

Analysis of Central Pulmonary Function Changes in Taiji Boxing Teaching Process Based on Biometrics

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Abstract: Through consulting domestic and foreign literature, it is found that the current researches on the effects of Taiji boxing exercise on balance ability and cardiopulmonary function are mostly aimed at the category of middle-aged and elderly people, and the researches are relatively mature. This paper uses the methods of literature review, interview, experiment and mathematical statistics to study Taiji boxing's effect on college students' cardiopulmonary function. The results show that the vital capacity of the college students who insist on Taiji boxing exercise is significantly higher than that of the college students who do not participate in Taiji boxing exercise. This shows that long-term adherence to Taiji boxing exercise can significantly improve the cardiopulmonary function of college students. The research in this paper provides a theoretical basis for Taiji boxing's extensive development on university campuses.

1. Introduction

Martial arts exercise has a good effect on heart and lung function. Long-term martial arts training can improve cardiac vascular function [1]. Taiji boxing is a treasure of Chinese civilization for thousands of years. It combines boxing, guiding and breathing techniques. In the exercise process, it requires guiding movements with thoughts, paying attention to breathing movements and active relaxation of neuromuscular muscles, so as to combine consciousness, breathing and movements closely, thus achieving the goals of strengthening body constitution and prolonging life [2]. Biometric identification technology mainly refers to a technology for identity authentication through measurable biological characteristics such as body or behavior. However, biological characteristics refer to the only physiological characteristics or behavior patterns that can be measured or automatically identified and verified. Taiji boxing has great influence on cardiac function, and there are many researches in this field. Indicators to study the effect of Taiji boxing on cardiac function include heart rhythm, blood pressure, stroke volume, myocardial oxygen consumption, energy utilization rate, peripheral resistance, etc. With the increase of age, more and more elderly people begin to have the consciousness of self-care and health preservation. They hope to enhance their physique and prolong their life through physical exercise, and at the same time, they also want to be happy in their psychology while exercising their physical functions. No matter martial arts athletes or martial arts majors, their vital capacity and breathing difference are greater than those of ordinary people and ordinary college students [3]. There are many types and routines of martial arts, and different boxing styles have different influences on heart and lung functions.

2. Research Objects and Methods

2.1 Research object

This article focuses on the effects of Taiji boxing on the cardiopulmonary function of college students. The study was designed to recruit 35 subjects, with a final sample size of 30. Age 21.03 ± 1.56 years, height 168.26 ± 3.81 cm, weight 56.37 ± 4.39 kg. All participants volunteered for this test. Subjects with cardiopulmonary function and dyskinesia were excluded. No special balance

training experience, no professional sports training and no foot deformity before the test. The final research objects are shown in Table 1.

Table 1. The research object

N	Gender	Height (cm)	Weight (kg)	Age
30	Male	168.26±3.81 cm	56.37±4.39kg	21.03±1.56

2.2 Research method

Through the China Journal Network, China HowNet System and so on, Taiji boxing, heart and lung, college students are used as keywords to search, and more than 30 related documents are consulted, so as to understand the research overview of predecessors on this subject and provide theoretical reference and support for the research.

2.3 Expert interview method

Before and after the experiment, experts in Taiji boxing, sports physiology, fitness qigong and other aspects were asked to understand the current research situation of Taiji boxing.

2.4 Test method

Exercise intensity is controlled within the target heart rate range of heart load. Target heart rate calculation formula: $[(220 - \text{age}) - \text{static heart rate}] * (60\% \sim 85\%) + \text{static heart rate}$ Each exercise intervention includes minute warm-up, minute Taiji boxing exercise and minute relaxation process. The previous week was the Taiji learning and intensive phase. The entire intervention cycle was guided and supervised by a professional Taiji boxing instructor. According to the standards in the National System Test Standard, the testee's resting state requires a height of 25cm for women and 30cm for men at a frequency of 30 times /3min for a total of 3 minutes. After the test is completed, the testee immediately starts to count the pulse frequency within one minute by himself and record the results.

Using the domestic electronic vital capacity tester, the subjects were tested for 3 times after teaching the test methods under the resting state, and the average value was taken. The exercise electronic vital capacity tester took the average value of 3 tests, and carried out physical qualities such as weight (kg), height (cm), quiet pulse (times /min), systolic pressure (mmHg), diastolic pressure (mmHg), grip strength (n), vital capacity (ml), reaction time (mm), leg and foot flexibility (s), hand-eye coordination ability (s), language ability (s), shoulder joint flexibility (cm). In order to avoid interference between experiments, the order of the two tests is: quiet pulse, vital capacity, standing on one foot with eyes closed and three-minute step experiment. The pulse was measured manually, recording a minute's quiet pulse. Close your eyes, stand on one foot, step test for 3 minutes and vital capacity test with instruments.

The test method of shoulder joint flexibility: the subject wears single clothes, stands naturally, and the two arms (upper arm of the affected arm) are respectively close to each other from top to bottom at the back. the distance between the fingertips of the two middle fingers is measured. the contact between the two fingertips is 0 point, the intersection distance is negative, and the non-intersection distance is positive. After each step up and down, the upper body and hind legs must be straight and not bend their knees. The test time is minutes. After the test is completed, according to the operator's instructions, the final instrument automatically gives the evaluation index, i.e. the step test index. It is an important indicator to reflect the functional status of human cardiovascular system. The greater the value. The higher the functional level of cardiovascular system.

2.5 Mathematical statistics

The test results, using SPSS13.0 statistical software for independent sample t test, according to the analysis results prove that Taiji boxing exercise on the balance ability of middle-aged people.

3. Results and Analysis

3.1 A survey on the basic situation of college students participating in Taiji boxing exercise and college students not participating in Taiji boxing exercise

Under international standards, the proportion distribution of BMI index level of middle-aged and elderly people tested is shown in Figure 1. Measured by Chinese standards, the average BMI index level of college students is in the overweight range, far from the normal range. The trend of its development and change is gradually changing to the normal range, and the change trend of its distribution also gradually tends to be concentrated.

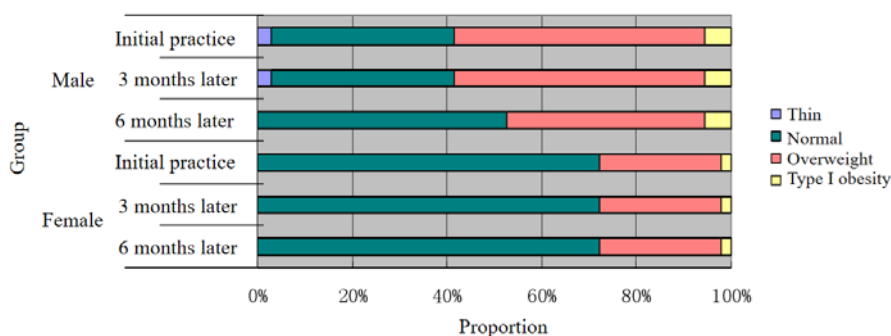


Figure 1. The distribution change of BMI index level proportion under international standards

When moving to 10 minutes. The heart rate increased significantly compared with that in quiet ($P > 0.05$). But in the later movement process. However, the heart rate gradually decreases with time until the end of exercise. The heart rate at that time was close to the quiet state ($P > 0.05$). However, when the quantitative load of 20 /30s squatting is completed, the immediate heart rate is lower than that without training [4]. This shows that a period of long boxing exercise has a good effect on heart function and improves the ability of heart reserve. There are 30 subjects in the experimental group participating in this research, including 15 subjects in the Taiji boxing exercise group and 15 subjects not participating in the Taiji boxing exercise group. the average age of the subjects participating in the Taiji boxing exercise group is 21.03, and the average age of the subjects not participating in the Taiji boxing exercise group is 20.18, indicating that there is no difference in age between the two groups.

3.2 Effect of Taiji boxing on cardiopulmonary function of college students

3.2.1 The survey results of vital capacity of college students participating in Taiji boxing exercise and those not participating in Taiji boxing exercise

After the investigation, the vital capacity of the two groups of subjects was counted. Table 2 is a comparison of the results between the two groups of subjects. table 2 shows that the vital capacity of the college students who participate in Taiji boxing exercise is higher than that of the college students who do not participate in Taiji boxing exercise. the statistical results show that the two groups of subjects have significant differences ($p < 0.05$), which indicates that Taiji boxing has great influence on the cardiopulmonary function of college students. In the 24-style Taiji boxing exercise, there are many movements that require the human body to support on one leg, such as leg splitting, leg patting, leg wiping, etc. When the subjects are practicing these movements, the support area for maintaining the balance of the human body will be reduced (normally standing on both feet, standing on one foot during practice), and it needs to be continuously repeated and strengthened. Taiji boxing exercise is beneficial to improving cardiovascular function and has certain curative effects on hypertension, coronary heart disease, etc.

Table 2 Comparative results of vital capacity between two groups of subjects

Group	Dimensions	$\bar{X} \pm S$	t	P
Participating in Taiji boxing exercise group	Vital capacity	3037.66±943.771	0.124	P<0.05
Not participating in Taiji boxing exercise group	Vital capacity	2786.72±773.32	0.307	

3.2.2 Results of step test index survey between college students who participated in Taiji boxing exercise and those who did not participate in Taiji boxing exercise

Assuming that x_i represents the cardio-pulmonary function related indexes of the racing athletes before aerobic training, the related cardio-pulmonary function indexes of the racing athletes before and after aerobic training are compared by using formula (1) [5]

$$\begin{cases} x_i = f(O_{i-1}, w_i)R^m \geq y_i \\ y_i = h(O_i, v_i)R^p w_i \leq x_i \end{cases} \quad (1)$$

Among them, h and f represent the body weight changes of the racers before and after training, y_i represents the cardio-pulmonary function related indexes of the racers after aerobic training, O_{i-1} and O_i represent the changes of body shape indexes of the racers before and after training, R^m and R^p represent the changes of body energy supply of the racers before and after training, w_i and v_i represent the definition of combined aerobic and anaerobic energy supply before and after training.

Use equation (2) to obtain the changes of cardio-pulmonary tolerance time, tolerance load, pulmonary ventilation and oxygen uptake of racing athletes at different training stages

$$p(x_i / y_{0i}) = C_i p(x_i / y_{0,i-1}) p(y_i / x_i) \quad (2)$$

Among them, $y_{0,i-1}$ represents the difference of the body indexes of the racing athletes before training, C_i represents the increasing load of the racing athletes at different training stages (cardiopulmonary endurance time, endurance load, pulmonary ventilation and oxygen uptake), and P represents the physical exhaustion of the racing athletes.

The formula (2) is brought in, and the cardio-pulmonary function detection model for aerobic training is established by using the formula (3)

$$N(x, \bar{x}) = \frac{(2k) \exp[-(x, \bar{x})]}{p(x_i / y_{0i})} \quad (3)$$

Among them, k represents the maximum allowable load of the racing athletes, and x, \bar{x} represents the maximum allowable load error of the racing athletes.

The activities of muscles and joints in various parts of the human body make the capillaries open and the reflux of veins and lymph accelerate, thus reducing the burden on the heart. The survey results in table 3 show that the step test index of the college students participating in Taiji boxing exercise is significantly higher than that of the college students not participating in Taiji boxing exercise. the step test can reflect the cardiopulmonary function, endurance and physical strength of the people. through the test measurement, the step test index of the two groups of subjects has significant difference ($p < 0.05$). Taiji boxing's cardiovascular stress response is close to the strength under the limit of four mettle bicycle dynamometers. This shows that Taiji boxing is a safe and reliable exercise for those with low cardiovascular function. The statistical results show that the

college students who insist on Taiji boxing exercise for a long time are higher in cardiopulmonary function, endurance and physical strength than those who do not participate in Taiji boxing exercise.

Table 3. Comparison results of bench test index between two groups of subjects

Group	Dimensions	$\bar{X} \pm S$	t	P
Participating in Taiji boxing exercise group	Step test	55.36±7.26	0.263	P<0.05
	Step test	53.67±9.22	0.272	

3.2.3 Physical fitness and athletic ability tests of college students participating in Taiji boxing exercise and college students not participating in Taiji boxing exercise

As Taiji boxing movement requires coordination and coordination of movements and breathing during exercise, and high concentration of mind, so as to reach the state of sinking qi into abdomen, thus scientifically regulating respiratory function and playing a positive role in developing lung function. Playing Taiji boxing can improve the air exchange capacity, poor breathing and large vital capacity. subjects can reduce breathing frequency and increase breathing depth to ensure oxygen supply by relying on their own respiratory muscle strength. The survey results in Table 4 show that there are significant differences in grip strength, shoulder joint flexibility, leg and foot flexibility, hand-eye coordination ability, reaction time and other indicators between college students who participate in Taiji boxing exercise and those who do not participate in Taiji boxing exercise, but there is no significant difference in language ability.

Table 4. Results of physical fitness and exercise ability tests for exercise and non-exercise

	Participating in Taiji boxing exercise group	Not participating in Taiji boxing exercise group	P
grip	23.81±5.26	15.36±4.12	<0.05
Shoulder joint flexibility (cm)	27.26±7.3	3878±6.22	<0.05
Language ability	20.17±3.22	26.25±3.08	>0.05
Hand-eye coordination	5.28±0.13	6.89±0.33	>0.05
Reaction time (s)	30.27±5.0	50.11±6.27	<0.05

3.3 Result analysis

Taiji boxing has a great influence on the cardiopulmonary function of college students. the vital capacity of college students participating in Taiji boxing exercise is higher than that of college students not participating in Taiji boxing exercise. Taiji boxing adopts abdominal breathing. During breathing, the contraction and relaxation of diaphragm and abdominal muscles cause the abdominal pressure to continuously change and the blood in myocardial nutrient vessels to continuously update, thus improving the function of cardiac nutrient vessels. Exercise Taiji boxing can reduce peripheral resistance, improve peripheral circulation, and play a good role in health care for senile peripheral circulation disorders. It also has a good effect on the pumping function of the heart. Due to the low exercise intensity of Taiji boxing exercise, it is often believed that although its influence on cardiopulmonary function is smaller than that of other training exercises, the special movements of Taiji boxing exercise greatly improve lower limb muscle strength and body balance. With the increase of age, the tissues and organs of the human body gradually age, and the structure and function of the heart and respiratory system undergo aging changes, among which the obvious changes are the decrease of vital capacity and vital capacity index. Wenzhe Wei et al. studied the exercise group over 60 years old and found that the time of standing on one foot with eyes closed increased significantly after Taiji boxing exercise [6]. After weeks of tai chi exercises for the elderly patients with osteoarthritis, Lin Feng found that the time of standing on one foot with eyes closed in

tai chi group increased significantly. Previous studies on the elderly have found that long-term Tai Chi intervention is needed to achieve significant changes [7].

Taiji boxing movement can enhance cardiac contractility, reduce pulse rate, shorten cardiac working time and relieve cardiac working pressure. Increasing blood circulation function during exercise can prevent cholesterol from depositing on the blood vessel wall, and the effect of muscle contraction force on blood vessels can effectively prevent arteriosclerosis of the elderly and increase the elasticity of the blood vessel wall. In the long run, the metabolic capacity of the elderly can be greatly enhanced, the respiration deepening and the respiratory frequency adaptability are slowed down, and the oxygen intake in quiet time can be increased. However, in the past, the research on Taiji boxing basically focused on excellent martial arts athletes, professional martial arts athletes or children and adolescents, and most of them were tested directly during routine exercises or before and after exercises, without following the training and testing process. The reason is that according to the principle of Taiji boxing, Taiji boxing is a gentle and slow movement, which has strict requirements on body posture and overall movement. Although these exercise essentials were mostly considered in terms of skill and attack at the beginning, they were in line with human physiological laws [8]. Zhang Quanhai conducted Zhou Taiji boxing exercise on two men, and found that standing time with eyes closed and one foot increased significantly, and the balance of lower limbs was effectively improved. Consistent with the results of this study, the table data show that the subjects' standing time with eyes closed and one foot standing significantly increased. In this paper, the bench test and vital capacity test and analysis were carried out on college students of different ages, and the influence of Taiji boxing on the cardiopulmonary function of college students was investigated.

Taiji boxing is gentle in movement, adopts abdominal breathing (so-called qi sinking abdomen), belongs to aerobic exercise, has less movement intensity, and has significant impact on cardiovascular system. During abdominal breathing, the abdominal internal pressure changes constantly. Massage on coronary artery can promote blood microcirculation, increase myocardial oxygen supply and improve body function. Liang Zhe's research shows that beating Taiji boxing can improve the air exchange capacity, poor breathing and large vital capacity. The subjects can rely on their own respiratory muscle strength to reduce respiratory frequency, increase respiratory depth and ensure oxygen supply. Some people abroad have also studied this problem [9], and their research has compared Taiji boxing with bicycle exercise, proving that exercise Taiji boxing is more effective in the use of ventilation. Taiji boxing exercise has a positive effect on improving the blood supply of the exerciser's heart, improving the working ability of the heart and reducing the incidence of cardiovascular diseases. After a long period of tai chi exercise, the strength of myocardial contraction and the tension dominated by the heart will change. at the same time, the requirements of Taiji boxing exercise on the control of various parts of the body promote the human body to need more blood circulation. In addition, Taiji boxing exercise can effectively promote blood vessel expansion, reduce blood pressure, promote fibrinolytic ability of blood, and soften blood vessels. with the growth of age, the fibrinolytic ability of human blood will gradually decrease, so college students should keep practicing Taiji boxing for a long time. It can make the heart rest better, improve and delay the aging of cardiovascular structure, and prevent cardiovascular diseases. Taiji boxing exercise also has certain therapeutic effects on chronic cardiovascular diseases such as hypertension and coronary heart disease [10].

4. Summary

Long-term adherence to Taiji boxing exercise can improve the cardiopulmonary function of college students. At the same time, it has a greater impact on men than on women. Fitness exercise for college students should focus on endurance items of aerobic exercise supplemented by muscle strength and flexibility exercises. Taiji boxing has a great beneficial effect on training college students' cardiopulmonary function and cardiovascular function. The myocardial oxygen consumption of the college students who did not participate in the exercise was higher than that of the college students who participated in Taiji boxing exercise before, after and during the recovery

period. Taiji boxing can increase cardiovascular function and prevent and treat diseases. Taiji boxing can scientifically regulate respiratory function and play a positive role in improving lung function. Taiji boxing exercise does not need special venues and equipment, is not limited by age and gender, is easy to carry out and is convenient to popularize. Long-term Taiji boxing exercise can slow down the heart rate, reduce blood pressure, effectively increase heart reserve, reduce myocardial oxygen consumption, and reduce peripheral resistance of blood vessels when college students are quiet, which shows that Taiji boxing can improve the body function of college students. It is suggested that Taiji boxing exercise should be vigorously carried out among college students.

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