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Article

Biomechanical effects of different intensity combinations of aerobic exercise on the enhancement of physiological fitness of college students

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Abstract: Aerobic exercise is an effective way to improve cardiorespiratory function and enhance physical fitness, which has a positive impact on the physiological health level of college students, and this study aims to investigate the impact of aerobic exercise with different combinations of intensity on the enhancement of physiological health level of college students. Twenty college students, aged 18–24, in robust health and devoid of long-term exercise backgrounds, were recruited. They engaged in three 30-minute aerobic exercise regimens: low-to-moderate, low-to-high, and moderate-to-high intensity. Biomechanically, each intensity level triggered distinct muscular activation patterns and energy demands. The physiological health indexes of the subjects were measured before and after the exercise, including the heart rate, the degree of self-consciousness of fatigue, the oxygen saturation, the perfusion index, and the emotional state. All indicators can be measured by professional equipment, and different intensity groups are determined according to the intensity of aerobic respiration. The results of the study showed that before the exercise intervention, there was no difference between the physiological health indicators of all subjects, which was homogeneous. In contrast, after the exercise intervention, physiological health indicators showed changes due to different intensities of aerobic exercise. In the two indicators of heart rate and conscious fatigue, there was a significant difference in the enhancement of the two indicators by aerobic exercise ($P < 0.05$), and the greater the intensity of aerobic exercise, the greater the effect on heart rate and conscious fatigue. Higher intensity aerobic exercise spurred the heart to work harder, pumping blood more vigorously to fuel active muscles, as dictated by biomechanical principles. In the two indicators of oxygen saturation and perfusion index, the effect of aerobic exercise did not have a significant difference ($P > 0.05$), and did not show a specific pattern of change. In terms of emotional state indexes, the effects of aerobic exercise of different intensities on the subjects were reflected in different emotional indexes, but in terms of the overall emotional disturbance index, aerobic exercise of different intensities did not have a significant effect on the emotional disturbance index. In sum, aerobic exercise's biomechanical benefits for students' health are clear. Colleges should boost its promotion, offer varied programs, and guide participation to harness these advantages for enhanced physical and mental health.

Keywords: college students; biomechanical effects; aerobic exercise; physiological health; emotional state; intensity differences

1. Background of the study

Aerobic exercise refers to the exercise that enables the body's oxygen supply to meet the body's energy needs, while being able to maintain a certain amount of sustained exercise time and intensity, which has a lot of benefits for the health of the body. In college life, aerobic exercise is a very popular form of exercise that can be used in different combinations of intensities to achieve improved levels of

physiological fitness in college students. Over the past few decades, there has been a great deal of research showing that aerobic exercise has many health benefits [1–3]. Through regular aerobic exercise, people's body weight and body fat content can be significantly reduced, while cardiorespiratory fitness, muscular strength and endurance can be improved [4,5]. In addition, aerobic exercise can improve sleep quality and reduce psychological problems such as anxiety and depression [6]. Meanwhile, aerobic exercise can also promote neuronal growth and synaptic plasticity in the brain, and this neuroplasticity can improve cognitive function and learning outcomes in college students. Studies have shown that regular aerobic exercise promotes the release of neurotransmitters such as dopamine in the brain, which can improve cognitive functions such as attention and memory [7].

College students are a special group of people who face multiple challenges such as academic pressure, social pressure and employment pressure, all of which can negatively affect their physical health. Improving the physical health of college students through aerobic exercise can help them better cope with these challenges. However, different intensities of aerobic exercise have different effects on physical health. High-intensity aerobic exercise can quickly improve cardiorespiratory fitness and metabolic levels, but may increase the risk of injury. Low-intensity cardio, on the other hand, reduces the risk of injury but requires longer workouts to see noticeable results. Therefore, finding an appropriate combination of intensities is important for college students to effectively improve their physical fitness.

In this study, college students will be divided into different groups for high-intensity aerobic exercise, low-intensity aerobic exercise and control group through the method of randomized controlled trial. During the trial period, the subjects' physical indicators will be measured and recorded regularly, including body weight, body fat content, cardiorespiratory function, muscle strength and endurance. The subjects' exercise feelings and health status will also be investigated and recorded to assess the effects of different intensity combinations of aerobic exercise on the physiological health level of college students. Through the results of this study, we can better understand the effects of aerobic exercise with different intensity combinations on the enhancement of college students' physiological health level, and provide references for college students to choose appropriate exercise methods. Meanwhile, it can also provide theoretical basis and practical guidance for physical education programs and health management in colleges and universities, and help college students better maintain their physical health and improve their quality of life.

2. Effects of aerobic exercise on physiological fitness levels

2.1. Mechanisms of the effect of aerobic exercise on the level of physiological fitness

Aerobic exercise refers to exercise of long duration and moderate intensity performed by the human body in the presence of an adequate supply of oxygen. Aerobic exercise has the functions of improving cardiorespiratory function, enhancing muscle strength and promoting metabolism, and has an important impact on physiological health level. At present, aerobic exercise has been widely used in

the prevention and treatment of many diseases and has become an effective means of improving health and quality of life.

It has been shown that aerobic exercise promotes cardiorespiratory fitness, strengthens the muscles of the heart and lungs, and improves the efficiency of the blood circulation and respiratory system [8]. At the same time, aerobic exercise can help control body weight and reduce the risk of obesity and related chronic diseases [9]. Specifically, aerobic exercise improves human physiological health in the following ways. First, aerobic exercise significantly lowers blood pressure, slows heart rate, and increases the heart's ejection volume. These can effectively improve the function of the cardiovascular system, thereby reducing the incidence of cardiovascular disease and improving the body's resistance to disease. Specifically, aerobic exercise can improve the function of the cardiovascular system by increasing cardiopulmonary function, enhancing blood vessel elasticity, and decreasing blood viscosity in a variety of ways, which can reduce the risk of coronary heart disease, stroke, myocardial infarction, and other cardiovascular diseases [10]. Secondly, aerobic exercise can not only help people keep fit, but also increase lung capacity and improve respiratory rate. Through aerobic exercise, people can inhale more oxygen and expel more carbon dioxide, and this improved breathing pattern can enhance the function of the respiratory system and improve the efficiency of the lungs. Long-term adherence to aerobic exercise can make the human immune system more perfect, reduce the incidence of respiratory diseases, and make people healthier [11]. Third, aerobic exercise plays an important role in promoting human metabolism. By increasing oxygen intake, aerobic exercise can accelerate fat burning and metabolism and reduce the accumulation of body fat. This process not only helps to build a healthy body shape, but also improves body functions and immunity. In addition, aerobic exercise can enhance insulin sensitivity and lower blood sugar levels. Insulin is a key hormone that regulates blood glucose levels, and aerobic exercise helps increase insulin secretion and sensitivity, thus maintaining stable blood glucose levels. This is crucial for the prevention and treatment of chronic diseases such as diabetes. Fourth, aerobic exercise not only enhances muscle strength and endurance, but also improves flexibility and coordination. A proper amount of exercise can promote the body's metabolism and accelerate blood circulation, which contributes to the health of the body [12]. In addition, aerobic exercise can promote the growth and development of bones, enhance the density and hardness of bones, and help to prevent osteoporosis and other diseases. The appropriate amount of exercise can promote the body's metabolism, accelerate blood circulation, enhance muscle strength and endurance, improve the body's metabolic level, accelerate blood circulation, and promote the health of the body.

2.2. A study on the effect of aerobic exercise on the physiological health level of college students

College students are a special population whose physical health is directly related to academic, social and overall quality of life. With the changes in modern lifestyles, college students face physical challenges in their studies and lives. Aerobic exercise, as a viable form of exercise, can improve the physical fitness level

of college students and have a positive impact on their studies and lives. At present, a large number of scholars' studies have begun to focus on the effects of aerobic exercise on college students' physical health level, and the current studies mainly focus on the following aspects.

First, the effects of aerobic exercise on the cardiovascular health of college students. College students typically face long periods of sedentary behavior and stress, which may negatively impact cardiovascular health. Research has shown that aerobic exercise can improve cardiovascular fitness, lower heart rate and blood pressure levels, and reduce the risk of atherosclerosis in college students [13].

Second, the effects of aerobic exercise on body composition in college students. Changes in body composition, including increased body fat and decreased muscle mass, often accompany college student periods. Aerobic exercise can help college students control their weight, reduce fat accumulation, and improve their body muscle mass. Research has shown that college students who engage in aerobic exercise have lower waist-to-hip ratios and body fat content compared to their inactive peers [14].

Third, the impact of aerobic exercise on the immune system of university students. The immune system of college students is easily affected by the stress of study and life, thus increasing the risk of infection and susceptibility to disease. Aerobic exercise can promote the improvement of immune function and increase the activity and number of immune cells, thus enhancing the resistance of the body. Studies have shown that college students' leukocyte counts, NK cell activity, and immunoglobulin levels significantly increase after aerobic exercise [15].

Fourth, the effect of aerobic exercise on college students' sleep quality. College students often face academic pressure and a stressful pace of life, which may lead to sleep problems. Aerobic exercise improves the physical health of college students by improving their sleep quality. Studies have shown that college students who regularly engage in aerobic exercise have improved sleep quality, decreased time to sleep, and increased sleep efficiency [16].

3. Research design

3.1. Research target

In this study, 20 university students were selected as subjects, the height and weight of all subjects were measured, and their basic information and their exercise in the last month were counted by inviting them to fill in the basic information form as well as the Physical Activity Registration Scale (PARS), and the results are shown in **Table 1**.

Table 1. Statistical results of subjects' basic information.

Basic Information	**Boys (*N* = 20)**
Age (years)	21.40 ± 2.27
Height (cm)	174.80 ± 8.17
Weight (kg)	65.79 ± 4.67
Physical Activity Rating Scale Scores	11.40 ± 1.63

According to the scoring criteria of the activity scale, only a small amount of training was performed in the last month (scoring criteria of training volume: ≤19 is a small amount of training; 20–42 is a moderate amount of training; ≥43 is a large amount of training). Subjects were determined to be free of chronic and infectious diseases, brain injury and mental illness, normal vision or corrected vision, and volunteered to participate in this trial. After initial screening, all 20 met the inclusion criteria and were included in the trial and signed an informed consent form.

3.2. Experimental program

All subjects in this study were required to undergo three aerobic exercise interventions, and the physiological indices of the trainees were tested before and after the interventions in order to determine the aerobic exercise training program that would produce the best intervention effect on the target group.

In this study, the exercise intervention was conducted under laboratory conditions, and aerobic running was chosen as the aerobic exercise program, which has been shown to have the effects of strengthening the body, calming the mind and body, and relaxing the emotions. In the experiment, all subjects performed three aerobic running workouts on a treadmill, each lasting 30 min. the intensity of aerobic exercise was a combination of low and moderate intensity (intensity 1), a combination of low and high intensity (intensity 2), and a combination of moderate and high intensity (intensity 3). Each of the two intensity combinations was exercised for 15 min. To eliminate the effects of muscle fatigue and ergogenic learning effects, the interval between each training session was 72 h. Prior to each test, subjects wore a Finnish Polar heart rate belt and a heart rate monitor to monitor their heart rate in real time and to adjust the intensity of the exercise during the exercise. According to the American College of Sports Medicine's classification criteria for aerobic exercise in healthy adults, low-intensity aerobic exercise is defined as 50% to 60% of an individual's maximum heart rate; moderate-intensity aerobic exercise is 60% to 69%; and high-intensity aerobic exercise is 70% to 79%. Subjects were asked to stop training immediately if they experienced any discomfort during exercise.

Through comprehensive and systematic testing of physiological indicators, we aim to assess the health status of individuals, prevent and identify possible health risks in advance, and provide them with personalized health management and improvement recommendations. Before and after the test, physiological parameters such as oxygen saturation were monitored and recorded by the Masimo finger-clip pulse oximetry analyzer, a widely used non-invasive oxygen saturation measurement device manufactured by Masimo Corporation in the U.S.A. The Masimo finger-clip pulse oximetry analyzer employs advanced Signal Extraction Technology (SET) technology. The Masimo Finger Clip Pulse Oximetry Analyzer utilizes advanced Signal Extraction Technology (SET), which allows for accurate measurement of oxygen saturation and pulse rate under challenging conditions such as low perfusion and patient movement. The device measures the degree of oxygenation in the blood by emitting and receiving infrared light through a small clip attached to the fingertip or earlobe, providing high accuracy, non-invasiveness, real-time monitoring, and

convenience. Before the exercise test, the subjects need to sit and rest on the seat for about 5min after entering the laboratory, after reaching a steady state, and then the pre-test of physiological indexes. Immediately after the end of the exercise, the oximetry analyzer was worn for post-exercise physiological index measurement, and the test time was about 20–30 s.

The Profile of Mood States (POMS) is a commonly used psychometric instrument for assessing an individual's emotional state, developed by American psychologist McNair et al. in 1971, and has been widely used in both clinical and scientific research. The POMS scale consists of 65 items categorized into six emotional dimensions: tension, depression, hostility, fatigue, confusion, and vigor. Each entry is rated on a 5-point scale of "no", "very mild", "moderate", "very strong", "strong", and "moderate" in terms of the degree to which the individual feels the emotion, "very strong" and "very strong", corresponding to "0" "1" "2", "3" and "4" scales. The highest score for each subscale is 24, 28, 20, 24, 20, 20, and the lowest score is 0. By scoring these entries, the total score for each emotion dimension and the total score for the overall emotional state can be calculated to assess the individual's emotional state. In this study, the short-form POMS Chinese norm was used to assess the mental health status through the overall emotional strife, which was calculated as (tension + anger + fatigue + depression + panic) − (energy + sense of self-esteem) + 100, and the higher the value, the worse the mental health status, and vice versa, the better.

The steps for using the POMS scale are as follows:

(1) Explain the purpose of the test, before the test begins, the purpose of the test needs to be explained to the subjects and they need to be told to answer the questions truthfully to ensure the accuracy of the test results.

(2) Completing the questionnaire, the POMS scale was distributed to the subjects and they were asked to answer each entry according to their situation. The subjects need to choose the degree corresponding to their emotional state.

(3) Calculating the score, the total score for each emotional dimension and the total score for the overall emotional state is calculated based on the subjects' responses. This step can be accomplished using manual calculations or electronic computer software.

(4) Analyzing the results, based on the score results, the subject's emotional state can be assessed. If the score for a particular mood dimension is high, it indicates that the subject has a problem with that mood. It is also possible to compare the scores at different points in time or across different populations to understand trends in emotional states or differences in emotional states across populations.

It is important to note that the POMS scale only assesses an individual's emotional state and cannot be used as a basis for diagnosing mental illness. In addition, the results of the test are also affected by a variety of factors such as environmental and individual factors, so other relevant factors such as physiological indicators and behavioral performance need to be considered in order to comprehensively assess an individual's emotional state. In the present experimental study, subjects were asked to complete the mood scale after entering the laboratory and resting for 5 min to assess their pre-test mood state. Subsequently, at the end of the exercise, when the subjects' heart rate returned to ±10% of their resting heart rate,

they were again asked to complete the Mood Scale to assess the effect of the exercise and its impact on the subjects' emotional state.

3.3. Data processing

The data on the behavioral tasks were first preprocessed using E-prime software, after which they were categorized and organized by Excel, and finally statistically analyzed by spss 20.0. Data on physiological indicators, RPE, and POMS Mood Scale scores were analyzed using a paired samples *t*-test, and all data were presented as mean ± standard deviation (M ± SD), with $p = 0.05$ set as the level of significance.

4. Results and analysis

4.1. Results

Prior to subjecting, physiological indices were measured and homogeneity tests were performed on all subjects, and the results are shown in **Table 2**.

Table 2. Results of homogeneity test.

norm	***F***	***P***
Heart rate (BPM)	0.004	0.31
Oxygen saturation (%)	0.218	0.10
Perfusion index (%)	0.689	0.68

From the original data, there was a large difference in the heart rate of different groups. The statistical results showed that there was no difference between the three physiological indices of heart rate ($P = 0.31$) oxygen saturation ($P = 0.10$) and perfusion index ($P = 0.68$), indicating that the relevant physiological indices of the two groups of subjects were homogeneous before the experiment.

Table 3. Effects of different intensity combinations of aerobic exercise on physiological indices of subjects ($M \pm SD$, $N = 20$).

		Intensity 1	**Intensity 2**	**Intensity 3**
pre-exercise	pulse rate	78.12 ± 5.27	78.06 ± 4.31	77.89 ± 4.20
	Level of conscious fatigue	9.64 ± 1.81	10.02 ± 1.84	10.58 ± 1.82
	blood oxygen saturation	97.62 ± 2.31	97.29 ± 2.14	91.87 ± 1.96
	perfusion index	5.76 ± 2.24	5.61 ± 2.04	5.71 ± 2.36
after exercise	pulse rate	123.42 ± 4.18**	146.40 ± 3.96**	154.63 ± 4.01**
	Level of conscious fatigue	12.44 ± 1.19**	13.62 ± 1.12**	14.89 ± 1.14**
	blood oxygen saturation	96.24 ± 1.72	96.82 ± 1.34	97.28 ± 1.25
	perfusion index	7.43 ± 5.12	6.89 ± 2.07	7.71 ± 5.46

Note: ** $P < 0.01$ indicates significant correlation at the 0.01 level.

After the subjects, the physiological indexes of all subjects were re-measured, and the results of the four indexes of heart rate, conscious fatigue, blood oxygen saturation, and blood perfusion index were collated and statistically analyzed by using the sample *t*-test, so as to obtain the changes in the physiological indexes before and after aerobic exercise of different intensities, and the results obtained are shown in **Table 3**.

In terms of heart rate indexes, as can be seen from **Table 3** and **Figure 1**, there was a significant difference in heart rate indexes before and after aerobic exercise of different intensities ($P < 0.01$). Before the exercise, the heart rate indexes of the three groups of subjects did not have much difference, and the maximum did not exceed 80, while after the exercise, the heart rate of the three groups of subjects had a significant increase. Moreover, as the intensity of aerobic exercise increased, the elevation of heart rate became more and more obvious. Among them, the aerobic exercise of intensity 1 had the smallest effect on heart rate elevation, with an elevation of about 57.99%, the aerobic exercise of intensity 2 had an elevation of about 87.55%, and the aerobic exercise of intensity 3 had an elevation of about 98.52%.

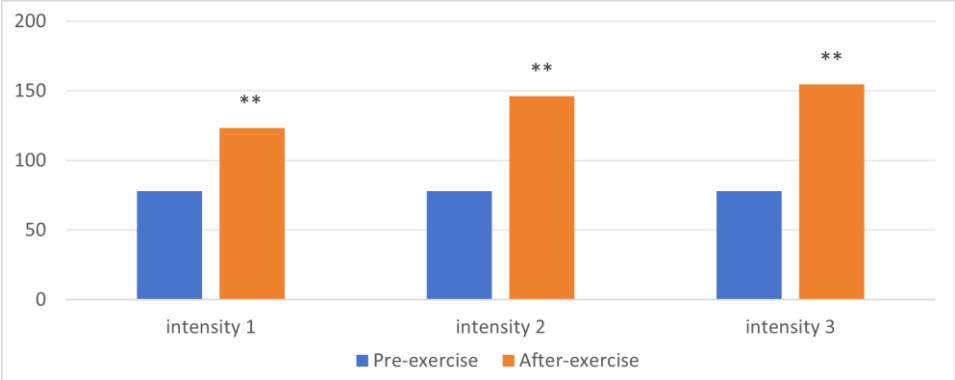

Figure 1. Effect of different intensities of aerobic exercise on heart rate.

Note: ** $P < 0.01$ indicates significant correlation at the 0.01 level.

In terms of self-conscious fatigue, as can be seen from **Table 3** and **Figure 2**, there was a significant difference in self-conscious fatigue indicators before and after aerobic exercise of different intensities ($P < 0.01$). Before the exercise, there was not much difference in the index of conscious fatigue degree among the three groups of subjects, and the average value was about 10. Moreover, as the intensity of aerobic exercise increased, the degree of self-conscious fatigue gradually increased, and the effect of aerobic exercise of intensity 1, intensity 2, and intensity 3 on the enhancement of the degree of self-conscious fatigue was about 29.05%, 35.93%, and 40.74%, respectively.

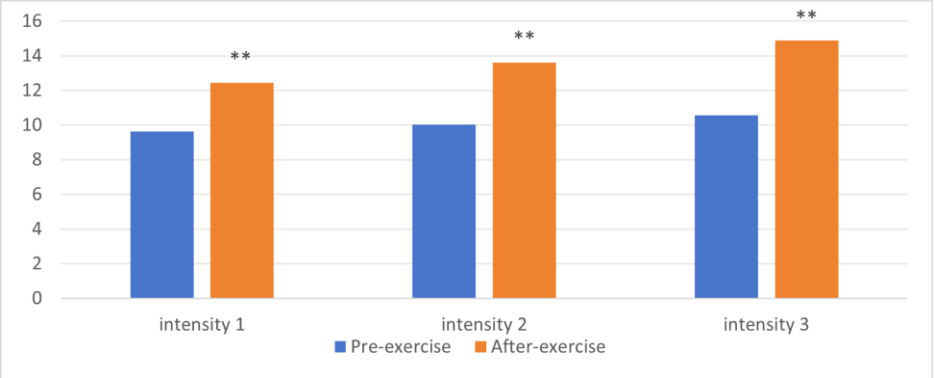

Figure 2. Effect of aerobic exercise of different intensities on heart rate.
Note: ** $P < 0.01$ indicates significant correlation at the 0.01 level.

In terms of blood oxygen saturation, as can be seen from **Table 3** and **Figure 3**, the blood oxygen saturation indexes before and after aerobic exercise of different intensities do not possess significant differences ($P > 0.05$). Under the aerobic exercise of intensity 1, the blood oxygen saturation after the exercise showed a slight decrease compared with that before the exercise, and the decrease was only about 1.41%. Under intensity 2 aerobic exercise, the post-exercise oxygen saturation also showed a slight decrease compared to the pre-exercise, with an even smaller decrease of only about 0.48%. Under intensity 3 aerobic exercise, the change in blood oxygen saturation was the opposite of the first two intensities, with post-exercise oxygen saturation instead increasing compared to pre-exercise, by a non-significant amount of 5.89%.

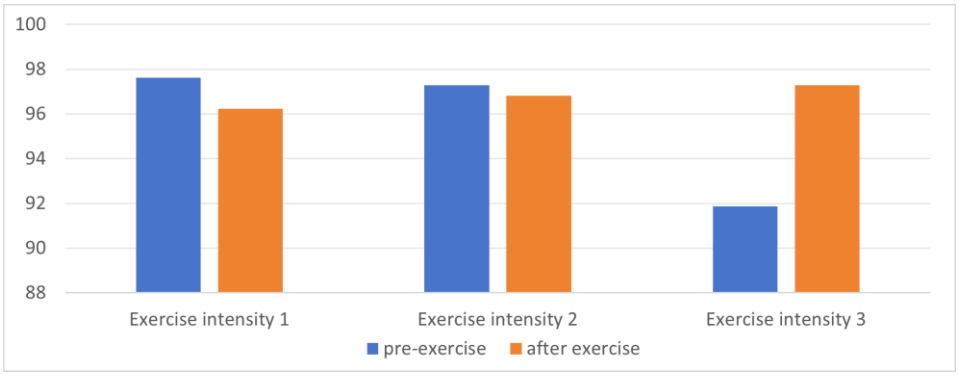

Figure 3. Effect of different intensities of aerobic exercise on heart rate.

In terms of blood perfusion index, as can be seen from **Table 3** and **Figure 4**, the blood perfusion index index before and after aerobic exercise of different intensities did not possess significant differences ($P > 0.05$). Before exercise, the blood perfusion indexes of the three groups of subjects were similar, with a difference of less than 0.15. After exercise, the blood perfusion indexes of the three groups of subjects were slightly reduced, with intensity 2 aerobic exercise having the lowest blood perfusion index of 5.61, and intensity 1 having the highest blood perfusion index of 5.76.

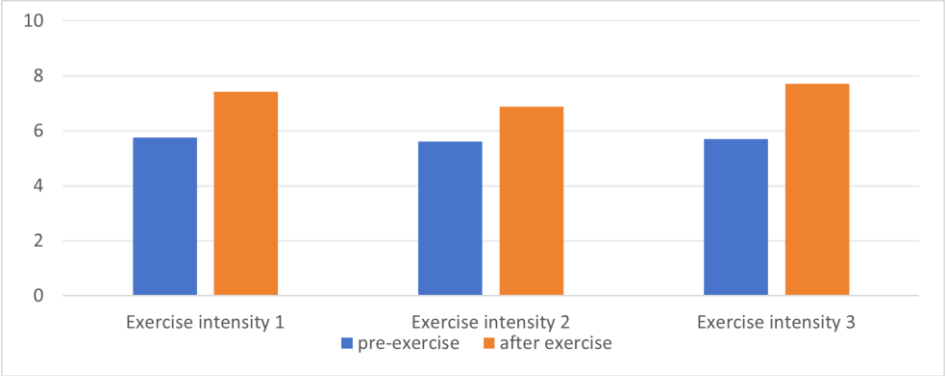

Figure 4. Effect of different intensities of aerobic exercise on heart rate.

Emotional state is also a very important physiological indicator, so this study used the short-form POMS Chinese norm to evaluate the emotional state of the subjects, and the effects of aerobic exercise at intensity 1 on the subjects' emotions are shown in **Figure 5**. As can be seen in **Figure 5**, under aerobic exercise of intensity 1, the two mood components of tension and fatigue were significantly different from those before exercise. Among them, tension showed a significant decrease ($P < 0.01$) with a decrease of 54.05%, and fatigue showed a significant increase ($P < 0.05$) with an increase of 40.91%.

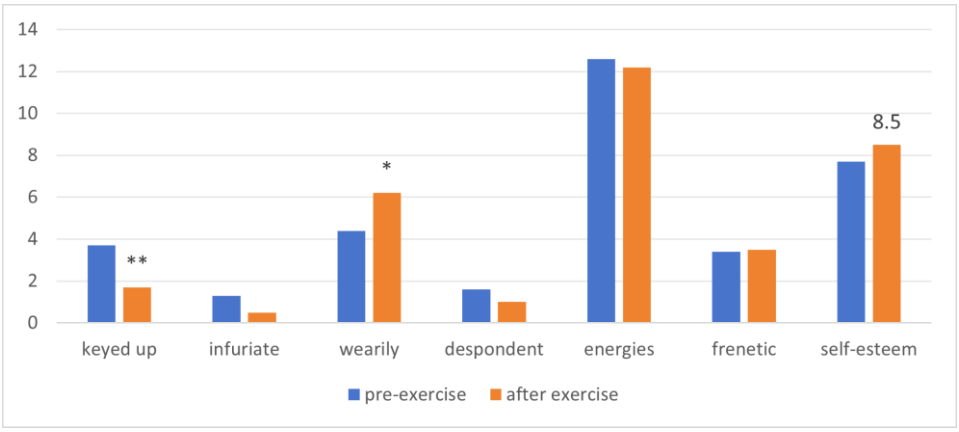

Figure 5. Effect of Intensity 1 on subjects' moods.

Note: ** $P < 0.01$ indicates significant correlation at the 0.01 level; *$P < 0.05$ indicates significant correlation at the 0.05 level.

The effect of aerobic exercise at intensity 2 on the subjects' mood is shown in **Figure 6**. As can be seen in **Figure 6**, under aerobic exercise at intensity 2, there was a significant difference ($p < 0.05$) in the change in mood for only one item, self-esteem, which rose by 13.89% compared to the pre-exercise period.

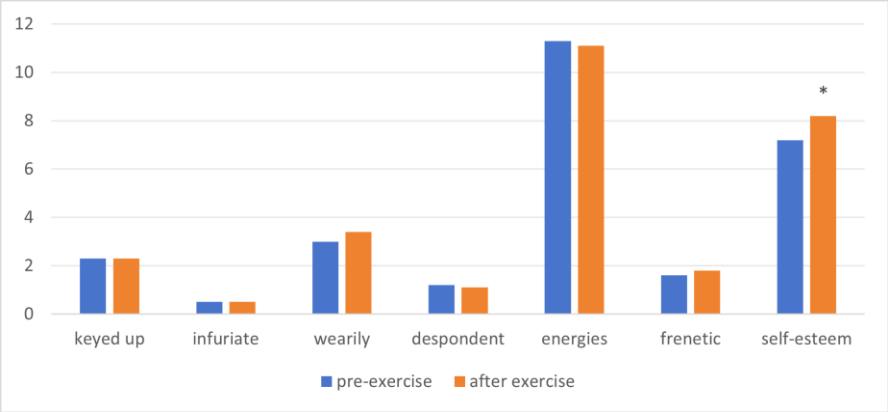

Figure 6. Effect of Intensity 2 on subjects' moods.

Note: *P < 0.05 indicates significant correlation at the 0.05 level.

The effects of aerobic exercise at intensity 3 on the subjects' mood are shown in **Figure 7**. As can be seen in **Figure 7**, under aerobic exercise of intensity 3, the two mood indicators, energy and self-esteem, showed significant changes (P < 0.05), and the changes in both of them were significantly elevated, with an elevation of 10.09% and 24.62%, respectively.

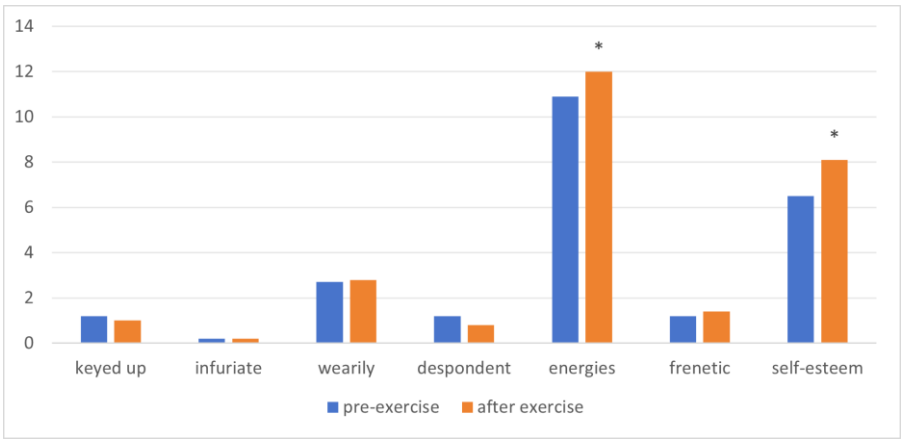

Figure 7. Effect of intensity 3 on subjects' moods.

Note: *P < 0.05 indicates significant correlation at the 0.05 level.

The Total Mood Disorder Index (TMD) can be considered an objective indicator to quantify the general mental state of the body. The higher the value of this index, the less favorable the emotional and mental state. Conversely, the better. TMD was calculated by subtracting the sum of the five positive mood scores from the sum of the two negative mood scores and then adding 100 to calibrate the gap between the two scores. According to the statistical results of the participants' Total Mood Distress Index in **Table 4**, it can be found that there was no significant effect of aerobic exercise of different intensities on the Total Mood Distress Index before and after the exercise.

Table 4. Effects of different intensities of aerobic exercise on the overall mood of the subjects.

exercise intensity	pre-exercise	after exercise
Intensity 1	94.10	92.20
Intensity 2	90.10	90.80
Intensity 3	89.10	86.50

4.2. Analysis of results

In the assessment of exercise intensity, this study used a rigorous experimental method to measure the subjects' heart rate and conscious fatigue level (RPE) after exercise, both of which are simple physiological indicators describing exercise intensity. The experimental results showed that the subjects' heart rate and RPE showed maximum values immediately after exercise, indicating that aerobic exercise at different intensities produced certain fatigue stimuli on the bodies of college students. At intensity 3, the heart rate of the subjects reached the maximum value (154.63 ± 4.01) and RPE was (14.89 ± 1.14). Overall analysis and comparison of these two indicators showed a linear relationship between post-exercise heart rate changes and RPE values. The detailed analysis revealed that the three intensities of aerobic exercise were incrementally loaded exercises for the subjects. In the assessment of acute aerobic exercise fatigue, combining physiological indexes such as blood perfusion index, blood oxygen saturation, RPE and heart rate to assess actual exercise fatigue can more objectively and accurately reflect the enhancement effects of exercise intensity, exercise time and muscle work status in different regions of the human body.

Oxygen saturation is the percentage of hemoglobin in the blood that is bound to oxygen and reflects the level of oxygen saturation of hemoglobin. It is an important physiologic indicator. Oxygen saturation has a close relationship with processes such as blood flow regulation and oxidative energy metabolism, and may play a role by influencing the release of ATP from erythrocytes and the regulation of ATP concentration in the vasculature. In this study, data on blood oxygen saturation of subjects before and after exercise were collected using finger-clamp method. The results showed that the subjects' blood oxygen saturation was not significantly lower than the pre-exercise level after three different intensities of aerobic exercise. This phenomenon may be attributed to the low intensity of exercise in the experiment, which failed to produce sufficient fatigue stimulus for the test subjects and therefore failed to trigger changes in oxygen supply in the body, suggesting that the different aerobic exercise regimens may have a limited role in triggering changes in oxygen supply in the body [17].

The perfusion index is calculated from the photoelectric volumetric tracing signal of the pulse oximeter and can be expressed as the ratio of the impulse component detected by the detector to the non-pulse component. This index may reflect circulation or metabolism and can be used to assess microcirculatory system function. However, blood perfusion is heterogeneous, and the final measured blood perfusion index of the same subject varies equally between different measurement sites chosen, and this variation has a wide range of sources, manifesting itself both

between tissues and within and between skeletal muscles. In the present study, data on subjects' perfusion indices were collected using the finger-clamp method. After statistical analysis of the relevant physiological parameters, it was found that there was no significant change in the subjects' blood perfusion index after three different intensities of aerobic exercise. The possible factors contributing to this phenomenon are related to the training mode. In the experiment, the aerobic intervention program for the subjects was done on a treadmill, and the working muscles of the subjects were mainly concentrated in the lower limbs. In contrast, the upper limbs had a very limited range or duration of work. However, several studies have shown significant differences in the perfusion levels of different muscle tissues during exercise, and differences in the perfusion indices and muscle working ranges at the end of the limb as measured by the finger-clamp method may be the main reason for the absence of significant changes in the test results.

The POMS Mood Scale used in this study contains a total of forty mood adjectives and seven mood dimension ratings that allow subjects to assess their current and past week's mood states. Aerobic exercise of intensity 1 mainly affects subjects' mood on two mood indicators: tension and fatigue, aerobic exercise of intensity 2 mainly affects subjects' mood on self-esteem, and aerobic exercise of intensity 3 mainly affects subjects' mood on two mood indicators: energy and self-esteem. Emotions occupy an inescapable position in people's daily life, and they are similar to a barometer that reveals to us changes in the overall mental health status, changes people's behavioral patterns, and affects the physical and mental health of the human body. Research has shown that there is a bidirectional relationship between psychological state and physical health [18]. In this experiment, all three intensities of aerobic exercise reduced the TMD index, which is a positive signal of human mood. This conclusion is supported by many scholars' studies, such as the study of Xu et al. [19], which explored the effects of moderate-intensity aerobic exercise on the state of mind of college students and divided the college students into two groups, where the experimental group was required to perform cycling for 20 minutes at 60% of the maximum oxygen uptake, and the two groups performed cycling for 1 h, 2 h, 4 h before, after, and 1 h, 2 h, 4 h, 4 h, and 4 h, respectively, after exercise, 8 h, 12 h, and 24 h. Changes in the emotional strife index were recorded. Participants had to report their emotional state accurately at the agreed upon time with no more than ±15 min error, in addition to adjusting their rest schedule. The data showed that the experimental group had lower mood strife indices than the control group at post-exercise, 4 h post-exercise, 8 h post-exercise, and 12 h post-exercise, and there was no gender main effect. This suggests that moderate-intensity aerobic exercise has a positive effect on the human body for a period of time after exercise, and that aerobic exercise of different intensities can optimize the psychological state of college students. It has been suggested that the phenomenon of post-exercise mood optimization may be due to two reasons: first, elevated levels of monoamines, especially hormones represented by norepinephrine and/or 5-hydroxytryptophan; and second, the release of endorphin hormones [20]. Furthermore, the results of the present study are consistent with the idea that aerobic exercise may be an effective means of improving the mental health status of college students.

5. Conclusion and discussion

The physical and mental health of college students is an important reserve force for the development of the country, so it is of great significance to maintain and further improve the physiological level of college students. Research has shown that aerobic exercise is an effective means to promote the development of college students' physical and mental health. The results of this study indicate that aerobic exercise promotes the development of college students' physiological functions, which is consistent with the results of previous studies. Specifically, aerobic exercise combining low-intensity and moderate-intensity as well as moderate-intensity and high-intensity improved the subjects' emotional state, and heart rate and fatigue index showed significant changes compared with the pre-exercise period, while other physiological indexes showed no significant changes. The combination of low-intensity and high-intensity aerobic exercise resulted in significant changes in heart rate and fatigue indices of college students compared to pre-exercise, but there were no significant changes in the subjects' mood states. In addition, there were no significant changes in other physiological indices after exercise.

Aerobic exercise has a positive effect on the mental health of college students. Participation in aerobic exercise can help college students effectively release pressure, relieve anxiety and tension, improve self-efficacy, enhance self-confidence and improve emotional state. This positive psychological experience helps to enhance the mental health of college students and promote the harmonious development of body and mind. At the same time, aerobic exercise also helps to enhance the social skills of college students, improve their social adaptability, and cultivate a positive attitude towards life. In sports, college students can make more friends, expand their social circles, and learn teamwork and communication skills, which are very beneficial to their future careers and lives. Participating in aerobic exercise can enable college students to better integrate into society, enhance their interpersonal skills, and develop a positive attitude towards life.

Therefore, colleges and universities should further strengthen the promotion and popularization of aerobic exercise to provide more opportunities and places for college students to meet their needs for physical and mental health. At the same time, colleges and universities should also strengthen the research and exploration of aerobic exercise to provide more scientific and effective guidance for the physical and mental health of college students. In terms of specific practice, colleges and universities can organize some aerobic exercise clubs or societies to attract more college students to participate in aerobic exercise. By participating in the activities of clubs or societies, college students can make friends with like-minded people and learn and make progress together. Colleges and universities can also carry out some aerobic knowledge lectures or skills training to help college students master the correct exercise methods and skills. The lectures or trainings can be hosted by professional sports coaches or fitness trainers to provide college students with professional guidance and advice. This can help college students better understand the characteristics and rules of aerobic exercise, master the correct exercise techniques and movement essentials, and avoid the occurrence of sports injuries. In addition, colleges and universities can organize some aerobic exercise competitions

or activities to stimulate college students' interest and enthusiasm in aerobic exercise. Different prizes and incentives can be set in the competitions or activities to encourage more college students to actively participate in them. Through the platform of competitions or activities, college students can show their athletic talents and skills, and at the same time, they can communicate and interact with other participants to share the joy and gains of exercise. At the same time, the introduction of scientific aerobic exercise methods, through digital technology, to create the right sports plan for each student.

In conclusion, it is of great significance to maintain and further improve the physiological level of college students, and aerobic exercise is an effective means to promote the development of college students' physical and mental health. By actively participating in aerobic exercise, college students can comprehensively improve their physical and mental health and lay a solid foundation for their future development.

It is worth noting that the samples selected by this institute are small, and there is a certain shortage of the limitations of objective conditions, which may have a certain effect on the results. In the post-continuation study, you should try to expand the range and capacity of the sample.

6. Discussion and outlook

Current research shows that different combinations of intensity aerobic exercise have different effects on the physiological health of college students. Low-intensity aerobic exercise can improve endurance and cardiorespiratory function, while high-intensity aerobic exercise can improve explosive force and muscle strength. Therefore, in order to better explore the effects of different intensity combinations of aerobic exercise on the physiological health of college students, future research can explore the following aspects in depth.

(1) Explore a wider variety of aerobic exercises

Currently, studies have mainly focused on a few common aerobic exercises such as running, swimming, cycling, etc., while some emerging aerobic exercises such as calisthenics and dance have been less involved. Future research can further expand the types of aerobic exercise and explore the effects of these emerging exercises on college students' physical health, so as to provide college students with more diversified exercise options.

(2) Increase sample size and time span

Existing studies tend to select only a small number of samples and have a short time span, which makes the findings somewhat limited. Future studies can increase the sample size and time span, and further validate the effects of different intensity combinations of aerobic exercise on the physiological health level of college students through long-term follow-up surveys and a large amount of data support.

(3) Consideration of individual differences and environmental factors

There are large individual differences among different college students, including physical condition, exercise experience, etc., and these factors will affect the effect of aerobic exercise. Future studies can further consider the effects of individual differences and environmental factors on aerobic exercise, so as to explore

more precisely the suitable aerobic exercise modes and intensities for different college students.

(4) Combining other forms of exercise

In addition to aerobic exercise, college students can also adopt other exercise modalities such as strength training and flexibility training to improve their physical health. Future research can further explore the effects of different combinations of exercise modalities on college students' physical fitness, so as to provide more comprehensive exercise recommendations for college students.

In conclusion, aerobic exercise with different combinations of intensity has an important impact on the improvement of college students' physiological health. Future research can explore the effects and scope of aerobic exercise from multiple perspectives, provide more scientific and comprehensive exercise suggestions for college students, and promote the improvement of physical health.

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