

Study on Physical Exercise Improving Self-Control Ability of Smokers

Jun Chen *

Department of Physical Education, Jingchu University of Technology
chenyshujj1137@yeah.net

Abstract

This study used structural equation model for the first time to explore the intermediary role of self-control in the prevention of College Students' bad smoking behavior by physical exercise, which provided a new idea for revealing the potential mechanism of physical exercise in the prevention of College Students' bad smoking behavior; Secondly, it discusses the time course characteristics of medium intensity aerobic exercise to improve self-control, so as to understand the time course characteristics of short-term aerobic exercise to prevent bad smoking behavior. At present, the methods of tobacco abstinence mainly include self behavior management, drug treatment, psychological intervention and combined psychological and drug intervention. Although the short-term intervention effect of these methods is obvious, the long-term intervention effect is not satisfactory. The operation of self-management and psychological intervention requires certain psychological skills, which is difficult for smokers to manipulate, and drug treatment will produce side effects and drug addiction. Therefore, it is necessary to seek a simple, economic and effective means without side effects to promote smoking at present.

Keywords: -physical exercise; self control; smoking behavior; aerobic exercise.

Tob Regul Sci.™ 2022; 8(1): 467-475

DOI: doi.org/10.18001/TRS.8.1.41

Introduction

As a self-control system, self-control plays an extremely important role in individual daily life. It refers to the ability to change their behavior response or inner state. It mainly includes three components: behavior goal, behavior monitoring and behavior operation. It usually suppresses one's own dominant reaction or behavior and replaces it with a behavior reaction that doesn't often occur but one wants. The ability of self-control is also of great value to the healthy development of individuals. The defect of self-control ability will produce a series of personal and social problems, such as addiction, crime, academic failure, gambling, smoking and so on.

Many empirical studies show that appropriate physical exercise can improve individual cognitive ability, including self-control ability. Both short-term exercise and long-term exercise can effectively improve self-control ability, and the effect of exercise on improving cognition is intensity dependent. For example, some studies have pointed out that moderate intensity physical exercise can effectively promote the self-control ability of sports participants, while high-intensity physical exercise can not improve individual self-control ability. MRI study found that physical exercise can inhibit the activation of prefrontal cortex and hippocampus induced by nicotine

abuse, suggesting that exercise may be involved in the repair process of cognitive control impairment caused by tobacco dependence.

According to the theory of drug addiction, individual drug intake will damage their learning and memory and cognitive control ability, and induce compulsive and uncontrollable drug intake or desire. A recent report published in *Nature* also clearly pointed out that the decline of cognitive control function of prefrontal cortex in tobacco addicts, especially the impairment of decision-making control function of prefrontal cortex to subcortical nuclei, such as ventral tegmental area, hippocampus and amygdala, etc., is one of the fundamental reasons for inducing tobacco dependence and relapse. Therefore, the decline of self-control function is an important reason for tobacco dependence and relapse. Improving self-control ability is likely to be one of the possible ways to reduce tobacco dependence and relapse.

Construction of self-control intermediary model for physical exercise to prevent smoking behavior of College Students

Research objective

Smoking is one of the main causes of lung cancer, coronary heart disease, stroke and other diseases. It is estimated that about 25.3% of global adults are smoking in 2020. Although the number of smokers in developed countries has decreased significantly in recent years, the number of deaths caused by smoking in the world remains at about 5.4 million every year. A survey report on tobacco use in China in 2021 shows that China's tobacco consumption ranks first in the world, with about 1 million deaths caused by smoking related diseases every year. If the government fails to take effective measures to curb the spread of this situation, the number of deaths caused by smoking in China will increase sharply every year, which is expected to reach as much as 3 million by the middle of this century. As an important national talent resource, college students' physical and mental health is particularly important. However, in recent years, research has found that the number of college students smoking has a growing trend year by year. They have become a special group of Chinese smokers, and their physical and mental health is worrying. Therefore, it is of great theoretical and practical value to clearly reveal the factors and action paths affecting college students' group smoking behavior, and provide targeted scientific methods and means to prevent smoking behavior for college students.

The study found that the influencing factors of College Students' smoking behavior mainly involve subjective and objective factors such as self-control ability, stress, anxiety, depression, peer and parental behavior. Among them, self-control, as a self executive control system, refers to the process in which individuals change their inherent or habitual behavior and thinking mode due to inhibiting or overcoming their own desires and needs, and use a behavior mode to replace the dominant behavior mode, which has attracted the attention of smoking addiction behavior researchers. The study found that the defect of self-control is one of the main psychological factors in the formation of smoking addiction behavior. Self-control can negatively predict smoking dependence. Improving self-control can effectively reduce smokers' smoking dependence and inhibit their smoking impulse.

To sum up, although existing studies have confirmed that sports and self-control can affect college students' smoking behavior, and physical exercise can improve college students' self-control, there is no structural equation model at home and abroad to explore the intermediary role of self-control in the relationship between physical exercise and college students' smoking

behavior (smoking dependence). Therefore, based on the existing research, this study puts forward the following assumptions: physical exercise can directly inhibit college students' smoking behavior, or indirectly inhibit college students' smoking behavior by improving the intermediary variable of self-control ability, in order to find out whether self-control is the intermediary variable of physical exercise inhibiting college students' smoking behavior, and provide a research basis for comprehensively revealing the potential mechanism of physical exercise Preventing College Students' smoking behavior.

Research method

Using the method of stratified random sampling, 500 first-year students of a university were selected to participate in this study. All students were non physical education majors. Each student needs to complete four questionnaires: physical exercise level scale, college students' self-control scale, Russell smoking reason questionnaire and simple Raven reasoning intelligence scale. All the above questionnaires were recovered. According to the elimination criteria of wrong or missing answers, the four questionnaires of each student were qualified, and the questionnaires of students who passed were regarded as valid questionnaires. Finally, 485 valid questionnaires were obtained, with an effective rate of 97%.

Measuring tools

The measurement of physical exercise level is as follows. Use the physical exercise Rating Scale (PARS-3) to measure the amount of physical activity of college students. According to the scores of each student's daily physical activity intensity, each activity time and weekly activity frequency, calculate the amount of physical activity and sports participation level of exercisers through the following calculation methods. The formula for calculating the amount of physical activity is described as the score of exercise intensity multiplied by the time of each activity, and the result multiplied by the score of weekly activity frequency. The score of each aspect is divided into 5 grades, and the score ranges from 1 to 5. The highest score of physical activity is 100 points and the lowest is 0 points. The evaluation of sports participation level is divided into three levels: those with low sports participation level have sports activity less than or equal to 19 points, those with medium sports participation level have sports activity more than or equal to 20 points and less than or equal to 42 points, and those with high sports participation have sports activity more than or equal to 43 points. The test-retest reliability of the scale is 0.84.

The measurement of College Students' self-control is as follows. The college students' self-control scale is adopted. The scale includes 19 items and five dimensions. The five dimensions are impulse control, work or study performance, health habits, controlling entertainment and resisting temptation. The internal consistency coefficient of this study is 0.81.

The investigation of smoking behavior of college students is as follows. Russell smoking reason questionnaire (RRSQ) was used to represent the smoking behavior of college students with smoking dependence score. The scale was compiled by Dr. Russell of the University of London in 1974. The original 34 items were modified to become the current 24 items. These 24 items belong to two dimensions: psychosocial dimension and pharmacological dimension, with a total of eight subscales. The dependence score is the sum of addiction, automatic and auxiliary subscales. It is applied to the smoking evaluation of individual smoking reasons in different populations and research fields in China. A domestic study took college students as the research object to test the

reliability and validity of the scale. The study found that the internal consistency reliability of the scale was 0.87, which had good structural validity.

Data collection and statistics

The test team is led by professional teachers and several students receive unified psychological test training. The formation of the team is strict, the personnel are stable, the professional structure is reasonable, the division of labor is carried out according to the test indicators, test instruments and testers, and the posts are relatively fixed; Select a person with serious and responsible work and strong professional ability as the test team leader to be fully responsible for the smooth development of the test work.

The social statistical analysis software package SPSS 23.0 was used for statistical analysis. Firstly, the amount of physical exercise, self-control and smoking behavior of college students were tested by independent sample t-test. Then, one-way ANOVA was used to investigate the influence of physical exercise participation level on College Students' self-control and smoking behavior; Finally, the mediation test method is used to test the hypothetical model proposed in this study. The statistical significance level was set as $\alpha = 0.02$.

Result

Characteristics of physical exercise, self-control and smoking behavior of College Students

The amount of physical exercise of college students is at the medium level, and most students have the habit of regular physical exercise. The smoking dependence of college students was significantly lower than that of social workers. In the effective questionnaire, only 22% of the subjects reached the possible dependence level. The results show that there are significant gender differences in college students' physical exercise and smoking behavior. The scores of male students' physical exercise and smoking behavior are significantly higher than those of female students, and there is no gender difference in self-control ability.

Effects of physical exercise on College Students' self-control and smoking behavior

In order to investigate the influence of physical exercise on College Students' self-control and smoking behavior, according to the amount of physical exercise, college students were divided into three groups (low exercise participation group ≤ 19 points; medium exercise participation group 20-50 points; high exercise participation group ≥ 51 points). The differences in self-control and smoking behavior of the three groups of college students were investigated, The results showed that there were significant differences in self-control and smoking behavior among college students in different physical exercise participation groups. The post comparison results showed that the self-control score of high exercise participation group was significantly higher than that of low exercise group and medium exercise group, and the smoking behavior score of high exercise group was also significantly lower than that of the other two groups.

The results show that there is a significant correlation between physical exercise, self-control and smoking behavior, which provides a basis for the intermediary effect test. There was a negative correlation between self-control and smoking behavior ($r = -0.395$), suggesting that the stronger the ability of self-control, the lower the score of smoking behavior; The weaker the self-control ability, the higher the smoking behavior score. There is also a negative correlation between the amount of physical exercise and smoking behavior ($r = -0.218$), indicating that the greater the amount of physical exercise, the lower the score of smoking behavior; The smaller the amount of physical exercise, the higher the score of smoking behavior. There is a positive

correlation between the amount of physical exercise and self-control ($r = 0.226$), indicating that regular participation in physical exercise can improve college students' self-control ability.

Based on the above results, physical exercise has an impact on College Students' self-control and smoking behavior. Students with a large amount of physical exercise have strong self-control ability, and the lower the score of smoking behavior.

An intermediary model test of the effect of physical exercise on College Students' smoking dependence behavior

It is assumed that self-control is an intermediary variable between physical exercise and smoking behavior. The mediating effect of self-control between physical exercise and smoking behavior was tested according to the test procedure of mediating variables. Standardized regression coefficient of regression analysis with smoking behavior as standard variable and physical exercise as predictive variable $\beta_1 = -0.238$ ($P < 0.01$), determination coefficient $R_{12} = 0.053$; The regression analysis with self-control as the standard variable and physical exercise as the predictive variable shows that the standardized regression coefficient $\beta_2 = 0.229$ ($P < 0.01$), determination coefficient $R_{22} = 0.048$; The regression analysis with smoking behavior as the standard variable and self-control and physical exercise as the predictive variables showed that the standardized regression coefficient of physical exercise on smoking behavior $\beta_3 = -0.162$ ($P < 0.01$), determination coefficient $R_{32} = 0.185$. The mediating effect analysis of self-control shows that the mediating effect of self-control is significant because the sequential test is significant.

The model analysis including intermediary variables shows that the amount of physical exercise has a direct effect on smoking behavior, that is, the greater the amount of physical exercise, the lower the score of smoking behavior; The amount of physical exercise has an indirect effect on smoking behavior through self-control, that is, college students with large amount of physical exercise have strong self-control ability, and the stronger the self-control ability, the lower the score of smoking behavior.

Discussion

Effects of physical exercise on College Students' self-control and smoking behavior

The results of this study show that most students have the habit of regular physical exercise. The amount of physical exercise of college students is at the medium level, but the amount of physical exercise of girls is significantly lower than that of boys. The phenomenon that the amount of physical exercise of college students is at the medium level is determined by the particularity of college students, because college students have enough time and conditions for physical exercise in school, and usually the school will encourage or even organize all kinds of physical activities. The phenomenon that girls exercise less than boys is also consistent with the previous research results: compared with boys, girls exercise for a short time, low intensity, low frequency and poor persistence.

The results of smoking behavior research show that the smoking behavior scores of the surveyed college students are at a low level, and the average value does not reach the level of smoking dependence. This may be related to the self-control of college students. According to the self-control theory, people with strong self-control rarely have health-related bad behaviors, such as smoking, excessive drinking and so on. The smoking behavior score of boys is significantly higher than that of women, which may be related to the influence of peers and social evaluation. This also confirms the previous research results on the smoking differences between male and

female college students: the smoking proportion of male college students is much higher than that of female college students.

The results of this study found that the correlation analysis and analysis of variance of the relationship between physical exercise and college students' smoking behavior basically verified the hypothesis that physical exercise could prevent college students' smoking behavior. This also confirms the previous research results: physical exercise can reduce smoking craving and adverse symptoms after withdrawal. In addition, the behavioral substitution mechanism and neurobiological mechanism of sports quitting smoking also provide strong theoretical support for the research results: the former believes that physical exercise can reduce or alleviate smokers' anxiety and depression, and control their weight gain after quitting smoking, which can be used as an alternative behavior of smoking. The latter believes that physical exercise can promote the secretion of endorphins in the brain, which can play an effect similar to nicotine and make people feel happy, and the physical exercise has the effect of quitting smoking. Therefore, the results suggest that physical exercise can be used as a simple and effective means to prevent and alleviate smoking behavior.

At the same time, this study also found that physical exercise can improve college students' self-control, which has been confirmed by relevant studies. Some studies have found that compared with the control group, physical exercise can effectively improve self-control, and this improvement of self-control can be observed under a variety of conditions, which means that this enhancement effect is common. There is also a widely accepted theoretical explanation for the effect of physical exercise on the enhancement of self-control ability: the self-control resource model points out that self-control depends on limited energy resources, which will be temporarily consumed due to continuous use. The process of physical exercise needs to consume self-control resources, especially in endurance running training. In long-distance running training and competition, with the increase of exercise load, the individual body will feel uncomfortable. In order to complete the established task, the individual needs to resist the idea of giving up impulse through self-control. If he can control himself and stick to it, he will improve his self-control ability, that is, adhering to the behavior that requires more self-control resources for a certain time can improve his self-control ability. This well explains the phenomenon that the greater the amount of physical exercise, the stronger the self-control, and also provides theoretical support for verifying the hypothesis of the intermediary role of self-control in reducing smoking dependence.

Mediating role of self-control in physical exercise to prevent smoking behavior of College Students

Based on the correlation coefficient between the amount of physical exercise and college students' self-control and smoking behavior, this study uses the structural equation model test program and several multiple regression analysis to verify the hypothetical model of the mediating role of self-control in the prevention of College Students' smoking behavior by physical exercise. The results showed that self-control played a mediating role in physical exercise to prevent smoking behavior of college students. In other words, physical exercise can not only directly prevent college students' smoking behavior, but also indirectly prevent college students' smoking behavior by improving their self-control ability.

The mediating role of self-control in the prevention of College Students' smoking behavior by physical exercise can be simply described as two links: first, the amount of physical exercise

improves college students' self-control ability; Second, the improvement of self-control ability can prevent smoking behavior of college students. The two links of this mediating effect are supported by corresponding empirical research, so it has a solid theoretical and empirical foundation. The first link can be explained by self-control resource model: the self-control resource model points out that self-control resources have two characteristics: commonality and limitation. Commonality refers to the universality of the energy resource, that is, it can provide energy for different self-control tasks; Limitation means that the total amount of self-control resources is limited and will be temporarily reduced due to continuous use. The process of physical exercise needs to consume self-control resources, especially in endurance running training. When the pole appears, people's physiological load increases, and it will be more difficult to stick to it. If you can control yourself, sticking to it will improve the ability of self-control, that is, sticking to the behavior that requires more self-control resources for a certain time can improve the ability of individual self-control. Compared with the control group, physical exercise can effectively improve self-control, and this enhancement effect of self-control can be transferred to other fields.

These findings help to explain the phenomenon that the greater the amount of physical exercise, the stronger the self-control. The second link, that is, the improvement of self-control can prevent smoking behavior, which has also been confirmed by empirical research: the study found that after two weeks of self-control practice, the subjects' self-control ability was improved, and their smoking cessation persistence was higher in the follow-up smoking cessation process, while the subjects in the control group had poor smoking cessation persistence in the follow-up smoking cessation experiment. After combing the above relevant studies, we can give an easy to understand explanation for this mediating effect: as a form of physical activity, the direct effect of physical exercise itself on College Students' smoking behavior may not be significant, but self-control, as an important will quality, is an important psychological variable affecting the formation of smoking behavior. Individuals with high trait self-control have stronger resistance to bad behaviors such as smoking and drinking. An important way to improve self-control is to increase physical exercise. Therefore, the hypothesis that physical exercise can prevent smoking behavior by improving college students' self-control has been verified.

Conclusion

The mediating role of physical exercise in college students' self-control of smoking; Secondly, through experimental research, this paper discusses the time course change characteristics of physical exercise on College Students' self-control ability from the perspective of behavior; Finally, using event-related potential technology, this paper explores the brain processing characteristics of physical exercise to improve college students' self-control ability. Finally, the following conclusions are drawn. The physical exercise can improve college students' self-control, so as to inhibit college students' bad smoking habits. The promoting effect of physical exercise on College Students' self-control ability can be maintained until 50 minutes after the end of exercise. The brain processing characteristic of physical exercise to improve college students' self-control ability is that college students participating in physical exercise can reasonably and effectively allocate brain cognitive processing resources. The above research conclusions suggest that physical exercise is one of the effective means to prevent and alleviate college students' bad

smoking behavior. Colleges and universities can develop and choose sports intervention programs from the perspective of improving self-control.

On the basis of revealing the self-control intermediary model of physical exercise to prevent college students' bad smoking behavior for the first time, this study further explores the time course characteristics and brain processing characteristics of physical exercise to improve college students' self-control ability, and confirms the research hypothesis that physical exercise can inhibit college students' bad smoking behavior by improving their self-control ability. However, this study still has the following deficiencies. Only the intervention study of short-term aerobic exercise was carried out, and the intervention study of long-term aerobic exercise was not carried out. It only reveals the role of aerobic exercise in promoting self-control ability from the intensity or amount of exercise, but fails to fully reveal the "dose effect" of aerobic exercise in improving self-control ability. Since the promoting effect of aerobic exercise on self-control and its time course benefits may be affected by factors such as exercise time, exercise type and subjects' fitness, future research should adopt different cognitive task paradigms on the basis of determining the influencing factors of exercise promoting self-control. From the aspects of multiple factors and interaction, this paper comprehensively and systematically reveals the "dose effect" relationship of aerobic exercise promoting self-control ability, so as to provide an empirical basis for physical exercise to prevent smoking behavior of college students.

References

- [1] Abrantes, A. M., Strong, D. R., Lloyd-Richardson, E. E., Niaura, R., Kahler, C. W., & Brown, R. A. "Regular exercise as a protective factor in relapse following smoking cessation treatment," *American Journal on Addictions*, vol. 18, pp. 100-101, 2019.
- [2] Adams, J. "Understanding exercise dependence," *Journal of Contemporary Psychotherapy*, vol.39, pp. 231-240, 2018 .
- [3] Adams, J., & Kirkby, R. J. "Excessive exercise as an addiction: A review," *Addiction Research & Theory*, vol.104, pp. 244-256, 2021.
- [4] Ahmad, K. Z. B. "Relationship between leader-subordinate personality congruence and performance and satisfaction in the UK," *Leadership & Organization Development Journal*, vol.29, pp. 396-411, 2018.
- [5] Arbour-Nicitopoulos, K. P., Faulkner, G. E., Hsin, A., & Selby, P. "A pilot study examining the acute effects of exercise on cigarette cravings and affect among individuals with serious mental illness," *Mental Health and Physical Activity*, vol.4, pp. 89-94, 2021.
- [6] Bailey, C. A., & Brooke-Wavell, K. "Exercise for optimising peak bone mass in women," *Proceedings of the Nutrition Society*, vol.67, pp. 9-18, 2018.
- [7] Baler, R. D., & Volkow, N. D. "Drug addiction: the neurobiology of disrupted self-control," *Trends in Molecular Medicine*, vol.12, pp. 559-566, 2016.
- [8] Banich, M. T. "Executive function the search for an integrated account," *Current Directions in Psychological Science*, vol.18, pp. 89-94, 2019.
- [9] Cahill, K., Stead, L. F., Lancaster, T., & Polonio, I. B. "Nicotine receptor partial agonists for smoking cessation," *Sao Paulo Medical Journal*, vol.130, pp. 346-347, 2020.
- [10] Carek, P. J., Laibstain, S. E., & Carek, S. M. "Exercise for the treatment of depression and anxiety," *The International Journal of Psychiatry in Medicine*, vol.41, pp. 15-28, 2021.
- [11] Carey, J. R., Bhatt, E., & Nagpal, A. "Neuroplasticity promoted by task complexity," *Exercise and Sport Sciences Reviews*, vol.33, pp. 24-31, 2015.

- [12] Daniel, J. Z., Cropley, M., & Fife-Schaw, C. "The effect of exercise in reducing desire to smoke and cigarette withdrawal symptoms is not caused by distraction," *Addiction*, vol.101, pp. 1187-1192, 2016.
- [13] Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., & Naglieri, J. A. "Exercise improves executive function and achievement and alters brain activation in overweight children: a randomized, controlled trial," *Health Psychology*, vol.30, pp. 91-97, 2017.
- [14] Eisenstein SA, Holmes PV "Chronic and voluntary exercise enhances learning of conditioned place preference to morphine in rats," *Pharmacology Biochemistry and Behavior* vol.86, pp. 607-615, 2021.
- [15] Elibero A, Janse Van Rensburg K, Drobjes DJ. "Acute effects of aerobic exercise and Hatha yoga on craving to smoke," *Nicotine Tob Res*, vol.13, pp. 1140-1148, 2021.
- [16] Ellemberg, D., & St-Louis-Deschênes, M. "The effect of acute physical exercise on cognitive function during development," *Psychology of Sport and Exercise*, vol.11, pp. 122-126, 2020.
- [17] Gomes da Silva, S., Doná, F., da Silva Fernandes, M. J., Scorza, F. A., Cavaleiro, E. A., & Arida, R. M. "Physical exercise during the adolescent period of life increases hippocampal parvalbumin expression," *Brain and Development*, vol.32, pp. 137-142, 2020.
- [18] Greenwood, B. N., & Fleshner, M. "Exercise, stress resistance, and central serotonergic systems," *Exercise and Sport Sciences Reviews*, vol.39, pp. 140-152, 2021.