A REVIEW OF PHYSICAL ACTIVITIES PROMOTING STUDENT'S ACADEMIC ACHIEVEMENTS AND ITS WORKING MECHANISMS

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Abstract

Beginning with learning, one of the most crucial tasks in a student's development during the formative years, the study compiled and succinctly analyzed studies on the benefits of physical activity for students' academic performance using psychological research methods in the categories of correlation research and experiment research, and they elaborated on the neurophysiological mechanism, cognitive mechanism, and social-psychological mechanism for physical activity to promote academic achievement. Physical activity can improve a student's mental and emotional well-being by encouraging the release of several neurotransmitters in the brain. These neurotransmitters increase arousal levels and the resources needed for cognition. They also help students develop a positive self-concept, which will benefit their academic performance and psychological well-being. The study elaborated on potential future study directions in this field in China based on existing studies. In conclusion, physical activities have a positive impact on students' academic achievements by improving cognitive function, reducing stress and anxiety levels, improving sleep quality and promoting overall well-being. Incorporating regular physical activity into daily routines can be an effective way to enhance academic performance.

Keywords: sports psychology, physical activity, academic achievement, students, cognitive mechanism.

INTRODUCTION

It is well known that exercise can strengthen muscles and enhance heart and lung function, but this is only the basic function of exercise. The key point is that exercise can improve people's brains, make them in the best condition, and prevent or alleviate a series of cognitive impairments, such as anxiety, fear, depression, attention deficit, addictive behavior, etc. [1]. A 2012 study found that student's physical and mental development is in a stage of rapid development, and exercise can promote changes in their brains, thereby improving learning, memory, and various abilities [2]. It can be seen that the role of exercise in promoting student's physical and mental development is more obvious. So, it is a very important and urgent research topic to determine what kind of exercise program to adopt to promote the healthy development of student's and adolescents' bodies and minds. The Third Plenary Session of the 18th Central Committee of the Communist Party of China pointed out that school education should "strengthen physical education and extracurricular exercises to promote the physical and mental health of young people and their physical fitness." As an important part of education, it is also related to students' mental growth, will training, personality cultivation, and the cultivation of awareness of rules, collaborative participation, fairness, etc., and affects the formation of a sound personality [3]. Learning is one of the most important developmental tasks in childhood. This article will comprehensively review student's academic achievement as the result of student's development, and explore the role of sports in promoting student's academic achievement, as well as the research progress of its internal physiological and psychological mechanisms, to provide psychological research evidence for the healthy development of physical education in our country.

1. Physical activity and students' academic achievement

When searching for research literature related to physical activity and child development, it was found that previous literature used different concepts, such as physical activity, physical education, exercise, physical training, and physical fitness. According to different classification standards, exercise can be divided into short-term exercise and long-term exercise, aerobic exercise and anaerobic exercise [4], and five kinds of exercise with different intensities from very small to maximum [5]. Therefore, in order to comprehensively sort out the research in this field, this article will include the research that contains the above-mentioned different concepts. As early as the ancient Greek period, some researchers believed that there was a certain connection between physical activity and intelligence, but it was not until 1990 that "Zero Hours PE,"

known as one of the most breakthrough physical education programs, surprised people to find that cardiorespiratory training is beneficial to student's reading comprehension and mathematics ability. In recent years, there have been many studies on the relationship between sports and student's academic achievement at home and abroad. The following will sort out the research results in this field according to the research paradigm.

1.1 Related studies

Correlative research is the premise of scientific theory. Many related studies have found that there is a positive correlation between sports and academic achievement, and large-sample studies also make the results more general. Dwyer et al. [6] surveyed nearly 8,000 Australian students (7–15 years old) on physical fitness, cardiorespiratory function, and general physical activity and found that there was a small positive correlation between these items and academic performance; Coe et al. [7] conducted a standardized field test (Fitnessgram) on 1,701 students in grades 3, 6, and 9 and found that student with high aerobic fitness in grades 6 and 9 performed better in mathematics and social science. High; and in order to better explore the long-term effects of sports on student's academic achievement, some researchers have developed a series of sports programs to track student for a long time. For example, Sallis [8] conducted a follow-up study on 759 students from kindergarten to grade 5 and found that students who participated in the SPARK (Sports-Play-Active Recreation of Kids) sports project for a long time had a lower percentile score than those who did not participate in sports. There are few students in the project; Pagani et al. [9] paid attention to the infant's motor development and tracked the subjects from 5 months to the 2nd grade of elementary school. They conducted parent questionnaires, student's motor development surveys, and teacher questionnaire surveys during infancy, and found that fine motor The development of two grades was a good predictor of student's reading, math ability, general academic performance, and classroom performance, but gross motor performance was not. For these student, more physical activity can reduce the formation of obesity and help to improve their fine motor development [10], which can promote students' cooperation, sharing, and compliance with rules, and students will use these qualities in classroom learning [11].

1.2 Experimental research

Recently, an increasing number of researchers have begun to use randomized, controlled experimental paradigms in order to better reveal the impact of physical activity on student's academic performance. Mairena et al. [12] randomly divided student in the third year of

21 kindergartens into an intervention group (1 299 people) and a control group (1 108 people), and adopted the Movi-Kids project for 2 years of intervention (including 3 times a week 60 minutes of physical activities, such as basic sports games, playground games, and dancing). It was found that the academic performance of student participating in the Movi-Kids project was significantly improved. Physical games on the playground can not only improve student's academic performance but also control obesity in student. Ericsson [13] divided 251 primary school students into two experimental groups (152 people) and a control group (99 people), added a physical education class to the student in the experimental group, and implemented two additional physical education classes every week for 3 years. After the intervention, it was found that the scores of students in the experimental group in mathematics, reading, and writing were significantly higher than those in the control group. The same advantage also existed in attention, but the enhancement of attention disappeared over time; Duncan and Johnson [14] divided primary school students into middle and high school students. a high exercise dose group and a rest group, the exercise group performed 20 minutes of bicycle ergometric exercise and found that no matter how intense the exercise, student's spelling ability can be improved, and moderate-intensity exercise can improve reading ability more significantly. Unfortunately, not all empirical studies have reached consistent conclusions, and some empirical studies have found that sports cannot improve student's academic performance. For example, Lambournea et al. [15] conducted an experimental analysis of the physical activity of 687 2nd and 3rd grade students, and found that physical activity and aerobic fitness were not significantly correlated with the students' Wechsler Achievement Test (WIAT-III) results. Jaakkola et al. [16] used the self-report method to test middle school students and obtained similar results. Therefore, it is found from the above research: (1) Different measurement tools for academic achievement led to different results. For example, most studies without results measured student's intelligence [15], while studies that found positive effects measured student's reading and mathematics abilities [13–14]. (2) Most of the studies on the positive impact of sports on student's academic performance focus on training student's physical fitness rather than general physical activities. For example, the survey results of the California Department of Education (CDE) in 2004 showed that 5, 7, and 9 The better the physical fitness standard test (aerobic exercise capacity, body composition, strength, and flexibility) scores of student in the three grades, the stronger the language and mathematics ability [17], and Hippel et al. [18] summarized previous research and found that students who are more physically fit have more strength and flexibility. (3)

The key to improving academic performance lies in how to increase the threshold of physical fitness so that student are in a "moving state" when exercising. In the SPARK project, Sallis [8] believes that unless student spend twice as much time in physical education class, putting them in a more active state can make them perform better in learning. (4) There are some intermediary or moderating variables in the influence of sports on student that can change the results. Pagani et al. [9] controlled child factors (such as age, gender, number of brothers and sisters, the number of times parents read to student, etc.) to get the positive effect of sports on student's academic achievement. Similarly, Mairena et al. [12] not only intervened in student's sports, but also intervened in parents, teachers, and the teaching environment, such as increasing the number of parents and teachers in the project. The degree of involvement in student and the improvement of student's lifestyles, etc. The study by Santiago et al. [19] further found that the impact of sports on student's academic achievement is moderated by gender. Girls spend more time participating in sports, and their math and reading performance will be better, but this advantage of sports does not exist for boys. It can be seen that the promotion effect of sports on academic achievement still needs further research to be verified.

2. The mechanism by which sports promote student's academic achievement

What are the potential mechanisms by which physical activity promotes student's academic achievement? Exercise physiologists and sports psychologists approach it from different disciplines. In previous studies in different fields, the mechanisms by which exercise promotes academic achievement include neurophysiological, cognitive, and psychosocial mechanisms. These three mechanisms are not mutually exclusive, for example, the social psychological mechanism contains the physiological mechanism [20].

2.1 Neurophysiological Mechanism

1) Changes in brain structure and function

The brain plasticity theory of exercise improving cognitive function points out that physical exercise can affect brain plasticity through multi-dimensional channels such as system level, cellular level, and molecular level, and the improvement of student's cognition can be said to be the result of plasticity development changes in related brain regions caused by exercise. Results [21]. For example, Chaddock et al. [22–23] did a series of studies, and the results showed that the dorsal striatum and hippocampus of the brain are susceptible to changes under the influence of exercise, thereby improving

cognitive control and memory and physical fitness. Tall student had a larger dorsal striatum, and the hippocampus was 12 percent larger in healthy student than in less fit student. Sports can not only change the structure of student's brains but also their function, which is manifested in the changes in activation levels and network connections between related brain regions. Davis [24] found that an exercise intervention program five times a week for 15 weeks could increase the activation level of the bilateral prefrontal cortex and reduce the activation level of the bilateral posterior parietal cortex in overweight student, thereby improving student's cognitive control ability. Chaddock et al. [25] used fMRI to study and found that student with high aerobic fitness had higher cognitive control ability and activated prefrontal and parietal brain areas when completing tasks. Chen Aiguo et al. [26] found that allowing student to perform a 30-min moderate-intensity aerobic exercise can increase the ReHo of student's bilateral posterior cingulate gyrus, bilateral posterior central parietal gyrus, and left dorsolateral prefrontal cortex; that is, exercise executive ability can be improved by increasing the local consistency of brain function in student's resting state and improving brain plasticity.

2) Neurotransmitters

The brain is composed of 100 billion different types of neurons, and these neurons transmit information by transmitting various chemical substances, of which about 80% of the signals are composed of glutamate (glutamate) and -aminobutyric acid. Transmitted by two neurotransmitters, GABA and NMDA, the former stimulates nerve impulses and leads the conduction of a series of signals, while the latter inhibits impulses [1]. And because of the active movement of neurons, the connections between them will be stronger and more attractive, making glutamate an indispensable factor in the learning process and allowing neurons to connect in sync. When people exercise, they can increase the levels of serotonin, norepinephrine, and dopamine in their bodies. These neurotransmitters play a very important role in the process of transmitting thoughts and emotions. In addition to the above-mentioned neurotransmitters, there is another type called brain-derived neurotrophic factor (BDNF), which is a protein synthesized in the brain and is mainly responsible for establishing and maintaining nerve cell circuits. "nutrient fertilizer", which exists in the hippocampus and is closely related to memory and learning [1]. BDNF is a vital biological link between thinking, emotion, and movement. It not only enables new cells to generate new branches faster and establish stronger connections, but also binds to receptors on synapses to release electron flow, increasing After a large voltage, the signal strength is rapidly expanded. According to the hypothesis of neurotrophic factor (BDNF), the

improvement of individual learning and cognitive ability comes from the changes of various parameters in the nervous system (such as the growth and density of capillaries, the connection of synapses, etc.). Animal studies have shown that aerobic exercise training can increase neurotrophic factors and other growth factors in the brain, and these factors can increase the supply of capillaries, new nerves, and synapses in the cerebral cortex, so that individuals are better at learning and performing tasks [27]. In other words, exercise not only motivates our body to gain momentum but also motivates the brain, and under the combined action of these neurotransmitters, exercise can make better preparation for learning and promote the differentiation of stem cells. It effectively demonstrates the connection between body and brain, improves memory and learning ability.

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2.3 Psychosocial Mechanism-Self-efficacy Theory

Bandura [40] believes that the central mechanism of behavioral reasons is self-efficacy, which affects the individual's emotions, thinking, and behavior processes, and thus puts forward a self-efficacy theory that can be applied to different fields. Studies in sports psychology have found that sports have a positive effect on individuals' self-concept and self-efficacy, and can provide opportunities for student who have had little success to rebuild a positive self-concept. For example, empirical studies have found that many forms of physical activity are closely related to self-efficacy, and there is the strongest and most stable relationship between physical activity and self-efficacy [41]. Lu Xiaochang et al. [42] conducted 12 weeks of moderate-intensity exercise training (basketball, rope exercises, roller skating) on 5,780 primary and middle school students and found that their physical and mental health improved significantly after training. They also have a higher sense of self-efficacy and better grades, because they are always confident that they can do what they should do. Petty et al. [43] conducted a group study on the daily exercise dose of 207 overweight student aged 7 to 11. Student in the exercise group could freely choose rope skipping, running, basketball, football, and other sports after school every day and exercise in special sports venues , keep the heart rate above 150 b/min during exercise (low dose group is 20 min of exercise and 20 min of quiet activities, such as painting, card games, etc., high dose group is 40 min of exercise), the whole project lasts for 13 weeks, and symptoms of depression are found The performance of the exercise decreased significantly linearly from the control group to the low exercise dose group and then to the high dose group, while the sense of self-worth worked as an intermediary variable, that is, through exercise, student can improve their sense of self-worth and reduce the performance of depression. A recent meta-analysis showed that physical activity has a positive effect on student's self-efficacy (d = 0.16), making student feel more satisfied with their body shape, receive more compliments from others, and perceive themselves as more valuable and attractive [44]. In research on the field of study, the level of self-efficacy can often predict the level of academic achievement of students

[45]. Therefore, sports can be used to enhance student's self-efficacy, so that they can perform better in academics.

3. Future research

National quality is an important manifestation of the country's comprehensive national strength and the foundation of the country's social and economic development. Sports, as an effective means to improve the quality of people's lives, need to be popularized urgently. At present, a large number of empirical studies at home and abroad have proved that moderate-intensity aerobic exercise, especially moderate-intensity aerobic exercise that requires cognitive participation, is beneficial to the development of student's cognitive function and the improvement of academic achievement [14]. The influence of sports on student's psychological development has reached some consistent conclusions, but there are still some key issues that need to be resolved in this field:

First of all, it is necessary to deeply examine the "dosage effect" of exercise on student's psychological development. Current studies on dose effects mainly include exercise items, exercise intensity, duration, and frequency, such as exploring the impact of different types of exercise on student's academic performance. Some exploratory evidence suggests that not all types of exercise improve student's cognitive development equally. Some recent studies have found that aerobic running can increase student's cognitive flexibility and creativity, and it can also significantly improve academic performance. Student who receives physical fitness training have faster improvement in working memory, while student who participate in yoga and sensory perception will be significantly improved, and student who undergo taekwondo training develop better inhibitory control [38]. Sports psychologists continue to explore the relationship between the type of exercise and student's cognitive development, but this field is still full of unknowns and challenges, especially the impact of traditional sports in our country on students' cognitive development and academic achievement. In addition, if exercise is used in combination with other educational intervention methods, it will be more effective in promoting the development of student's brains, and there is an effect of 1+1>2 [46]. Therefore, the focus of future research is to develop a sports program suitable for Chinese student in combination with the physical fitness of student of different ages in our country. Second, examine the moderating role played by population characteristics. As far as exercise itself is concerned, its impact on student's psychological development may be positive or negative, and its effect is mainly determined by the various components of

the exercise program and the individual differences of the student themselves. That is to say, if a certain sport is ineffective for student's physical and mental development, it is necessary to think about whether the sport itself is ineffective or whether the ineffectiveness is caused by the participants themselves. Ellis [47] found that student with low IQ can benefit the most from exercise intervention; a large number of sports studies have found that girls can improve their academic performance through exercise more significantly [17, 19]; and in terms of age, multiple aspects of executive function follow different development trajectories: infants can complete more complex working memory (such as updating and manipulating information) at about 15 months old, simple response inhibition occurs at about the end of one year old, and cognitive flexibility is the most complex component of executive function. Based on the first two, student can switch between different dimensions at about 2.5 years old [48]. Therefore, the impact of exercise on executive function will vary with age. At present, researchers have not systematically manipulated social, psychological, or biological factors. Future research needs to separate the influence of these potential psychosocial factors on the observed indicators, and perhaps form a model of the impact of exercise on cognition. Used to elucidate disagreements in the literature and identify possible mechanisms underlying the link between movement and cognition. Third, strengthen exercise interventions and treatments for student with cognitive or behavioral impairments. For example, exercise is arguably the best intervention for overweight student. Humans have become accustomed to regular physical exercise. The physical discomfort and learning difficulties of obese student are actually due to their lack of exercise rather than their own body weight. A large number of studies have shown that exercise can improve the executive function and academic achievement of overweight student [24]. Similarly, foreign studies have found that physical exercise can also improve hyperactivity symptoms in ADHD student [49], and reduce or prevent a series of cognitive or behavioral disorders in student, such as anxiety, fear, depression, and addictive behaviors [1]. Exercise has obvious advantages, such as low cost, ease of carrying out, and no side effects. Future research can consider how to use exercise intervention to improve or prevent student's cognitive or behavioral impairments.

CONCLUSION

Physical activities have been found to have a positive impact on students' academic achievements. Several studies have shown that regular physical activity can improve cognitive function, memory, attention, and academic performance.

One mechanism through which physical activity promotes academic achievement is by increasing blood flow and oxygenation to the brain. Exercise also stimulates the release of neurotransmitters such as dopamine and serotonin, which are associated with improved mood, motivation, and cognitive function.

Another mechanism is through the reduction of stress and anxiety. Physical activity has been found to reduce cortisol levels; a hormone associated with stress. Lower levels of cortisol can lead to improved cognitive function and better academic performance.

Additionally, physical activity can improve sleep quality, which is essential for optimal cognitive function. Studies have shown that regular exercise can increase the duration and quality of sleep, leading to improved academic performance.

Some examples of physical activities that promote academic achievement include aerobic exercises such as running or cycling, strength training exercises such as weightlifting or resistance bands, yoga or other forms of mindfulness practices, and team sports such as basketball or soccer.

In conclusion, physical activities have a positive impact on students' academic achievements by improving cognitive function, reducing stress and anxiety levels, improving sleep quality and promoting overall well-being. Incorporating regular physical activity into daily routines can be an effective way to enhance academic performance.

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