

# The Impact of Physical Exercise on Adolescents' Emotional Regulation Abilities and Advances in Intervention Research

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**Abstract:** Physical exercise plays an essential role in the emotional regulation abilities of adolescents. This paper explores the influence and intervention of physical exercise on teenagers' emotional regulation ability by analyzing and summarizing the relevant literature at home and abroad. By distilling this information, the aim is to understand further the influence of physical exercise on emotional regulation abilities, providing theoretical support for more effective use of various physical exercise interventions to regulate adolescents' emotional capabilities. Additionally, suggestions for future research directions are proposed to promote a deeper understanding and exploration of this field.

**Keywords:** Physical exercise, Adolescents, Emotional regulation ability

## 1. Introduction

Emotion is the immediate response of an individual to external stimuli. In emotion generation, the individual's physiological activation, emotional experience, and expression behavior will change significantly (Gross, 2013). The mind-body changes induced based on external stimuli are critical for individual survival, a process that reflects how individuals respond to challenges and how they respond to critical information in a specific environment (Sang Biao and Deng Xinmei, 2015). Thus, the ability to regulate experience, physiological response, and behavioral performance, namely Emotional regulation ability.

As an essential part of the overall physical and mental development of teenagers, physical exercise not only plays a significant role in physical health but also plays a crucial role in the cultivation of emotional regulation ability. This paper aims to summarize the influence of physical exercise on adolescent emotional regulation ability based on domestic and foreign research status, further analyze the relevant intervention methods, and finally look forward to future research in this field.

## 2. Analysis of the Impact of Physical Exercise on Emotional Regulation in Adolescents.

### 2.1. The Impact of Physical Exercise on Different Types of Emotions.

The impact of physical exercise on emotions can vary depending on the type of emotion. Through extensive literature review, it has been found that emotions can be broadly categorized into two main types: positive and negative. General psychology considers emotions a form of attitude, manifested as an individual's response to external stimuli during cognitive and conscious processes. This includes emotional feelings, emotional behaviors, emotional arousal, and their complex components. Emotions reflect the relationship between self-needs and objective realities, representing an inner activity between personal needs and aspiration (Zhang Liwei and Ren Weiwei, 2000).

Frijda believes that positive emotions include four types: interest, expectation, surprise, and pleasure, among other positive feelings (Frijda, 1986). Lazarus considers positive emotions to include love, joy, pride, and hope (Fredrickson, 1998). In the scale developed by Fredrickson, negative emotions are categorized into ten types: shame, disgust, anger, embarrassment, hatred, sadness, contempt, stress, fear, and guilt (Barbara Fredrickson, 2010). Research conducted by Duan Yimei, Lu Guotian, and others

found that regular physical exercise positively impacts the emotions of college students, with moderate intensity exercise is better to improve college students' mood than high intensity or low intensity exercise (Duan Yimei and Lu Guotian et al.,2014).Additionally, a survey conducted by Li Haihan and others involving 1,865 college students at China Jiliang University showed that students who participate in physical exercise have significantly lower levels of five negative emotions—depression, anger, panic, fatigue, and tension—compared to those who do not exercise. The research concluded that college students who engage in physical exercise have lower average scores in these five negative emotions compared to those who do not, indicating that physical exercise has a specific positive effect on these negative emotions(Li Haihan and Wei Jingjie,2007).

Liu Feiyang and Guo Liya(2023), based on theories such as the emotional effects of exercise, concluded through research that negative emotions in college students can be reduced through physical exercise and by improving core self-evaluation. They also emphasized the need to closely monitor the changes in cognitive styles of college students when they engage in emotional regulation. Wang Shanshan(2017) surveyed 324 college students in Chengdu, and the study showed that students who participated in physical exercise scored significantly higher in positive emotions (such as admiration, humor, hope, gratitude, and motivation) compared to those who did not exercise. Further analysis of the impact of exercise duration on college students' positive emotions revealed that physical exercise can enhance positive emotions to a certain extent. With the continuous development and change of society, scholars at home and abroad for the influence of physical exercise and the classification of emotional vary, but have to say, from the above scholars research conclusion, physical exercise on the influence of positive emotions and negative emotions is different, but they have in common is the influence of mood is a positive trend.

## ***2.2. The impact of physical exercise on different emotional regulation abilities.***

Emotional regulation is the process by which individuals set a specific goal and continuously improve their emotional state to achieve that goal(Sang Biao and Deng Xinmei,2015). Research by Zhao Lirun(2018) indicates that college students exhibit different emotional regulation abilities in various sports exercise environments. Compared to independent exercise environments, college students' emotional regulation abilities do not show significant changes in cooperative situations. However, during moderate-intensity exercise and after more than 84 training days, the participants' emotional regulation abilities significantly improved. Leng Chan(2021) believes that the ability to regulate emotions includes five aspects:

- the ability to control negative energy signals
- the ability to restrain the emergence of negative emotions
- the ability to rationally manage emotions
- the ability to seek help from others
- the ability to face them with optimism

The study concludes that appropriate physical exercise effectively regulates students' emotions and significantly enhances their emotional regulation abilities, reducing the pressure faced during the college entrance examination.

Emotional regulation includes self-efficacy, which is the level of confidence an individual has in their ability to regulate their emotional state effectively(Liu Yingand Zhai Jing et al.,2016). Through meta-analysis, Liu Jie and Gao Shuqing(2016) found that physical exercise is beneficial for improving emotional regulation abilities. The intensity of exercise, the season, and different populations did not show significant moderating effects; however, physical exercise correspondingly improved the emotional regulation abilities of most individuals. Liu Jie and Gao Shuqing(2021) found through meta-analysis and research that physical exercise is conducive to improving the ability of emotional regulation. The intensity, quarter, and different groups of people have no noticeable regulation effect, but physical exercise, for most people, correspondingly improves their emotional regulation ability. Meta-analysis of RCT shows that physical exercise can improve emotional regulation ability, and the cycle, intensity, and effect of exercise have no regulatory effect on individuals. However, sports can improve most people's emotional regulation ability to some extent. According to the research of the above scholars, physical exercise has a significant improvement effect on emotional regulation ability. However, there needs to be a clear definition of the influence of different emotional regulation abilities, which is worthy of our in-depth exploration and research.

### ***2.3. The impact of different types of physical exercise on emotional regulation ability.***

Physical exercise can be categorized into low-, medium-, and high-intensity activities based on the intensity of the exercise. Different exercise intensities are supported by various energy systems in the body that provide energy for physical activity. Through research, Cao Chenyu(2023) found that exercise intensity affects a person's emotions during exercise, which is determined by the anaerobic threshold intensity value. Ma Mengjiao, Li Yajing, and others mentioned that the anaerobic threshold is a major influencing factor for exercise-induced emotional responses. When the exercise intensity is below an individual's anaerobic threshold, it brings positive emotions(Ma Mengjiao and Li Yajing et al.,2021). Conversely, when the exercise intensity approaches or exceeds this threshold, it leads to a sustained decline in positive emotions and a continuous emergence of negative emotions.

Secondly, aerobic exercise has different effects on emotional regulation. Giles suggested that aerobic exercise is considered to influence the ability of emotional regulation in a dose-dependent manner(GILES G E and EDDY M D et al.,2018). Additionally, Professor Zhou Chenglin(2021) explored the relationship between aerobic exercise and higher emotional regulation ability in his report "The Promoting Effects of Aerobic Exercise on Emotional Regulation and Academic Research Practice." He found that long-term aerobic exercise can lead to plastic changes in the brain, thereby improving emotional regulation methods, enhancing cognitive reappraisal abilities, and strengthening individuals' emotional control capabilities(Zhou Chenglin and Jin Xinhong,2021). Research by Edwards and others indicates that acute aerobic exercise can prevent adverse negative emotions and reduce harmful health risks(EDWARDS M K and RHODES R E et al.,2018). Petruzzello conducted a systematic analysis of various physical exercises from 1960 to 1989 and found that, compared to anaerobic exercise, aerobic exercise is more effective in alleviating anxiety and depressive emotions(Petruzzello S J and Landers D M et al.,1991). Wang Linqi found in her research that acute aerobic exercise has a positive effect on emotional regulation, especially concerning anxiety. Han Fulai(2023) also believes that short-term high-intensity exercise significantly impacts emotional regulation ability.

Through the above analysis, both anaerobic and aerobic exercises can affect emotions differently. However, it is essential to note that an anaerobic intensity threshold determines the impact of anaerobic exercise on emotions and emotional regulation. Once the intensity exceeds this threshold, it can counterproductively affect emotions and emotional regulation. The influence of aerobic exercise on emotional regulation occurs through short-term acute aerobic exercise. It is essential to strictly differentiate between acute aerobic and anaerobic exercise to avoid turning it into anaerobic exercise.

## **3. Exploration of the Intervention of Physical Exercise on Emotional Regulation Ability in Adolescents.**

### ***3.1. Intervention methods for emotional regulation through physical exercise.***

Physical exercise is a simple and effective way to promote adolescents' physical and mental health. Research shows that physical exercise significantly improves adolescents' emotional regulation abilities(Fang Liming and Guo Jing et al.,2019), and it is also a vital and effective means of emotional intervention for young people(Yuan Yuan and Shi Yuxuan et al.,2023). At present, emotional intervention based on physical exercise at home and abroad has gradually pointed to the emotional response and emotional regulation of teenagers and carried out extensive research, unlike the emotional regulation of teenagers. According to Telles' randomized controlled trial, physical exercise can significantly enhance adolescents' self-esteem. Although the yoga group did not show higher scores than the exercise group, there was still a certain degree of improvement, indicating that various intervention methods in sports impact emotional regulation abilities(TELLES S and SINGH N et al.,2013). Skurvydas and others, through CRT scoring, found a strong correlation between physical exercise and adolescents' emotional regulation abilities, with the intensity of this correlation being determined by the methods of intervention used(SKURVYDAS A and LISINSKIENE A et al.,2022). Domestic scholars have verified the critical role of different intervention methods on adolescents' various emotional regulation strategies using three types of exercise (sports, dance, basketball, and badminton)(Duan Yimei,2014).

With the continuous maturation of physiology and psychology, numerous domestic and international studies have shown that reasonable physical exercise methods can help the human body release neurotransmitters, such as promoting the secretion of dopamine, endorphins, and

catecholamines, thereby improving and regulating a person's mood (Dai Zhixin and Cheng Peng et al., 2023). This intervention method has also been confirmed in psychological research. In a review of literature related to psychology and sports from 2016 to 2022, Silva (2023) proposed that physical exercise is a beneficial and critical factor in regulating negative psychological emotions. Through various forms of exercise intervention for emotional regulation, the goal is to prevent and reduce the occurrence of negative psychological phenomena. In addition to the impact of different sports on the emotional regulation abilities of adolescents, some scholars in China have also focused on various training methods for different sports(). For example, in basketball training, Zhao Hao (2023) used methods such as imagery, simulation, and induction to intervene in adolescents' emotions during their daily training, helping to regulate their emotions towards a more positive state. In tennis training, Yu Lihua (2009) conducted psychological intervention training for adolescents through cognitive regulation and relaxation training, enabling them to manage their anxiety during training or competitions. Both of these types of projects have achieved the expected effects on the emotional regulation abilities of adolescents, not limited to a single intervention method but rather employing a combination of various regulatory strategies tailored to individual differences to meet the emotional regulation needs of different adolescents.

Currently, many unknown exercise methods can intervene in adolescents' emotional regulation abilities. In the future, more in-depth research can be conducted to adapt to the complexity of adolescents' emotional regulation abilities through different intervention methods, enabling them to possess a more comprehensive emotional regulation capacity when facing various situations.

### ***3.2. The intervention effect of physical exercise on emotional regulation ability.***

Currently, a large number of studies have explored how physical exercise can effectively intervene in the emotional regulation abilities of adolescents, particularly concerning negative emotions such as anxiety and depression. Existing research has provided data support for the effects of physical exercise on emotions (LONG Z and LIU G et al., 2021); however, there are certain limitations in the intervention process studies. For example, Sveaas (2018) and Schmit (2019) studied the effects of low-, medium-, and high-intensity exercise interventions on emotional regulation. However, the lack of phase analysis over time led to an inability to demonstrate the possibility that physical exercise has a more significant effect on emotional regulation as the intervention nears its end. If this premise is assumed to hold naturally, it remains to be seen whether the intervention effect of physical exercise on adolescents can reach the key part when different intensities or different intervention methods change.

From the development of research both domestically and internationally, exploring the intervention effects of physical exercise on adolescents' emotional regulation abilities is still limited to emotional management and psychological responses. With the continuous maturation of exercise methods, numerous studies have already suggested the critical role of emotional regulation as an intervention. Muller examined whether 584 adolescents could effectively interact and regulate various emotional abilities after physical exercise. The survey results showed a significant difference in the emotional regulation abilities of adolescents before and after exercise participation (BERNSTEIN E E and MCNALLY R J, 2018). Bernstein (2018) proposed that a 30-minute cycling and stretching exercise intervention could effectively enhance emotional recovery abilities affected by long-term stress. These experimental results demonstrate that physical exercise interventions can play an important role in adolescents' emotional regulation abilities, and even indirect exercise interventions can positively affect emotional regulation.

## **4. The prospect of physical exercise on emotional regulation.**

### ***4.1. Develop personalized methods of physical exercise.***

Based on scientific evidence, due to differences in individuality, training programs, and training adaptability among groups, it is only possible to meet the exercise guidance for some individuals. Adolescents are at a critical period of individual development, with different developmental speeds due to gender, and there are also significant differences within the same gender. Therefore, exercise methods should reflect personalized characteristics (Qiu Junqiang and Lu Mingyue et al., 2022). Personalized physical exercise refers to designing different sports projects according to adolescents' different interests and strengths, allowing them to participate based on their abilities and preferences. This can make adolescents more actively participate in physical exercise activities, improving their

physical fitness and sports quality. The perfection of sports facilities is one of the essential conditions for meeting adolescents' personalized physical exercise behavior. It is necessary to increase the investment in sports resources, supplement related sports resources, and meet the personalized learning needs of adolescents (Wang Guozhong,2022). Schools, while ensuring the basic exercise needs of teaching, can fully use venues and equipment, adapt to local conditions, and innovate equipment that meets exercise needs. Schools should promptly improve relevant policies and systems and conduct characteristic sports activities that align with students' learning conditions and physical and mental development characteristics (Yang Yongsheng and Sun Benchang et al.,2023). Various sports can be offered, including traditional ball games, track and field, and emerging sports such as rope jumping, roller skating, rock climbing, etc., to enrich the content of sports projects. Personalized services can also be provided, such as individual, group, and team training, aiming to meet the exercise needs of different adolescents. New digital technologies can be used to model and track the exercise behavior of adolescents, customize personalized exercise methods and sports methods for them, help adolescents independently set sports activity goals and plans, evaluate exercise effects, thereby improving their initiative and proactivity in participating in physical exercise, and promote the formation of an autonomous exercise behavior pattern in adolescents (Chen Zusong and Wang Liu et al.,2023).

#### ***4.2. Design innovative physical exercise intervention tools.***

The rapid development of national network technology provides individuals and organizations more channels for information acquisition and dissemination and broadens sports participation. With the promotion of multiple entities such as governments, enterprises, and media, an "online + offline" exercise model is implemented (Liu Qiang and Li Fengmei et al.,2023). Compared to the traditional single supply entity and offline methods, the digital lifestyle brings various personalized sports services to the public. It expands the social network of individuals participating in physical exercise(Pan Lei and Liu Chao et al.,2022). Physical exercise has a positive effect on the emotional regulation ability of most people, and long-term persistence is more evident in terms of exercise effects. However, even without ample time, a single 30-minute exercise session also positively impacts emotional regulation ability (Liu Jie and Zhang Wenjing et al.,2022). To ensure the scientific nature of adolescents' physical exercise, Chen Changzhou(2023) proposed an innovative form of family physical exercise guidance, emphasizing the linkage between home and school and working around the needs of family physical exercise to expand the "online + offline" guidance model. An "order-style" family physical exercise guidance system is formed by publishing family physical exercise guidance manuals and prescriptions. Internet-based lectures on family physical exercise and micro-videos of family physical exercise guidance are recorded to meet the needs of physical exercise. In an information society, modern teaching technologies such as virtual reality (VR) education and "Internet + education" can be combined to meet the diverse learning needs of adolescents and improve learning outcomes. Introducing technological means, such as virtual reality and motion monitoring equipment, allows adolescents to experience the fun and effectiveness of exercise more intuitively. Fitness apps are a great way to use network digital media to assist in physical education teaching. Students can exercise during their spare time, which allows flexible control of time and yields good exercise results. Schools and teachers can understand and grasp students' physical sports conditions through the software and have an in-depth and detailed understanding and control of students' physical health status(An Jinlong and Shan Baohai et al.,2023). Currently, ChatGPT's intelligent communication and precise information push provide new opportunities for national fitness, offering personalized guidance and support for people participating in physical exercise. ChatGPT can provide personalized fitness in terms of exercise content, intensity, and frequency based on personal exercise levels, health conditions, age, and goals, thereby effectively guiding exercisers in scientific exercise (Yang Guoqing and Hu Haixu et al.,2023).

#### ***4.3. Integrating the multidisciplinary research mechanisms of emotion regulation.***

Physical exercise as a form of reactive regulation cannot control the generation of negative emotions; therefore, physical exercise is only one way to regulate emotions and needs to work in conjunction with other emotional regulation methods (Kong Weimin,2001). Chinese has a rich humanistic connotation to the subject; in the education stage, the effective use of classroom teaching strategies and skills is crucial to improve students' emotional regulation ability; in the teaching process, from four aspects to discuss how to cultivate students' emotional regulation ability: create a positive classroom learning atmosphere, strengthen the experiential teaching, perceive the charm of the language and strengthen the emotional education (Li Keren,2016). Similarly, emotional regulation is also needed in mathematics; a positive mood can stimulate students' strong interest in mathematical

research and their passionate pursuit of mathematical truths. As mathematics teachers, they can sincerely praise students for inspiring their motivation to learn; in classroom questioning, they can design questions to ignite students' enthusiasm for learning; when handling students' homework, it is crucial to focus on the learning process to maintain students' interest in learning, thereby improving students' mathematics achievement levels(Wu Yongping,2014). In the multimedia era's English classrooms, teachers can enhance the effectiveness of emotional appeal by establishing a good image, thereby increasing the credibility and attractiveness of the information source. They also need to regularly guide students to resolve negative emotions, promoting an emotional connection between students and teaching materials to enhance their interest in learning materials. Moreover, they can cultivate students' emotional experiences at the subconscious level, improving their intuitive abilities for language learning, and by creating a positive and harmonious social and emotional atmosphere, reduce students' state anxiety during classroom participation (Wang Jifeng,2020). Therefore, the development of emotional regulation requires the integration of multiple disciplines and levels, which helps to improve adolescents' overall emotional regulation abilities.

## 5. Conclusion

According to existing studies, the effect of physical activity on mood shows a positive trend, both for positive and negative mood regulation. However, there are differences in the specific effects of different types of physical activity on mood, which need to be further clearly defined. In particular, the effects of aerobic and anaerobic exercise on mood are each characterized by their own characteristics, and therefore a strict distinction between acute aerobic and anaerobic exercise should be made in practice to ensure that the form of exercise does not shift to the other, thus maintaining its positive effect on mood regulation. In research on adolescents' emotion regulation skills, physical activity has been shown to be an effective intervention that can contribute to the development of adolescents' psychological well-being in a variety of ways. Current research has revealed the effects of multiple forms of exercise, including but not limited to traditional sports, on adolescents' emotion regulation abilities, but most of the current explorations have focused on the dimensions of emotion management and psychological responses, and have not yet comprehensively covered all aspects of adolescents' emotion regulation abilities. Physical activity is a key tool for promoting emotion regulation in adolescents, and its potential is far from being fully recognized. In order to maximize its positive effects, future research could focus on three areas: first, the development of personalized physical activity programmes; second, the design of innovative intervention tools; and third, the establishment of multidisciplinary cooperation mechanisms. Through these efforts, it is hoped that more substantial progress will be made in this area to better support the mental health development of adolescents.

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