



## Case Control Study

**Effect of exercise prescription teaching on exercise quality and mental health status of college students**

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The teaching mode of fitness exercise prescriptions for college students in physical education conforms to the scientific principles and rules of fitness, which can adapt to the characteristics of students' individual physiological functions and stimulate their interest in learning.

**AIM**

To analyze the effect of prescribed exercise teaching on the sports quality and mental health of college students.

**METHODS**

The participants of the study were 240 students in our class of 2021, of which 142 were men and 98 were women. The 240 students were randomly divided into an experimental group using the exercise prescription teaching model and a control group using the conventional teaching model. The experimental and control groups were divided into four classes of 30 students each. The teaching activities of the two teaching mode groups were strictly controlled, and the same tests were used before and after the experiment to test the subjects' exercise quality (including standing long jump, 50 m race, 800 m race, sit-ups, sit-and-reach), physical form (including height, weight, Ketorolai index), cardiopulmonary function (including heart rate, blood pressure, spirometry, 12-min running distance, maximum oxygen intake) and mental health (SCL-90, including somatization, obsessive-compulsive, interpersonal, depression, anxiety, hostility, phobia, paranoia, psychotic symptoms) to understand the effects of the exercise prescription teaching mode on students' physical and mental health status.

**RESULTS**

There were differences in the exercise scores of standing long jump, 50 m, 800 m/1000 m running, sit-ups, and sit-and-reach in the experimental group after the experiment compared with those before the experiment, and the above indices of

the experimental group were different from those of the control group after the experiment ( $P < 0.05$ ). There were differences in body weight and Ketorolai index in the experimental group after the experiment compared to those before the experiment, and the indices of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ). After the experiment, there were differences in spirometry, 12-min running distance, and maximum oxygen intake in the experimental group compared to those before the experiment, and the indices of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ). After the experiment, the indicators of somatization, interpersonal sensitivity, depression, anxiety, and hostility in the experimental group were different from those in the pre-experimental group, and the indexes of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ).

### CONCLUSION

Exercise prescription teaching can mobilize college students' consciousness, enthusiasm, and initiative; expand personalities; enhance physical fitness and improve their mental health more than the conventional fitness exercise prescription teaching method.

**Key Words:** Exercise prescription teaching; College students; Exercise quality; Mental health status

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**Core Tip:** In order to better create a positive and optimistic outlook on life for college students and increase their interest in physical exercise, it is necessary to apply the physical health prescription course in the process of school physical education teaching. By using sports prescription teaching, teachers develop targeted teaching contents and methods in the teaching class according to the physical quality and health status of students, combine the teaching materials with students' self-learning, self-exercise, self-control, self-regulation and self-evaluation, give full play to students' main role, mobilize students' subjective initiative, realize the transformation from exam-oriented education to quality education, and promote students' all-round development. In view of the continuous decline in the physical and mental health of college students, based on the perspective of special teaching of physical education in colleges and universities, this study starts with the diagnosis of students' physique, provides students with personalized sports prescription teaching experiments with the main purpose of promoting physique, and provides scientific basis for improving students' current physical and mental health, guiding students to conduct scientific and reasonable physical exercise, and improving the effectiveness of school physical education.

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## INTRODUCTION

Higher general education institutions are the cradles of training qualified personnel of comprehensive quality[1]. College students, as practitioners of China's social, economic development and socialist core values, play the role of the backbone in the future development of society. Ensuring the mental health of college students is increasingly becoming a real problem in the development of China[2,3]. In recent years, problems concerning the physical and mental health of college students have also become the focus of attention, and the results of a large number of surveys and studies[4-6] have shown that the physical conditions, psychological and mental health problems of contemporary college students are more prominent than previously. Therefore, there is an urgent need to find practical and effective measures to strengthen the mental health education and physical exercise of college students, and to strive to improve the physical and mental health of college students.

To create a more positive and optimistic outlook on the lives of college students, as well as to increase their interest in physical exercise, it is necessary to apply physical health prescription courses in the process of physical education in schools[7]. In the traditional process of teaching physical education in institutions, the lack of attention given to exercise health by teachers and students has left many college students facing health problems. Exercise prescription teaching is a highly targeted teaching content and method developed by teachers according to students' physical fitness and health status. It combines teaching according to the material with students' self-learning, self-practice, self-control, self-regulation,

and self-assessment, which can realize the transition from examination-based education to quality education and promote students' overall development by providing full attention to the main role of students and mobilizing their subjective initiative[8-10]. Currently, colleges and universities are making unremitting efforts to continuously "enhance students' physical fitness" and implement "lifelong sports." The physical education mode of self-management and self-development for college students by developing different exercise and fitness prescriptions is beneficial to the physical and mental development of college students.

In response to the trend of continuous decline in the physical and mental health of college students, based on the perspective of college physical education special teaching, this study conducted physical fitness tests on students before the experiment, analyzed the students' various test results, corresponding indices, and provided students with personalized exercise prescription teaching experiments with the main purpose of promoting physical fitness for students' deficiencies in endurance, speed, and strength. It is expected to provide a scientific basis for improving students' current physical and mental health, guide students toward scientific and reasonable fitness, and improve the effectiveness of school physical education.

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## MATERIALS AND METHODS

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### **Study population**

In this study, 240 students from our school class of 2021 were randomly selected (142 men and 98 women), and all participants had no contraindications to sports after taking their medical history and physical examination. The 240 students were randomly divided into an experimental group using the exercise prescription teaching model and a control group using the conventional teaching model. In the experimental group, there were four classes of 30 students each with a total of 120 students, including 69 men and 51 women, aged 18-21 years, with a mean of  $(19.21 \pm 0.61)$  years. In the control group, there were four classes of 30 students each with a total of 120 students, including 73 men and 47 women, aged 18-20 with a mean of  $(19.16 \pm 0.39)$  years. The differences in baseline information such as sex, age, height, and weight between the two groups of students were not statistically significant ( $P > 0.05$ ) and were comparable. The study was approved by our ethics committee and all participants signed an informed consent form.

### **Literature method**

We reviewed many articles and textbooks related to exercise prescription teaching as well as teaching curriculum reform and collected the results of domestic and international research on exercise prescription in recent years through Internet searches and other methods for an in-depth understanding of the current state of research and cutting-edge development. Simultaneously, relevant literature was organized and analyzed to provide more informative theoretical data and case support for the study.

### **Questionnaire method**

**Questionnaire content:** A questionnaire was developed for the implementation of exercise prescription teaching, and the students were divided into experimental and control groups; the results were analyzed and compared in depth. The survey effectively reflected students' opinions on physical education classes, which laid the foundation for the future development of exercise prescription teaching. The survey reflected students' exercise attitudes, learning habits, interests, and other aspects. This way, a scientific exercise prescription curriculum could be effectively developed.

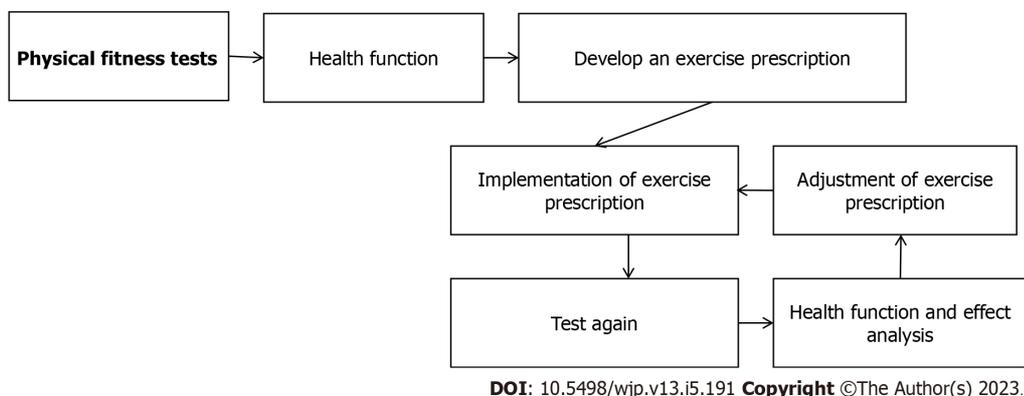
**Distribution and recovery of questionnaires:** Students in the experimental and control groups participated in a questionnaire survey (Table 1).

### **Experimental content**

Exercise prescription teaching is a highly targeted teaching method developed by the teacher according to the physical fitness and health status of students in the teaching class. It was a method in which the teacher combined the teaching of students according to their abilities with self-learning, self-practice, self-control, self-regulation, and self-assessment. By providing full attention to the main role of students and mobilizing their initiative to achieve the transition from examination-based to quality education, we promoted the overall development of students. The experimental group and the control group were both taught by the same physical education teacher. The experimental group used "exercise prescription" as the basic teaching procedure, the implementation process was cyclic and repetitive (Figure 1). A physical fitness test was conducted to evaluate the exercise ability of students and will be used as the basic basis for exercise prescription control. Teachers analyzed the students' physical fitness according to comprehensive scoring levels in the National Student Physical Fitness Standards and assessed their health functions. Corresponding to the weaknesses of the students in the experimental group, relevant exercise prescriptions (development of speed quality exercise prescription, development of muscle strength exercise prescription, development of endurance exercise prescription, improvement

**Table 1** Statistics on the distribution and return of questionnaires

Number of actual issue	Number of recoveries	Recovery rate (%)	Effective number	Effective rate (%)
240	240	100%	240	100%



**Figure 1** Diagram of the implementation process of exercise prescription in the experimental group.

of physical function exercise prescription, *etc.*) were designed to develop appropriate exercise content, exercise load, intensity, frequency, and duration; each exercise prescription determines the upper and lower limits of effective physical exercise for the students[11,12]. The experimental group participated in one physical education class (two class periods) and two extracurricular physical activities every week and exercised according to the formulated exercise prescription. Teachers conducted physical fitness tests every four weeks and adjusted the exercise program according to the actual situation of students to ensure the scientific nature of students' physical exercise. The control group was taught according to the normal physical education syllabus (including formation and assembly, teachers and students greeting each other, teacher briefly introducing the teaching content and requirements, yoga to warm up, and starting exercise), with one physical education class (two class periods) per week and two extracurricular physical activities conducted by the students themselves.

**Teaching plan**

The exercise prescription intervention lasted for 16 wk, as shown in Table 2.

**Observation index**

**Motor quality:** The test items included the standing long jump, 50-meter run, 800-meter run, sit-up, and sit-and-reach. The tests were conducted and scored on a standard athletic field using standard sports equipment. The test content and test methods were tested in accordance with the requirements of the "Student Physical Fitness Standards (pilot program)" published by the People's Education Publishing House. Measurements were taken before and after the experiment, and specific values were recorded.

**Body shape:** Included height, weight, and Ketorai index. The equipment used for height and weight measurement was the XTC series of student body mass measurement instruments sold by Dandong Tiangkang Sporting Goods Co. Measurements were taken before and after the experiment, and specific values were recorded.

**Cardiopulmonary function:** Heart rate was measured directly by an electronic meter using the manual pulse measurement method; blood pressure was measured using a mercury sphygmomanometer; spirometry was measured using a Tiangkang XTC series student physical measurement spirometer, and a total of three measurements were taken at 15 s interval each time, and the maximum value was taken as spirometry. Maximal oxygen uptake: Extrapolation was done by 12 min running distance performance, and a 12 min running distance was measured on the track of a 400 m standard athletic field. After measuring the 12-min running distance, the maximum oxygen uptake per kilogram of body weight was determined using an extrapolation table developed by the Japan Sports Science Center. Measurements were taken before and after the experiment, and specific values were recorded.

**Mental health:** A name-based questionnaire was used to assess the mental health status of students using the SCL-90, a self-assessment scale for mental health and psychiatric conditions in China. The scale has 90 items, and the severity level is classified according to the weight of each item (Table 3). This scale consists of 10 main factors: somatization, obsessive-compulsiveness, interpersonal sensitivity, depression, anxiety, hostility, fear, paranoia, psychoticism, and others. The high-weighting factor also

**Table 2 Specific contents of the exercise prescription teaching program in the experimental group**

Teaching content	Number of exercise sets	Exercise intensity	Exercise time	Heart rate (beats/min)	
				Average	Highest
<b>In-class exercise</b>					
1 Preparatory activities: Jogging and marching unarmed exercise.		30-40	15	100	130
2 Normal teaching content.		50-75	40	140	160
3 Exercise content: Focus on the development of strength, agility, speed and endurance qualities.		60-80	30	150	180
(1) Fast moving exercises.	2-3				
(2) Chest, back, abdominal, arm muscles and other parts of the comprehensive apparatus strength exercises.	6-8				
(3) Single and double leg jumping steps.	3-4				
(4) Standing jump, multi-level jump.	3-4				
(5) Various development of aerobic endurance quality exercise.	4-5				
4 Relaxation and finishing exercises.	2-3	20-40	5	100	120
<b>Extracurricular sports</b>					
1 Preparatory activities: Jogging and marching unarmed exercise.		30-40	10	100	120
2 Exercise content: Focus on the development of strength, agility, speed and endurance qualities.		60-80	15	150	180
(1) Fast moving exercises.	3-4				
(2) Holding light equipment strength exercises.	8-10				
(3) Single and double leg jumping steps.	3-4				
(4) Standing jump, multi-level jump.	3-4				
(5) Various development of aerobic endurance quality exercise.	4-5				
3 Relaxation and finishing exercises.	2-3	30-40	5	100	120

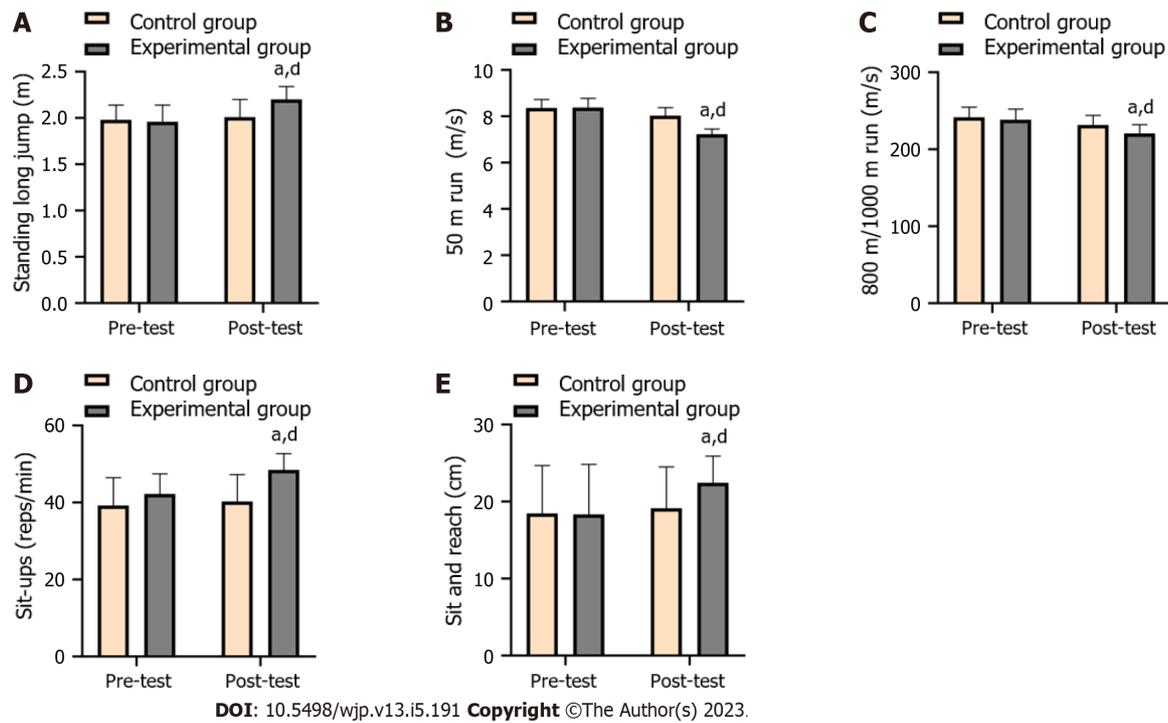
**Table 3 Classification of SCL-90 severity levels**

Serial number	Grade	Symptom
1	No	Self-perceived absence of symptoms
2	Mild	Conscious presence of the symptom, but no real effect on the subject
3	Moderate	Conscious presence of the symptom, with some effect on the subject
4	Fairly severe	The symptom is often perceived and has a significant impact on the subject
5	Severe	The frequency and intensity of symptoms are very severe

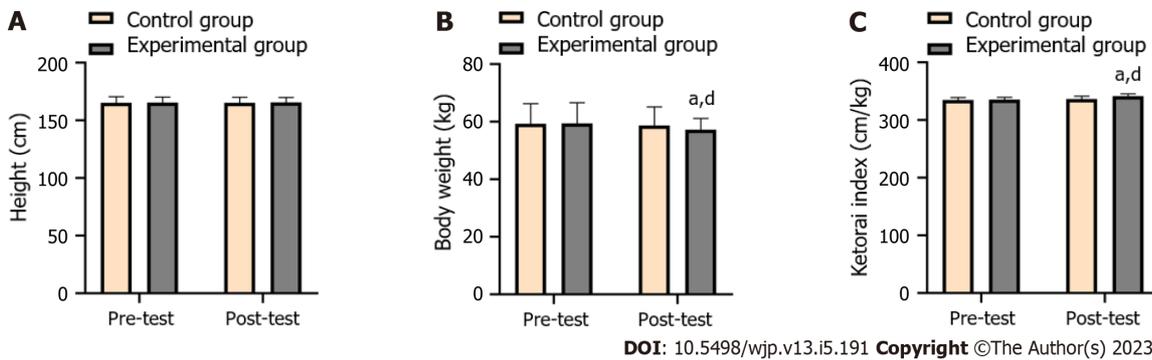
laterally reflects the presence of mental health problems. Measurements were taken before and after the experiment, and specific values were recorded.

**Statistical analysis**

The relevant data obtained from the survey and test before and after the experiment were analyzed using SPSS 20.0, and a *t*-test was conducted to verify whether there were differences between the experimental and control groups. Therefore, the experimental results were quantified and the objectivity and feasibility of the study were ensured.



**Figure 2 Comparison of exercise quality between the two groups before and after the experiment.** A: Standing long jump test (m); B: 50 m run test (m/s); C: 800 m/1000 m run test (m/s); D: Sit-up test (reps/min); E: Sit and reach test (cm). <sup>a</sup> $P < 0.05$  vs the same group before test. <sup>d</sup> $P < 0.05$  vs the control group after test.



**Figure 3 Comparison of body morphology between the two groups before and after the experiment.** A: Height (cm); B: Weight (kg); C: Ketorai index (cm/kg). <sup>a</sup> $P < 0.05$  vs the same group before teaching. <sup>d</sup> $P < 0.05$  vs the control group after teaching.

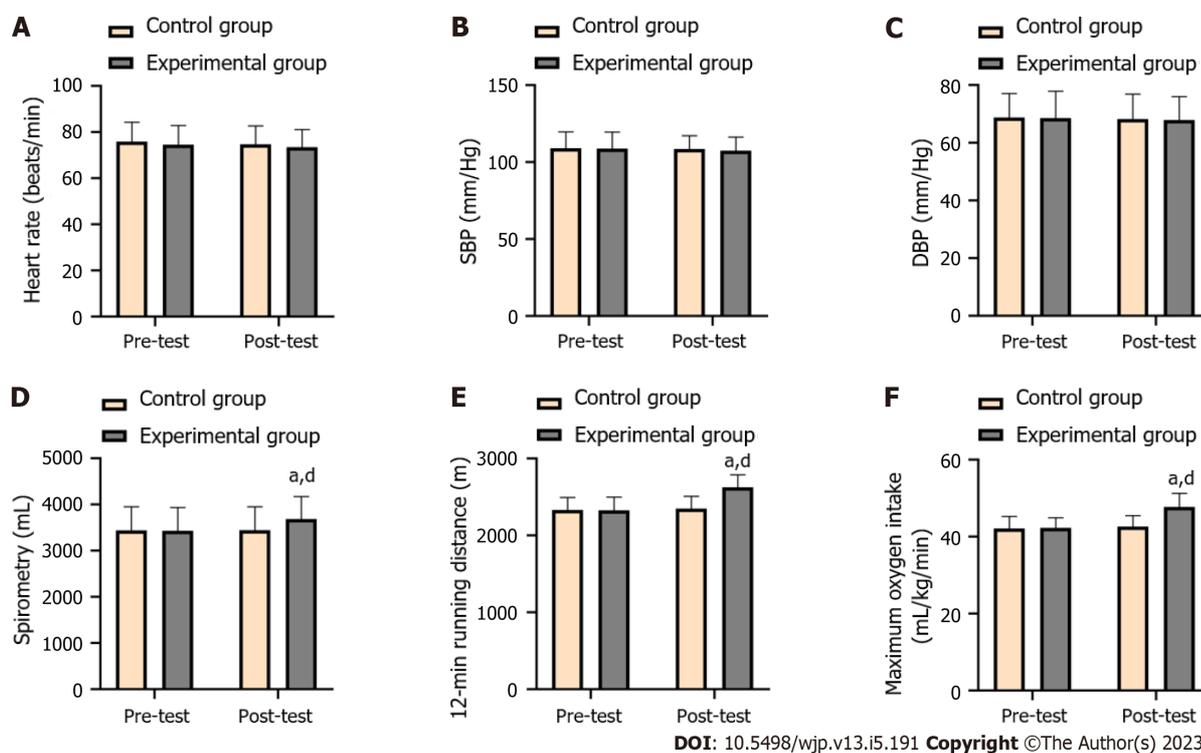
## RESULTS

### Comparison of exercise quality between the two groups before and after the experiment

The differences between the two groups in the pre-experimental exercise test scores for standing long jump, 50 m, 800 m/1000 m running, sit-ups, and sit-and-reach were not significant ( $P > 0.05$ ). After the experiment, there were differences in the exercise scores of standing long jump, 50 m, 800 m/1000 m running, sit-ups, and sit-and-reach in the experimental group compared with those before the experiment, and the indices of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ) (Figure 2).

### Comparison of body morphology between the two groups before and after the experiment

The differences in height, weight, and Ketolai index before the experiment were not significant between the two groups ( $P > 0.05$ ). There were differences in body weight and Ketolai index in the experimental group after the experiment compared with the pre-experimental group. The above indices of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ), and there were no significant differences in height between the two groups before and after the experiment ( $P > 0.05$ ) (Figure 3).



**Figure 4 Comparison of cardiopulmonary function between the two groups before and after the experiment.** A: Heart rate (beats/min); B: Systolic blood pressure (mm/Hg); C: Diastolic blood pressure (mm/Hg); D: Spirometry (mL); E: 12-min running distance (m); F: Maximum oxygen intake (mL/kg/min). <sup>a</sup> $P < 0.05$  vs the same group before teaching. <sup>d</sup> $P < 0.05$  vs the control group after teaching. SBP: Systolic blood pressure; DBP: Diastolic blood pressure.

#### Comparison of cardiopulmonary function between the two groups before and after the experiment

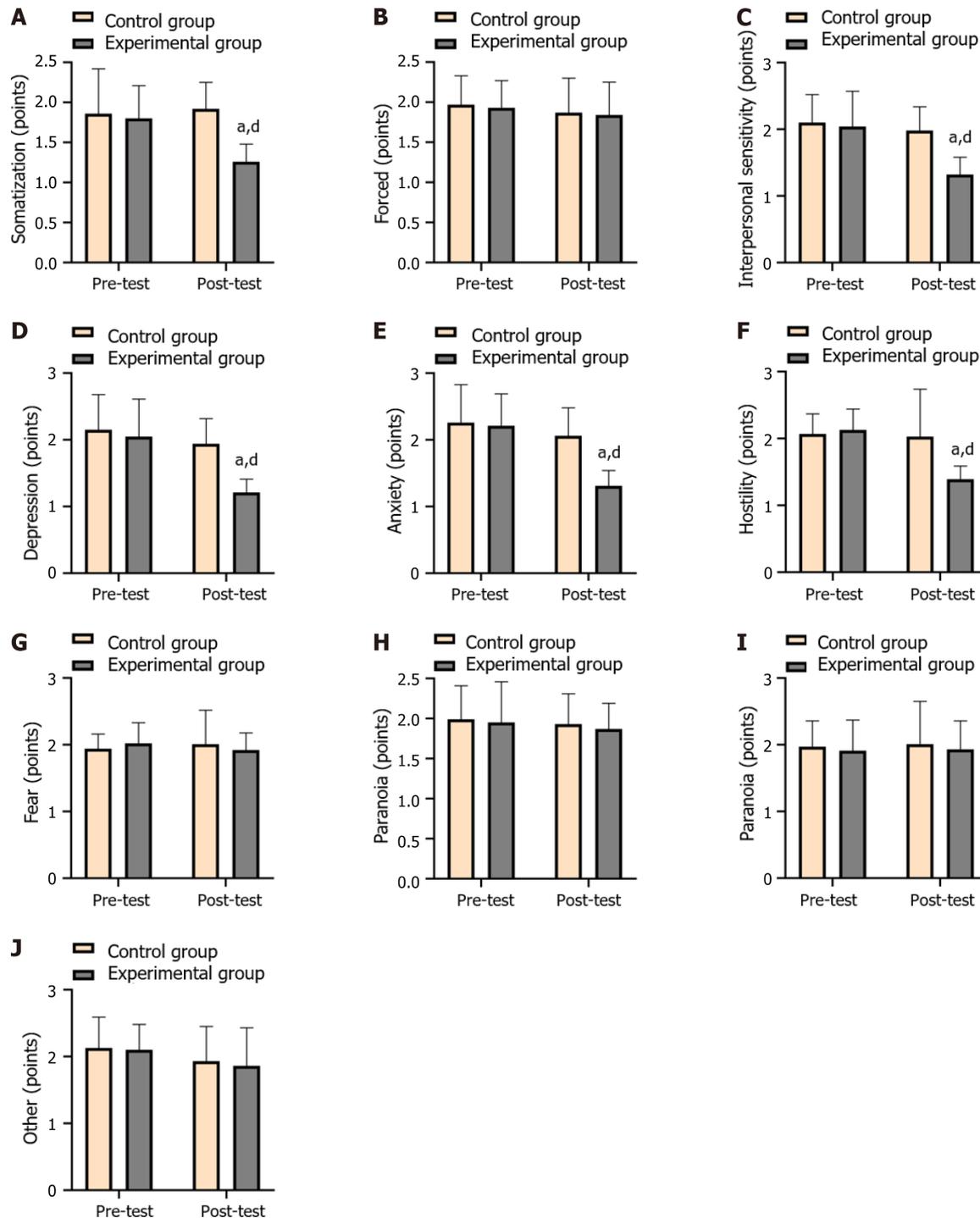
The differences between the two groups in heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), spirometry, 12-min running distance, and maximum oxygen intake before the experiment were not significant ( $P > 0.05$ ). There were differences in the post-experimental spirometry, 12-min running distance, and maximum oxygen uptake in the experimental group compared with those before the experiment; the above indices of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ), and there were no significant changes in heart rate, SBP, and DBP levels before and after the experiment in both groups ( $P > 0.05$ ) (Figure 4).

#### Comparison of the mental health status of the two groups before and after the experiment

Differences in the indicators of somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, and paranoia were not significant between the two groups before the experiment ( $P > 0.05$ ). Post-experimental somatization, interpersonal sensitivity, depression, anxiety, hostility, and other indicators in the experimental group differed from the pre-experimental comparison. These indices of the experimental group were also different from those of the control group after the experiment ( $P < 0.05$ ). The post-experimental compulsions, fear, paranoia, psychoticism, and other index scores of the experimental group did not differ significantly from the pre-experimental scores, nor did they differ significantly from those of the control group ( $P > 0.05$ ). No significant changes were seen in the index scores of the control group before and after the experiment ( $P > 0.05$ ) (Figure 5).

## DISCUSSION

In recent years, problems regarding the physical and mental health of college students have become a focus of attention, and the results of a large number of surveys and studies have shown that the physical conditions, psychological and mental problems of contemporary college students are very prominent [13,14]. The exercise prescription teaching mode interrupted the teaching material system of teaching competitive sports technology and established a fitness-centered fitness teaching system that realized the consistency of teaching purpose, content, and form and made the enhancement of physical fitness come into practice [15-17]. This study explored interventions for college students' mental health through sports and the use of exercise prescriptions to find new ways to improve college students' mental health.



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**Figure 5 Comparison of the mental health status of the two groups before and after the experiment.** A: Scores of somatization (points); B: Scores of forced (points); C: Scores of interpersonal sensitivity (points); D: Scores of depression (points); E: Scores of anxiety (points); F: Scores of hostility (points); G: Scores of fear (points); H: Scores of paranoia (points); I: Scores of psychotic (points); J: Scores of other (points). <sup>a</sup> $P < 0.05$  vs the same group before teaching. <sup>d</sup> $P < 0.05$  vs the control group after teaching.

**Effect of exercise prescription teaching on students' motor quality**

As can be seen from Figure 2, the results of motor quality tests after the experiment for students in the experimental group showed significant changes in motor ability such as a 50 m run, 800 m/1000 m run, standing long jump, sit up, and sit-and-reach show significant changes, indicating that the students' speed, endurance, spring, and upper body strength have been greatly improved. The reason for this may be that the exercise prescription instruction is well arranged and has a good effect on improving all aspects of students' abilities. The above suggests that college students should pay attention to strength training, especially the strength training of lower limbs and shoulder belt muscles[18,19].

**Effect of exercise prescription teaching on students' body morphology**

After the exercise prescription teaching mode exercise, body morphological indices such as height, weight, and Kotorai index before and after the experiment in the control group were not significantly different, whereas there was little change in height before and after the experiment in the experimental group, which was related to the basic stability of bone development in college students. The weight and Kotorai index of the experimental group differed significantly after the experiment compared with those before the experiment, which may be related to an increase in physical exercise and energy consumption. Slight weight loss is a good adaptation to exercise, and a more significant weight loss may be related to the physical condition of the subject and the content of the exercise received; however, these are all normal conditions[20].

**Effect of exercise prescription teaching on students' cardiorespiratory function**

From the changes of cardiopulmonary function assessment indexes before and after the experiment. There was no significant difference between the cardiopulmonary function indexes of the experimental group and the control group before the experiment. After the experiment, the vital capacity, 12-min running distance, maximum oxygen intake, step index, and other indices of the experimental group were different from those before the experiment and from those of the control group. The changes in the indexes of students' cardiorespiratory fitness indicate the enhancement of physical fitness and the improvement of exercise capacity, and that the physical exercise of the exercise prescription teaching model has greatly improved students' physical quality and mastery of athletic skills[21,22].

**Effect of exercise prescription teaching on students' mental health status**

The average score of the SCL-90 scale in the experimental group showed that after 16 wk of exercise prescription teaching, the scores of all factors in the experimental group were decreased, and the scores of interpersonal relationship, anxiety, and depression factors were significantly decreased, and there were very significant differences when compared with those before the experiment. This shows that the implementation of a fitness exercise prescription affected the psychological health of the experimenter. The university stage is a period of gradual maturation of students' psychological processes and complex psychological changes. In a good classroom atmosphere, students experience the pleasure of living with teachers and other students through the medium of cognition and emotion. The elimination of negative emotions caused by the social environment through exercise can have good short- and long-term benefits on the psychological quality of students[23,24].

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**CONCLUSION**

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Students can master practical methods to strengthen their bodies and be better prepared for "lifelong sports" activities. Through this study, we found that the application of an exercise prescription teaching model in tertiary institutions has some limitations, such as venues, instruments, equipment, resulting in the limited tests and exercises that can be completed. Therefore, it is impossible to develop comprehensive, effective, and targeted exercise prescriptions. In a follow-up study, we may consider combining social professional outreach training with college sports to provide the necessary conditions for a comprehensive design of exercise prescription training.

**ARTICLE HIGHLIGHTS****Research background**

The teaching mode of fitness exercise prescriptions for college students in physical education conforms to the scientific principles and rules of fitness, which can adapt to the characteristics of students' individual physiological functions and stimulate their interest in learning.

**Research motivation**

The physical, psychological, and mental health problems of contemporary college students are more prominent than ever. Therefore, there is an urgent need to find practical and effective measures to strengthen mental health education and physical exercise for college students, and strive to improve their physical and mental health. In order to have a more positive and optimistic view of the lives of college students and increase their interest in physical exercise, it is necessary to apply physical fitness prescription courses in school physical education teaching. In the traditional physical education teaching process in colleges and universities, teachers and students pay insufficient attention to sports health, resulting in many college students facing health problems.

### **Research objectives**

Currently, the main research is to assess the physical fitness and mental health of college students, and this field will continue in the future.

### **Research methods**

Total 240 students were randomly divided into an experimental group and a control group. The experimental group used exercise prescription teaching mode, while the control group used traditional teaching mode. The experimental group and the control group were divided into four classes with 30 students in each class. Strictly control the teaching activities of the two teaching mode groups, and use the same tests before and after the experiment to test the exercise quality, body shape of the subjects, Cardiopulmonary function and mental health to understand the impact of sports management teaching models on students' physical and mental health.

### **Research results**

In response to the trend of continuous decline in the physical and mental health of college students, based on the perspective of college physical education special teaching, this study conducted physical fitness tests on students before the experiment, analyzed the students' various test results, corresponding indices, and provided students with personalized exercise prescription teaching experiments with the main purpose of promoting physical fitness for students' deficiencies in endurance, speed, and strength. It is expected to provide a scientific basis for improving students' current physical and mental health, guide students toward scientific and reasonable fitness, and improve the effectiveness of school physical education.

### **Research conclusions**

Sports prescription teaching can mobilize college students' consciousness, enthusiasm, and initiative, and improve their mental health level.

### **Research perspectives**

Through this study, we found that the application of an exercise prescription teaching model in tertiary institutions has some limitations, such as venues, instruments, equipment, resulting in the limited tests and exercises that can be completed. Therefore, it is impossible to develop comprehensive, effective, and targeted exercise prescriptions. In a follow-up study, we may consider combining social professional outreach training with college sports to provide the necessary conditions for a comprehensive design of exercise prescription training.

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## **FOOTNOTES**

**Author contributions:** Zhong XL conceptualized and designed the study, and collected and compiled the data; Sheng DL provided administrative support; Chen TZ provided the research materials and patients; Zhang ZW and Chen TZ analyzed and interpreted the data; and all authors wrote and approved the final version of the manuscript.

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**Informed consent statement:** All study participants provided informed written consent prior to study enrollment.

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**STROBE statement:** The authors have read the STROBE Statement, and the manuscript was prepared and revised according to the STROBE Statement.

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