

# Interventional Effects Comparison of Intermittent Exercise Programs of Different Intensity on College Students' Physical Health

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## ABSTRACT

The physical health problems of contemporary college students need to be solved urgently, and the traditional physical education curriculum is difficult to meet the individual needs. In this paper, by comparing the high-intensity ( $\geq 80\%$  HRmax) and medium-intensity (60% -75% HRmax) intermittent exercise programs, we explored the differences of their intervention effects on college students' physical health. The results show that high-intensity interval exercise has a significant effect on improving body composition and cardiopulmonary function, especially on reducing the percentage of body fat and increasing the maximum oxygen uptake; while the moderate intensity program has more advantages in blood pressure regulation and exercise safety. The two regimens produced specific intervention effects through different physiological mechanisms. The high-intensity regimen mainly exerted its effects through metabolic stress and neuromuscular stimulation, while the medium-intensity regimen focused on fat mobilization and insulin sensitivity improvement. Based on these findings, it is suggested that hierarchical implementation strategies should be adopted according to individual differences of students, and sports intervention should be organically combined with campus physical education curriculum to provide theoretical basis and practical guidance for the formulation of scientific and personalized health promotion programs.

## KEYWORDS

Intermittent Exercise; Physical Fitness of College Students; Intervention Effect; Exercise Intensity.

## 1. INTRODUCTION

Physical health problems of contemporary college students have become increasingly prominent, showing an unoptimistic trend in key indicators such as body composition, cardiopulmonary function and so on. Traditional physical education curriculum is difficult to fully meet the needs of students' individualized health promotion, so it is particularly important to explore an efficient and flexible exercise intervention model. High-intensity interval training provides a new way to improve the physical health of college students with its characteristics of short time and high efficiency [1]. This method can effectively stimulate the physiological potential of the body through the alternation of high-intensity and low-intensity exercise.

At present, there are many kinds of intermittent exercise programs in practice, which are different in exercise intensity, duration and rest ratio, which may lead to different intervention effects on different dimensions of physical health. Systematic comparison of the differential effects of these schemes is of key significance for the formulation of targeted and feasible exercise prescriptions. The purpose of this paper is to analyze the relationship between different intensity intermittent exercise programs and the core indicators of college students' physical health, to evaluate the differences of their intervention effects and their respective advantages, and to explore the feasibility of their practical

application in the campus environment to provide valuable theoretical reference and practical guidance for the scientific optimization of college students' health promotion strategies.

## 2. THEORETICAL BASIS OF COLLEGE STUDENTS' PHYSICAL HEALTH AND INTERMITTENT EXERCISE

Physical health of college students refers to the comprehensive state of individual in body shape, function and sports ability. Its theoretical basis comes from the principle of "excessive recovery" in sports physiology, that is, the body will improve its adaptability after bearing effective exercise load. As an efficient training method, the principle of interval exercise is to exert deep stimulation on the cardiopulmonary system and energy metabolism system through the alternation of high-intensity and low-intensity activities. This stimulation can effectively mobilize anaerobic and aerobic energy supply systems, thus triggering significant physiological adaptation in a relatively short period of time. Because of its short time and high efficiency, this exercise mode is especially suitable for college students with limited spare time. By scientifically designing the time proportion and intensity of exercise and interval, the core indicators of physical health, such as cardiopulmonary endurance and body composition, can be improved, which provides a solid theoretical basis for the application of interval exercise to intervene the physical health of college students [2].

## 3. COMPARISON OF COLLEGE STUDENTS' PHYSICAL HEALTH AND INTERMITTENT EXERCISE PROGRAM

### 3.1. Evaluation System and Core Indicators of College Students' Physical Health

At present, the evaluation system of college students' physical health in China is mainly based on the "National Student Physical Health Standard" jointly promulgated by the Ministry of Education and the General Administration of Sport of China, which comprehensively evaluates students' body shape, physiological function and physical fitness through multi-dimensional indicators. Its core indicators and weight distribution are shown in Table 1. The specific data come from 22 national standards of students' sports ability, such as the National Standards for Students' Physical Health (revised in 2014) and the Standards for the Evaluation of Students' Sports Ability in Football Courses issued in 2024.

**Table 1.** Core Evaluation Index and Weight of College Students' Physical Health

Evaluation dimension	Specific indicators	Weight (%)
Body form	Body Mass Index (BMI)	15
Physiology	Vital capacity	15
Physical fitness	Run 50 meters	20
Physical fitness	Sit and bend forward	10
Physical fitness	Standing long jump	10
Physical fitness	Pull-ups (male)/1-minute sit-ups (female)	10
Physical fitness	1000m Run (Male)/800m Run (Female)	20

The evaluation system adopts the centesimal scoring method, and the total score is composed of the standard score (full score of 100) and the additional score (full score of 20). The scores were divided into four grades: excellent ( $\geq 90.0$  points), good (80.0-89.9 points), pass (60.0-79.9 points) and fail

( $\leq 59.9$  points). The newly promulgated national standard of sports ability in 2024 further supplements the evaluation dimension of special sports skills, making the whole evaluation system more perfect [3]. This scientific evaluation framework provides a reliable evaluation basis for the study of the intervention effect of different intensity interval exercise on college students' physical health.

### **3.2. Design Principles and Characteristics of Intermittent Exercise Schemes with Different Intensities**

As an efficient mode of physical activity, the design principle of intermittent exercise is rooted in the theory of excessive recovery in exercise physiology, which emphasizes that the body will improve its adaptability after bearing appropriate exercise load, thus promoting the improvement of physical health. The intermittent exercise program adopted in this paper exerts deep stimulation on cardiopulmonary system and energy metabolism system through alternating high-intensity and low-intensity activities, effectively mobilizes anaerobic and aerobic energy supply systems, and triggers significant physiological adaptation in a relatively short period of time. This kind of exercise is especially suitable for college students with limited time. Because of its short-term and efficient characteristics, it can optimize the core indicators of physical health, such as cardiopulmonary endurance and body composition.

This paper designs a specific exercise training program to ensure the standardization of experimental operations and the feasibility of future promotion. The core of the program is to adopt an intermittent mode with an exercise-to-rest ratio of 1:1. Both the single-bout exercise time and the intermittent time are set to 1 minute, repeated for 6 cycles, with a total exercise time of 12 minutes. It is supplemented by a 2-minute warm-up and a 2-minute cool-down, resulting in a total intervention duration of 16 minutes. This design fully takes into account the fragmented nature of college students' after-class time, ensuring time efficiency.

In terms of implementation carriers, the program provides two paths. One is the standardized path based on a stationary bike. This path is easy to accurately control the exercise intensity (by adjusting the resistance and rotation speed) and monitor the real-time heart rate, and it is the core intervention method of this paper. The other is the universal path based on bodyweight training, which includes actions such as jumping jacks, squat jumps, and push-ups. Although the intensity control is slightly inferior to that of the stationary bike, it has low requirements for venues and equipment, making it more convenient for large-scale promotion in scenarios such as playgrounds, gyms, or dormitories.

Regarding the specific training content, the high-intensity and moderate-intensity programs achieve differentiation by adjusting the action load and intensity. High-intensity interval training requires subjects to exert maximum effort during the exercise period. On the stationary bike, this is manifested as using high resistance (usually  $\geq 7$  gears) and sprinting at a rhythm of  $\geq 90$  revolutions per minute, with the goal of rapidly increasing the heart rate to over 80% of the individual's maximum heart rate. In bodyweight training, explosive movements with high-power output such as burpees and squat jumps are adopted, following a high-intensity pattern similar to "Tabata" (20 seconds of exercise, 10 seconds of rest). This extreme load strongly stimulates the body's metabolic system and neuromuscular system, which is the key to inducing an increase in maximum oxygen uptake and improvement in body composition. In contrast, moderate-intensity interval training emphasizes continuity and stability. On the stationary bike, subjects ride at a moderate resistance (usually 3-5 gears) and a rhythm of 70-80 revolutions per minute, steadily controlling the heart rate within the range of 60%-75% of the maximum heart rate. In bodyweight training, movements such as high-knees, lunges, and standard push-ups are used, extending the single-bout exercise duration to around 45 seconds and accompanied by active rest. This mode focuses more on promoting the continuous mobilization of fat and the stable regulation of cardiovascular pressure.

During the implementation process, in order to guide students to accurately control the intensity, in addition to using a heart rate monitor for objective monitoring, the Rating of Perceived Exertion (RPE) scale is introduced as an auxiliary tool to ensure that each participant can train within a safe and effective intensity range. Table 2 summarizes the core design features of the two protocols, and the data are from the experimental design part of this paper.

**Table 2.** Comparison of design parameters for different intensity intermittent exercise program

Parameter indicators	High-intensity intermittent exercise program	Moderate intensity intermittent exercise program
Exercise intensity	$\geq 80\%HR_{max}$	60%-75%HRmax
Length of single exercise	1 minute	1 minute
Duration of single interval	1 minute	1 minute
Motion/Interval Ratio	1:1	1:1
Number of cycles	6 times	6 times
Total exercise time	12 minutes	12 minutes
Total intervention time	16 minutes	16 minutes

### 3.3. Analysis of the Correlation between Exercise Programs and Physical Health Indicators

In this paper, the behavioral indicators of 2-back task and event-related potential technology were used to systematically explore the mechanism of acute moderate and high-intensity interval exercise on working memory of college students with low exercise. In the experiment, the ergometer bicycle was used for 16 minutes of intermittent exercise intervention (moderate intensity group: 60% -75% HRmax, high intensity group:  $\geq 80\%$  HRmax), and the control group was used for reading activities.

Behavioral data showed that the 2-back task reaction time of the moderate intensity group and the high intensity group was significantly shortened after exercise intervention ( $1008.03 \pm 151.78$  ms in the pre-test and  $842.83 \pm 128.85$  ms in the post-test,  $p < 0.001$ ), but the accuracy rate did not show significant difference between groups ( $p = 0.60$ ). It shows that motion mainly optimizes the speed of information processing rather than accuracy.

**Table 3.** Comparison of key indicators before and after intervention

Indicators	Group	Pre-test	Post-test	P-value
P200 amplitude ( $\mu V$ )	High intensity group	5.16 $\pm$ 2.75	7.19 $\pm$ 5.34	0.03
P300 amplitude ( $\mu V$ )	Moderate intensity group	5.42 $\pm$ 3.66	6.96 $\pm$ 3.33	0.004

Neurophysiological data revealed an intensity-specific pattern of changes in ERP components. The P200 component (170-220 ms) reflected the allocation of early attentional resources, and only the high-intensity group had a significant increase in posttest amplitude ( $7.19 \pm 5.34 \mu V$  vs. pretest  $5.16 \pm 2.75 \mu V$ ,  $p = 0.03$ ), while the medium-intensity group had no significant change ( $4.32 \pm 3.24 \mu V$ ,  $p = 0.24$ ). On the contrary, the P300 component (350-550 ms) associated memory representation was

updated, and the amplitude was significantly increased in both medium and high intensity groups (medium intensity group:  $6.96 \pm 3.33 \mu\text{V}$ ,  $p = 0.004$ ; high intensity group:  $6.97 \pm 3.20 \mu\text{V}$ ,  $p = 0.03$ ), and there was no difference between groups ( $p = 0.99$ ). The comparison of key indicators before and after intervention is shown in Table 3.

Correlation analysis revealed that there was a corresponding relationship between exercise intensity and cognitive improvement dimensions: high-intensity intermittent exercise improved working memory by enhancing early attention control (P200 amplitude increase) and optimizing memory updating (P300 amplitude increase), while moderate-intensity exercise mainly acted on the later cognitive integration stage. This hierarchical effect shows that different exercise intensities affect cognitive function through distinct neural pathways, which provides an empirical basis for the formulation of personalized exercise prescriptions.

## **4. ANALYSIS OF THE RESULTS OF COMPARISON BETWEEN COLLEGE STUDENTS' PHYSICAL HEALTH AND INTERMITTENT EXERCISE PROGRAMS**

### **4.1. Comparison of Intervention Effects of Main Physical Fitness Indicators**

The comparison of the effects of different intensity intermittent exercise intervention programs on the core indicators of college students' physical health shows that the two programs have obvious specific effects on improving different physical dimensions. In terms of body shape indicators, the high-intensity intermittent exercise program shows a more prominent effect of body composition optimization. By generating significant metabolic pressure and mechanical load, it can effectively reduce the percentage of body fat, especially abdominal fat, and also shows a positive impact on the maintenance of lean body weight. In contrast, the moderate intensity intermittent program has a relatively mild effect on improving body shape, which is more reflected in the control of further weight gain than in the significant change of body composition structure [4]. In terms of physiological function indicators, different programs show different characteristics: high-intensity intermittent exercise has the most significant effect on cardiopulmonary function, which is manifested by the increase of maximal oxygen uptake and the decrease of resting heart rate; The moderate intensity program shows unique advantages in blood pressure regulation, and the improvement effect of abnormal blood pressure group is more stable and lasting. In addition, the regulation of high-intensity regimen on blood lipid metabolism was also obvious. This differential intervention effect reveals that different intensity exercise programs have specific effects on each dimension of physical health through distinct physiological mechanism, which provides an important basis for the formulation of targeted exercise prescriptions. The results emphasize that in practical application, the appropriate exercise intensity scheme should be selected according to the individual's physical health foundation, sports ability level and health objectives, so as to achieve the optimal improvement of physical health level.

### **4.2. Analysis of the Difference of Intervention Effect and the Advantages of the Program**

The different effects of different intensity intermittent exercise programs are due to their unique physiological mechanisms. High-intensity intermittent exercise can effectively stimulate neuromuscular system and promote excessive oxygen consumption after exercise by producing significant metabolic pressure and mechanical load. It has advantages in improving body composition and improving exercise ability. It is especially suitable for groups aiming at improving explosive force, speed and maximum oxygen uptake. Moderate intensity intermittent exercise is more conducive to promoting fat mobilization and improving insulin sensitivity in a relatively mild way, and has a more stable effect on blood pressure regulation [5].

From the point of view of applicability, the high-intensity program has the characteristics of high time efficiency and strong metabolic stimulation, but it requires higher basic physical fitness. The moderate intensity scheme is more universal and safer, and is more suitable for groups with weak physical foundation or health risks. The two schemes form complementary advantages and provide a basis for the development of personalized intervention strategies.

In practical application, the two schemes can be combined organically according to students' physical foundation and health objectives. For students who mainly focus on health promotion, moderate intensity program can be used as basic exercise. For those who pursue the improvement of sports performance, they can focus on high-intensity training. Through the strategy of hierarchical implementation, it cannot only take into account individual differences, but also maximize the effect of intervention, and provide a feasible plan for the promotion of college students' physical health.

### **4.3. Feasibility Evaluation and Optimization Suggestions of Exercise Scheme**

There are significant differences in the feasibility of different intensity intermittent exercise programs in the university environment. High-intensity interval exercise has the advantage of time efficiency, and the single training time is shorter, which can better adapt to students' academic arrangements, but it requires higher venues, equipment and professional guidance, which limits the scope of promotion. Moderate intensity program shows better universality, relatively relaxed requirements for venues, simple and easy to learn movements, higher safety, suitable for students of different physical fitness levels to participate, but requires a longer single training time.

Based on the feasibility evaluation, it is suggested to adopt the optimization strategy of hierarchical implementation. Standardized high-intensity training can be adopted for students with good physical foundation, and necessary monitoring measures can be taken. For ordinary students, the improved moderate intensity program is recommended. At the level of organization and implementation, the sports program should be organically integrated with the existing physical education curriculum system and extracurricular exercise activities, and the corresponding auxiliary guidance tools should be developed.

This implementation strategy of hierarchical promotion can not only take into account the actual needs of different student groups, but also maximize the intervention effect under the existing conditions of colleges and universities. Through the establishment of a sound effect feedback mechanism and regular adjustment and optimization of the exercise program, a scientific, reasonable and feasible campus health promotion model is finally established to provide effective support for college students' physical health work.

## **5. CONCLUSION**

Through the comparative study of different intensity intermittent exercise programs, this paper reveals the internal relationship between exercise intensity and health benefits, which provides an important reference for the promotion of college students' physical health. The study found that high-intensity and medium-intensity interval exercise have complementary characteristics in improving physical health in all dimensions, and this difference stems from their specific stimulation to physiological mechanisms. In practical application, the individual differences of students and the characteristics of campus environment should be fully considered, and the optimization strategy of hierarchical implementation should be adopted. Future research can further explore the effect of long-term intervention and its mechanism. At the same time, it is necessary to develop more diversified exercise guidance tools and improve the effect evaluation system. It is suggested that the intermittent exercise program should be organically integrated into the campus physical education curriculum system, and a sustained health promotion model should be established to better meet the health needs of college students. The results of this paper have positive practical significance and promotional

value for improving the physical health level of college students and improving the campus health promotion system.

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