

Exploring the Correlation between Diverse Physical Activity Characteristics and High School Students' Academic Performance and Analyzing its Influence Mechanisms

Jiawei Luo^{1, *}, Ziteng Wang², Yun Li³

¹Institute of Sport Science, College of Physical Education, Southwest University, Chongqing, China

²Institute of Sport Science, College of Physical Education, Southwest University, Chongqing, China

³Institute of Sport Science, College of Physical Education, Southwest University, Chongqing, China

* Corresponding author: luojiawei559012@email.swu.edu.cn

Abstract: Over the past two decades, with the continuous innovation of educational concepts and the deepening of scientific research, the positive role of physical exercise in the all-round development of high school students has become increasingly prominent, gradually transforming from an "additional item" outside academic studies into one of the key factors promoting academic success. Traditional concepts often mistakenly hold that physical exercise may distract students, thereby exerting a negative impact on academic performance. However, recent extensive and in-depth research findings at home and abroad have subverted this traditional cognition, clearly revealing the positive and complex correlation between physical exercise and high school students' academic performance. Focusing on the characteristics of diverse physical activities, this paper aims to comprehensively analyze how physical exercise promotes the improvement of high school students' academic performance through multiple mechanisms such as enhancing physical health, strengthening psychological resilience, and improving social interaction abilities, by systematically reviewing and in-depth analyzing relevant research results. Furthermore, we will explore how different types of physical activities stimulate students' potential in their unique ways, optimize their learning status, and ultimately achieve a win-win situation between academic performance and physical and mental health. This research not only helps update the traditional concepts in the education sector but also provides a solid theoretical basis and practical guidance for formulating more scientific and reasonable physical education teaching policies and strategies.

Keywords: Physical Activity, Academic Performance, High School Students, Correlation Exploration, Influence Mechanisms.

1. Introduction

An analysis of the physical health status of Chinese adolescents shows that their overall physical fitness has shown a slight downward trend in recent years. Fundamentally, this is inseparable from the popularization of modern means of transportation and the lack of physical exercise among students[1], which is indeed worrying. Over the past ten years, management departments at all levels have actively responded to the national call and issued a total of 88 policy measures aimed at promoting the physical health of adolescents. This series of initiatives profoundly demonstrates the common vision and firm determination of the Party, the government, and all sectors of society to improve adolescents' physical fitness, cultivate healthy lifestyles, and shape strong physiques[2]. Currently, academic performance and physical exercise are often regarded as a pair of contradictions. Especially against the backdrop of fierce college entrance examination competition, students often indulge in cram schools to pursue high scores. Although parents generally recognize the benefits of physical exercise for physical and mental health, they often worry that it will occupy valuable study time, thus tending to give priority to cultural courses. However, extensive research, whether sociological surveys or natural science experiments, has clearly pointed out that physical exercise not only does not harm academic performance but also has a positive promoting effect on it. These research conclusions strongly refute the

notion that physical exercise and academic performance are oppositional, emphasizing the harmonious coexistence between the two[3]. To comprehensively promote the growth of adolescents, the state issued the "Opinions on Deepening the Integration of Sports and Education to Promote the Healthy Development of Adolescents"[4] (referred to as the "Opinions") in 2020. Its core is to advocate the harmonious progress of cultural education and physical exercise for adolescents, aiming to realize their all-round development through the integration of the two. In this context, we cannot help but ask: How exactly does physical exercise help improve academic performance? Although this issue has attracted widespread attention, the relevant evidence is still scattered. Therefore, this paper focuses on domestic and foreign research results over the past more than 20 years, reviews and evaluates how physical activity promotes high school students' academic performance, and strives to provide more solid evidence support for this positive correlation.

2. Relevant Research on the Impact of Different Physical Activity Characteristics on High School Students' Academic Performance

2.1. Types of Physical Activities and Their Impact on Academic Performance

Different types of physical exercise have shown diverse positive impacts on high school students' executive function

and academic performance, with each method promoting students' all-round development in its unique way. Specifically, aerobic exercises such as running and swimming significantly improve cardiopulmonary function and cerebral oxygen supply, effectively enhancing students' attention concentration, memory, and overall cognitive abilities, which in turn may directly improve learning efficiency and academic performance. This view is strongly supported by the research of Hillman et al[5]. In contrast, although there is limited empirical evidence that resistance training such as weightlifting and resistance band training directly improves academic performance, this type of training significantly enhances students' self-efficacy and psychological resilience. These positive psychological changes invisibly lay a solid foundation for the improvement of academic performance, which is supported by the research results of Dwyer et al[6]. Studies by Marsh and Kleitman have pointed out that team sports such as basketball and football are famous for their unique social interactivity. They not only significantly improve students' physical fitness but also profoundly cultivate team spirit, effective communication skills, and leadership. These abilities are transformed into more prominent cooperative learning abilities and classroom participation enthusiasm in the academic environment[7]. Individual sports such as tennis and track and field require students to have a high degree of self-discipline and concentration. These qualities tempered in sports can naturally be transformed into self-management abilities and learning motivation in the academic field. Linder's research shows that this transformation process has an undeniable role in improving academic performance[8]. In addition, studies by Caterino and Polak have shown that although the direct promoting effect of leisure-time physical activities such as walking and cycling on academic performance is relatively subtle, they indirectly create favorable conditions for the stability and improvement of academic performance by effectively relieving students' learning pressure and improving their overall sense of happiness and mental health[9]. In summary, different types of physical exercise act on the physical and mental health and academic development of high school students through their unique mechanisms, showing diverse positive effects, and emphasizing the indispensability of diverse physical activities in promoting the all-round development of high school students.

2.2. The Impact of Physical Activity Frequency and Intensity

As key elements of physical activity, frequency and intensity profoundly affect their dual role in academic performance. Specifically, moderate physical activity frequency (e.g., 3-5 times a week) and reasonable intensity (30-60 minutes each time), as shown in the research of Rasberry et al., can significantly improve the academic performance of high school adolescents, benefiting from the positive promoting effect of physical activity on physical and mental health[10]. Similarly, Zhang Long's research also put forward the same view. He found that 1 hour of moderate exercise per day has the most significant impact on students' academic performance[11]. In addition, the impact of extracurricular physical exercise on academic performance is not a simple linear relationship but an "optimal range". Within this range (e.g., 1.4-2.0 hours per day), physical exercise can significantly promote the improvement of academic performance. However, once exceeding this optimal value,

physical exercise may instead have a negative impact on academic performance, mainly because excessive physical exercise will occupy the time for cultural courses, leading to a reduction in students' investment in academic studies[12]. Dong Yanmei believes that when physical exercise exceeds the moderate range and turns into excessive participation (e.g., strenuous exercise for more than 2 hours per day), its negative impacts become apparent, mainly manifested as physical exhaustion and imbalanced time management, which in turn adversely affect academic performance[13]. Therefore, when formulating educational policies and designing physical education courses, it is necessary to seek a balance. We should not only encourage students to actively participate in physical activities to promote physical and mental health and academic improvement but also be alert to the potential problems caused by excessive participation. This requires us to provide a variety of physical activity options to meet the interests and needs of different students; reasonably arrange the time and intensity of physical activities to ensure that students have sufficient rest and study time; and strengthen the guidance on students' time management and stress regulation to help them better balance learning, sports, and rest.

3. Influence Mechanisms of Physical Exercise on High School Students' Academic Performance

As a popular health intervention method, physical exercise not only promotes physical health but also potentially improves the academic performance of high school students. Recent studies have focused on the internal mechanisms affecting academic performance, mainly analyzing from three aspects: physiology, psychology, and society, aiming to provide theoretical support for the formulation of education and health policies.

3.1. Physiological Mechanisms of Physical Exercise

Physical exercise exerts a profound impact on brain structure and function through a series of complex physiological mechanisms, thereby promoting the improvement of academic performance. Specifically, physical exercise can significantly enhance cerebral blood flow and oxygen supply. This physiological effect not only improves the activity of neurons and synaptic plasticity but also directly relates to the functional optimization of the prefrontal cortex of the brain, which is responsible for executive functions such as attention and planning ability and is crucial for academic performance. At the same time, exercise promotes the secretion of neurotransmitters such as dopamine, serotonin, and norepinephrine. These chemical substances play a key role in emotion regulation and cognitive function. In particular, the increase in dopamine levels has been proven to improve the academic performance of adolescents with attention deficit hyperactivity disorder (ADHD)[14]. In addition, Vaynman and Gomez-Pinilla pointed out that physical exercise also stimulates the secretion of brain-derived neurotrophic factor (BDNF). As an important factor for neuroprotection and promoting neural plasticity, the increase in BDNF levels is closely related to the enhancement of memory and learning ability[15]. It is worth noting that the hippocampus and prefrontal cortex in the brain work synergistically in the process of memory and learning. Exercise can increase the volume of the hippocampus and

reshape its structure, thereby further strengthening memory function and improving emotional state, laying a solid foundation for academic success[16][17]. In summary, physical exercise effectively improves the academic performance of high school students through multiple physiological mechanisms such as optimizing cerebral blood flow, regulating neurotransmitter balance, and promoting BDNF secretion.

3.2. Psychological Mechanisms of Physical Exercise

Physical exercise indirectly improves academic performance by enhancing mental health and cognitive function. Specifically, it can reduce the level of stress hormones such as cortisol in the body, effectively relieve stress and anxiety, and thus improve students' learning concentration and efficiency[18]. At the same time, the sense of accomplishment brought by physical exercise and the improvement of body image significantly enhance students' self-esteem and self-efficacy, making them more confident in facing academic challenges. This positive attitude is an important driving force for the improvement of academic performance[19][20]. In addition, physical exercise optimizes attention concentration and cognitive control ability. The enhancement of these psychological abilities is a key element of efficient learning. As revealed by the research of Donnelly et al., the superior performance of students participating in aerobic exercise in attention tasks is highly consistent with the improvement of their academic performance[21].

3.3. Social Mechanisms of Physical Exercise

Physical exercise indirectly promotes the improvement of academic performance by enhancing social interaction and cultivating behavioral habits. Specifically, in physical education, students learn social skills such as interpersonal communication, tolerance, and respect, as well as team cohesion skills, teamwork, and team adaptation[22]. In addition, students also learn to enhance self-confidence and self-esteem and strengthen the development of social cognition. Furthermore, Marsh pointed out that physical exercise itself requires good time management and self-discipline. The self-management ability tempered in sports can be transferred to learning tasks, enabling students to manage time more effectively and improve homework completion rates, thus forming a positive correlation with higher academic performance [23].

4. Conclusion and Prospects

4.1. Conclusion

In summary, different types of physical activities have diverse positive impacts on high school students' academic performance due to their unique characteristics. Aerobic exercise, resistance training, team sports, individual sports, and leisure-time physical activities have collectively promoted the improvement of high school students' academic performance through different physiological, psychological, and social mechanisms. In terms of physiological mechanisms, physical exercise optimizes cerebral blood flow, regulates neurotransmitter balance, and promotes the secretion of neurotrophic factors, thereby enhancing cognitive function and memory. Psychologically, physical exercise relieves learning pressure, improves self-esteem and self-efficacy, optimizes attention and cognitive control ability,

and provides students with a more positive learning attitude. Socially, it indirectly promotes students' classroom participation and academic performance by enhancing social skills, teamwork ability, and self-management ability. At the same time, moderate frequency and intensity of physical activities are crucial for exerting these positive impacts, while excessive participation may have negative effects. Therefore, educational policy makers and schools should fully recognize the importance of physical exercise, reasonably plan and design physical education courses, to promote the all-round development of high school students and achieve a win-win situation between academic performance and physical and mental health.

4.2. Prospects

Current research on how physical exercise can optimize high school students' academic performance has made some progress, but several issues remain unresolved. For example, inadequate control of variables or differences in control methods may lead to inconsistent conclusions. To address this challenge, future studies need to focus on refining experimental designs, ensuring precise regulation of core exercise elements such as duration, intensity, frequency, and type, and strictly excluding potential confounding factors. This will allow for accurate analysis of the independent effects of individual exercise variables. Such precision requires not only rigorous research methods but also technological innovation.

Given the diversity and individual needs of high school students, the adoption of cost-effective measurement tools such as wearable devices has become particularly important. These tools can provide personalized data that helps design exercise programs better suited to students' specific requirements.

To enrich the research framework and provide a scientific basis for educational practice, it is necessary to conduct detailed analyses of how different exercise programs differentially affect high school students' academic, physical, and mental health. Establishing a comprehensive evaluation system that includes academic performance, physical health indicators, and mental health status is crucial for ensuring a holistic and objective assessment of physical exercise interventions. Such a system will clearly demonstrate the multiple roles of physical activity in promoting students' overall development and provide strong data support and decision-making references for policymakers, school administrators, and educators.

To overcome the limitations of existing research—often characterized by small sample sizes or single-region studies, which restrict the representativeness and generalizability of results—large-scale, multicenter studies are urgently needed. In particular, longitudinal follow-up studies have unique advantages in revealing the long-term impact of physical exercise on academic achievement. Although such studies are difficult to implement, they remain indispensable. Future research should shift toward longitudinal tracking, monitoring high school students' exercise habits over an extended period and linking them to key academic outcomes such as college entrance examination scores. This approach will help build a robust causal chain, more accurately reveal the long-term effects of physical exercise on academic performance, and provide a solid foundation for the scientific formulation and adjustment of educational policies, ultimately supporting the cultivation of healthy, well-rounded

high school students in the new era.

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