

# Study on the influence mechanism of sports on adolescent depression under the background of physical-medical integration

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**Abstract:** The "Healthy China 2030" plan outlines that strengthening the integration of physical and medical medicine and strengthening the adolescent mental health service system aims to promote the physical and mental health development of Chinese adolescents. In this paper, the causes of adolescent depression are sorted out from the aspects of physiological, psychological and social environment, and then the intervention mechanism of sports to improve adolescent depression is deeply explored. Studies have shown that physical activity improves the level of depressive symptoms by regulating factors such as central monoamine neurotransmitters, central inflammatory response, HPA axis activity, expression of hippocampal nerve and neurotrophic factors, and self-efficacy. Suggestions: Focusing on the different effects of aerobic exercise on depressive symptoms, innovative development of school sports should be carried out to promote the improvement of depressive symptoms in adolescents; Combined with sports can regulate emotional self-efficacy, scientifically and reasonably set up physical activity content, enhance students' self-efficacy, and reduce adolescents' depressive symptoms; Combined with sports can effectively improve the cognitive function of patients with depression, and choosing the appropriate physical activity can improve the improvement of cognitive function, thereby improving depressive symptoms.

**Keywords:** Physical and medical integration; Sports; Juvenile; Depression

## 1. Introduction

In October 2016, the "Healthy China 2030 Plan Outline" pointed out that it is necessary to strengthen the discovery and intervention of adolescents' psychological problems and strengthen the integration of physical medicine and non-medical means of intervention. Xiang Yuhong et al. proposed that the "integration of sports and medicine" refers to the use of sports to improve physical health, adding sports elements to the concept of "medical treatment". Zhu Haiqiang et al. proposed to integrate sports and medicine interdisciplinarily and enhance the functions of sports in promoting health, prevention, treatment and rehabilitation of chronic diseases. Ma Shengqi et al. investigated the depression status of 806 adolescents aged 12-18 in Shandong Province and found that 102 of them may have depression, with a detection rate of 12.7%. Two hundred ninety people must have depressive symptoms, and the detection rate was 36.0%<sup>[1]</sup>. It can be seen that mental health problems such as adolescent depression in China need to be solved urgently. Sports As a carrier of mental health education, it can effectively improve mental health while promoting physical health<sup>[2]</sup>. At present, the policy of integration of sports and medicine is in gradual practice, and the implementation of integration of sports and medicine is facing difficulties and obstacles to integration. This study combs the theoretical basis of sports on mental health, such as depression, from the aspects of the physiological mechanism, psychology and social environment. Through the effective combination of sports science and medical means, the growth process of adolescents is effectively intervened to promote the comprehensive development of the physical and mental health of adolescents in China.

## **2. Causes of adolescent depression**

### **2.1. Physiological factors**

#### **2.1.1. Genetic factors**

A large number of studies have found that the heritability of depression among relatives is 10 to 30 times that of ordinary people. Bartels et al. studied the effects of gender and age on the level of emotional and behavioural problems and genetic factors in 6381 pairs of twins and 1195 siblings aged 12 to 20 years in the Netherlands by genetic structural equation modelling. The results showed that the heritability of anxiety/depression and withdrawal/depression increased throughout puberty. In patients with depression, kinship is proportional to the risk of illness. Eley and Stevenson analyzed the difference between depression and anxiety from a genetic perspective in 395 twins aged 8 to 16 years. They found that the heritability of depression increased significantly from childhood to adolescence in boys and decreased significantly in girls<sup>[3]</sup>. Li et al. conducted a mating analysis of the COMT Val158Met gene in East Asians and found the genotypes AG and AA for depression<sup>[4]</sup>. In summary, adolescence is the development period and critical period of the genetic effect of depression. Many adolescents are affected by family heredity, and the acquired growth environment stimulation eventually leads to the occurrence of depression.

### **2.2. Psychological factors**

#### **2.2.1. Personality factors**

Personality has a profound impact on depression. The most widely used personality theory is the five-factor model summarized by researchers in the 1980s: neuroticism, extraversion, conscientiousness, agreeableness and openness to experience, based on the five-factor model. From a higher level, it can be simplified into a three-factor model: negative emotionality, positive emotionality, and disinhibition. Many studies have shown that the greater impact on depression is neuroticism / positive emotions / chronic stress. Brown et al. found that the effect of neuroticism on depression increased with the increase of chronic stress, indicating that chronic stress played a mediating role between neuroticism and depression<sup>[5]</sup>. Therefore, personality factors in the onset of depression, symptoms and the recovery process have an important impact. Adolescence is a critical period to shape a sound personality through the law and characteristics of adolescent personality development to guide young people to develop a sound personality, thereby preventing depression and hair

#### **2.2.2. Cognitive factors**

Leucht et al. observed the changes in automatic thinking in 67 patients with depression from admission and found that automatic thinking was positively correlated with the level of depression, which had an important impact on the occurrence and development of depression<sup>[6]</sup>. Chen Shulin et al. investigated 263 college students, verified the social cognitive theory factors in the depression model, and established a causal relationship model between negative self-concept and depression<sup>[7]</sup>. Therefore, cognitive factors play a key role in the occurrence of depression. Love song teenagers are at a critical stage of life development. With the continuous enhancement of self-consciousness, they cannot have a correct understanding of their subjective state and are easy to lose self-consciousness and causing depression.

### **2.3. Environmental factors**

#### **2.3.1. Family factors**

Family is a necessary environment for people's life. Parents' poor education attitude, education mode, parent-child relationship and parent-child relationship will lead to adolescent depression. Zou Shaohong et al. investigated 72 patients with depression and found that domestic violence was positively correlated with depression scores<sup>[8]</sup>. Wang Qian et al. showed that parents' educational background and family per capita income had an impact on the detection rate of depression<sup>[9]</sup>. Meanwhile, studies have shown that children's depression scores are negatively correlated with their parents' marital status ( $r = 0.51, 0.42, 0.42, 0.30, 0.51, 0.29, 0.36, 0.32, 0.39, -0.31, P < 0.01$ )<sup>[10]</sup>. In summary, parental education, education methods, and parental relationships are closely related to the occurrence of depression in adolescent growth.

### 2.3.2. *Interpersonal relationships*

Interpersonal communication makes people use language to exchange ideas, opinions, and emotional expression process, interpersonal psychology family, depression 80 % is derived from poor interpersonal communication. Liu Junxi et al. investigated the students of Hebei North Agricultural College and found that 43.9 % of the students had interpersonal and serious difficulties<sup>[11]</sup>. Chen Guixia et al. conducted a survey of 450 college students and found that 18.55 students had interpersonal problems, and 3% had communication problems<sup>[12]</sup>. Gan Lu et al. found that 26.1 % of the students had interpersonal problems, of which 6.19 % had major problems. On the whole, the interpersonal skills of young students are poor<sup>[13]</sup>. Interpersonal barriers often lead to depressive symptoms, and good interpersonal relationships can help eliminate loneliness, enhance self-confidence and a sense of security, and prevent depression to a certain extent.

## 3. Intervention mechanism of exercise on depression

### 3.1. *Sports intervention physiological factors*

Sports play an active role in the intervention of depression, and the effect is more significant than psychological intervention and drug treatment. By consulting various literature on the pathogenesis of depression and synthesizing the research on exercise intervention in depression, it is concluded that the physiological mechanism of exercise antidepressants is related to cytokines, monoamine neurotransmitters, inflammatory factors, central nervous system and other factors in the body. Xue Xiangli et al. showed that exercise had a regulatory effect on adipocytokines (adiponectin, leptin, epicene peptide, nesfatin, irisin, resistin, etc.) and achieved antidepressant effects by regulating the expression and secretion of adipocytokines, increasing the expression level of central monoamine neurotransmitters, HPA axis activity, central inflammatory response, hippocampal neurogenesis and neurotrophic factor expression, and neurotoxic substance metabolism<sup>[14]</sup>.

Wei Hongwen et al. showed that the expression of PERK and VGF was enhanced by exercise, resulting in the structure and function of the hippocampus of rats not being destroyed<sup>[15]</sup>. Li Xue et al. (2008) showed that moderate-intensity exercise could increase the content of monoamine neurotransmitters and promote the recovery of depression<sup>[16]</sup>. Lee et al. have shown that regular moderate or high-intensity strenuous exercise can prevent chronic stress-induced depressive behaviour. Zhu Beijing et al.<sup>[17]</sup>. Found that the levels of IL-1 $\beta$ , IL-6 and TNF- $\alpha$  in serum were significantly decreased after transcranial magnetic stimulation (rTMS) and exercise therapy ( $P < 0.05$ ). It is concluded that transcranial magnetic combined with exercise can improve the cognitive function of patients with depression by inhibiting the verification response<sup>[18]</sup>. Wang et al. performed ovariectomy on mice to induce depressive behaviour. Through exercise intervention, it was found that exercise could reduce the levels of IL-1 $\beta$  and IL-18 in the hippocampus of mice, thereby inhibiting the hippocampal NLRP3 inflammation pathway and effectively improving the depressive behaviour of mice<sup>[19]</sup>. Roh et al. found that running exercise can inhibit the expression of caspase-3 and Bax in the hippocampus of rats, effectively promote the increase of 5-hydroxytryptamine and tryptophan hydroxylase (TPH) in rats, inhibit hippocampal cell apoptosis, and improve depressive symptoms in the study of running exercise on depression caused by cerebral haemorrhage in rats<sup>[20]</sup>. Qu Honglin et al. found that aerobic exercise reduced the apoptosis rate of hippocampal cells by increasing the expression levels of BDNF and Bcl-2 in the hippocampus of mice<sup>[21]</sup>. In summary, moderate or high-intensity exercise can improve the expression of BDNF, the central nervous system, monoamine neurotransmitter release and other factors in the hippocampus of the brain, which can effectively improve the symptoms of patients with depression.

### 3.2. *Intervention of psychological factors*

By consulting a large number of literature, it is shown that previous studies have focused on the relationship between physical exercise, emotion regulation, self-efficacy and mental health. Han Li et al. found that the Hamilton Depression Scale (HAMD) and Social Function Screening Scale (SDSS) scores were significantly reduced ( $t = 9.62, 10.05, P < 0.05$ )<sup>[22]</sup>. After health education and moderate intensity exercise combined intervention for 84 adolescent depression patients in Wuhan Mental Health Center. Jiang Yuan et al. conducted physical exercise intervention on 814 college students and middle school students. The results showed that physical exercise could affect self-efficacy, which in turn significantly affects the level of anxiety and depression<sup>[23]</sup>. Liu Yang et al. tested the anxiety and depression scale of 265 people in the physical fitness group, 266 people in the mindfulness tai chi group and 258 people in

the control group and conducted five weeks of exercise intervention<sup>[24]</sup>. The results of variance analysis showed that self-efficacy played an indirect mediating role in the process of an exercise intervention to improve depression. Therefore, different ways of sports can significantly improve adolescent depression.

### **3.3. Intervention cognitive function factors**

As an important means of rehabilitation for mental illness, exercise has received extensive attention. Conventional aerobic exercise and anaerobic exercise can significantly improve the treatment of depression. The most common and direct manifestation of patients with depression is a cognitive dysfunction, which leads to social disorders in patients with depression.

Studies have shown that sports can improve the cognitive function of patients with depression. Han et al. found that after 24 weeks of Baduanjin exercise intervention in patients with traumatic brain injury, Baduanjin exercise can significantly improve their cognitive function, thereby improving emotional disorders in patients with depression<sup>[25]</sup>. In the study of the effect of Baduanjin on the cognitive function of the elderly with mild cognitive impairment, Zheng et al. showed that Baduanjin exercise could reduce the decline of memory and secondly has a positive effect on reducing the risk factors of cognitive impairment, such as blood pressure and inflammatory factors, and is more effective than conventional aerobic exercise<sup>[26]</sup>. Zhang et al. conducted eight weeks of an aerobic exercise intervention on 125 patients with cognitive impairment of depression. The results showed that the scores of the post-exercise tracking test (TMT), continuous performance test (CPT), digital span test, visual reproduction test and verbal fluency test (VFT) were significantly higher than those of the control group ( $P < 0.01$ ). It is concluded that aerobic exercise can improve cognitive function and symptoms in patients with depression<sup>[27]</sup>. Nastasia et al. conducted a 12-week exercise intervention in 34 Australian patients with major depressive disorder (MDD) and found that the negative self-cognition of MDD patients was significantly improved and correlated with the improvement of depressive symptoms<sup>[28]</sup>.

## **4. Sports and adolescent depression treatment integration strategy**

The study found that sports in improving the treatment of depression, whether from physiological intervention, emotional intervention or cognitive function intervention, are significantly related. Under the background of deepening the integration of social sports through the combination of sports activity innovation and depression treatment program reform, early detection and timely intervention of adolescent mental health problems promote the development of adolescent mental health in China and improve the implementation effectiveness of the integration policy of sports and medicine.

### **4.1. Innovative development of school sports around the different effects of aerobic exercise on depressive symptoms**

Exercise can significantly improve the related physiological function factors such as BDNF, 5-hydroxytryptamine and monoamine neurotransmitters in the hippocampus of patients with depression, and exercise can improve the cognitive function of patients with depression and regulate the self-efficacy in emotions and reduce the occurrence of depressive symptoms. Thus, we should take the reform of integration of sports and medicine as an opportunity and the reform of integration of sports and education as a carrier to integrate the treatment of sports combined with depression into the design of school sports work and sports activities to promote the development of adolescent mental health.

(1) School physical education in the teaching process should avoid boring, boring and irregular sports, at the same time, should control the exercise load of each course to maintain moderate intensity and above, the course content, link setting as easy as possible, pleasant, avoid easy to lead to tension fatigue and negative emotions of the movement, the integration of school physical education teaching resources, carry out rich content, various forms of sports activities. Strengthen the education of extracurricular activities, advocate to participate in 0.5 ~ 1 hour of moderate-intensity exercise every day (heart rate of 130 ~ 150 times/min), and participate in aerobic activities at least three times a week through aerobic exercise to reduce the risk of adolescent depression and improve the emotional and cognitive function of patients with depression, reduce the level of depressive symptoms.

(2) With the integration of physical education as the carrier, mental health education courses should be added to the school physical education curriculum. In addition to the construction of psychological counselling centres, physical health education should also be strengthened, which is irreplaceable by psychological counselling and other disciplines. Exercise intervention and mental health education at the

same time improve cognitive dysfunction in patients with depression, effectively reduce the level of depressive symptoms, and prevent new depression in patients.

#### **4.2. Reasonable setting of physical activity content enhance students ' self-efficacy, and reduce adolescent depression symptoms**

(1) In the process of designing classroom activities, physical education teachers should correctly guide attribution for different teaching objects, enhance students ' self-esteem and self-confidence, and set appropriate goals to enable students to understand their progress so as to enhance students ' self-efficacy and reduce the level of depressive symptoms.

(2) Teachers in the teaching process to treat students with a fair, equitable and developmental vision, timely to give students positive encouragement hints for different students to give different goals, and individualized, respect for students' personalities. So as to enhance students ' self-confidence and learning enthusiasm and enhance self-efficacy.

(3) Sports can improve the social disorder of patients with depression by improving the cognitive function of patients with depression. Physical exercise can not only improve memory function but also improve human response-ability and eye-hand coordination through basketball, football, table tennis and other sports. Therefore, choosing appropriate physical activity can improve the cognitive function of patients with depression.

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