilience, enabling individuals to work better in coping with stress and challenges in life and reducing self-control failures caused by emotional disorder.

In summary, the chain mediation effect of subjective emptiness and self-control uncovers the underlying mechanisms through which physical exercise affects short-video addiction in adolescents. Future formulation of interventions to solve short-video addiction should prioritize adolescents' emotional state and psychological resources. More effective intervention strategies can be constructed by leveraging physical exercise to enhance self-control and alleviate subjective emptiness.

The following limitations of this study should be noted. First, geographical constraints in the sample may limit the generalizability of the results. Future studies should expand the sample to verify the universal applicability of the conclusions. Second, the cross-sectional design may limit causal inferences. Longitudinal studies are recommended to probe deeper into the causal relationships among the variables.

Conclusion

Short-video addiction is prevalent among adolescents, and physical exercise reduces addiction risk, with subjective emptiness and self-control acting exerting a chain mediation effect. These findings provide empirical evidence for interpreting the multidimensional mechanisms of short-video addiction in adolescents and directions for the development of comprehensive intervention frameworks. Practically, physical exercise, self-control training, and psychological counseling must be incorporated into holistic strategies for preventing and intervening in short-video addiction. Strengthening physical exercise, cultivating adolescents' self-control, and addressing their subjective emptiness can effectively reduce addiction risk and ensure physical and mental health in adolescents during their development.

Journalism Ethical considerations

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