EFFECTS OF AEROBIC GYMNASTICS ON HEART RATE VARIABILITY AND PHYSICAL PERFORMANCE IN MALE COLLEGE STUDENTS

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

EFEITOS DA GINÁSTICA AERÓBICA SOBRE A VARIAÇÃO DO RITMO CARDÍACO E DO DESEMPENHO FÍSICO DOS ESTUDANTES UNIVERSITÁRIOS MASCULINOS

EFECTOS DE LA GIMNASIA AERÓBICA SOBRE LA VARIABILIDAD DE LA FRECUENCIA CARDÍACA Y EL RENDIMIENTO FÍSICO DE ESTUDIANTES UNIVERSITARIOS MASCULINOS

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ABSTRACT

Introduction: There are many forms of physical exercise, and the traditional simple exercise can no longer meet people's increasing needs. With the rapid development of the economy, people's living standards have improved progressively. Exercise and fitness have become one of ways for people to relax and improve their quality of life. Objective: Analyze the effects of aerobic gymnastics on male college students' heart rate variability and physical performance. Methods: 10 male college students volunteered for a 6-week aerobic gym-based protocol. This paper discusses the influence of aerobic exercise on heart rate variability and physical fitness of 10 male college students through aerobic interventions for 6 weeks. Results: The HRV indexes SDNN, RMSSD, TP, HF, and LF/HF significantly differed before and after training. Conclusion: There are significant differences in the physical performance of volunteers such as grip strength, flexion of sitting posture, and sitting posture itself before and after the intervention. It is suggested that aerobic training can improve people's cardiac function and physical fitness. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Aerobic Exercise; College Athletes; Heart Rate; Physical Functional Performance.

RESUMO

Introdução: Existem muitas formas de exercício físico, e a forma tradicional de exercício simples já não pode satisfazer as necessidades crescentes das pessoas. Com o rápido desenvolvimento da economia, o nível de vida das pessoas tem melhorado progressivamente. O exercício físico e a condicionamento físico tornaram-se uma das formas de as pessoas relaxarem e melhorarem a sua qualidade de vida. Objetivo: Analisar os efeitos da ginástica aeróbica sobre a variação do ritmo cardíaco e desempenho físico dos estudantes universitários masculinos. Métodos: 10 estudantes universitários masculinos foram voluntários de um protocolo baseado em ginástica aeróbica com duração de 6 semanas. Este artigo discute a influência do exercício aeróbico na variabilidade do ritmo cardíaco e na aptidão física de 10 estudantes universitários masculinos através de intervenções aeróbicas por 6 semanas. Resultados: Os índices HRV SDNN, RMSSD, TP, HF e LF/HF foram significativamente diferentes antes e depois do treino. Conclusão: Existem diferenças significativas do desempenho físico dos voluntários como força de preensão, flexão da postura sentada e da própria postura sentada antes e depois da intervenção. Sugere-se que o treino aeróbico pode melhorar a função cardíaca e a condição física das pessoas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Exercício Aeróbico; Atletas Universitários; Frequência Cardíaca; Desempenho Físico Funcional.*

RESUMEN

Introducción: Hay muchas formas de ejercicio físico, y la forma tradicional de ejercicio simple ya no puede satisfacer las necesidades crecientes de la gente. Con el rápido desarrollo de la economía, el nivel de vida de la población ha mejorado progresivamente. El ejercicio físico y el acondicionamiento físico se han convertido en una de las formas de relajarse y mejorar la calidad de vida de las personas. Objetivo: Analizar los efectos de la gimnasia aeróbica sobre la variabilidad de la frecuencia cardíaca y el rendimiento físico de estudiantes universitarios de sexo masculino. Métodos: 10 estudiantes universitarios se ofrecieron como voluntarios para un protocolo de 6 semanas de gimnasia aeróbica. Este artículo analiza la influencia del ejercicio aeróbico en la variabilidad de la frecuencia cardíaca y la aptitud física de 10 estudiantes universitarios masculinos mediante intervenciones aeróbicas durante 6 semanas. Resultados: Los índices de HRV SDNN, RMSSD, TP, HF y LF/HF fueron significativamente diferentes antes y después del entrenamiento. Conclusión: Existen diferencias significativas en el rendimiento físico de los voluntarios como la fuerza de agarre, la flexión de la postura sentada y la propia postura sentada antes y después de la intervención. Se sugiere que el entrenamiento aeróbico puede mejorar la función cardíaca y la aptitud física de las personas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: Ejercicio Aeróbico; Atletas Universitarios; Frecuencia Cardíaca; Rendimiento Físico Funcional.

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0488 Article received on 09/05/2022 accepted on 10/24/2022

INTRODUCTION

A large number of studies have shown that regular participation in sports can increase HRV (Heart Rate variability), strengthen the ability of autonomic nerve to regulate the heart, reduce the heart rate at rest, make vagus nerve dominate and improve the activity of sympathetic nerve, thus reducing the occurrence of cardiovascular diseases. Long-term calisthenics exercises can enhance heart and lung function, increase muscle strength and shape the body, so they are deeply loved by everyone.[1]

Aerobics in the windy world draws on the strengths of many people, and can complete various movements such as running, jumping, turning, twisting, swinging, etc. with moderate intensity of aerobic energy under the accompaniment of sweet music, which makes people always feel happy and in high spirits during the whole exercise process, thus having a good influence on human body fitness and bodybuilding.[2,3] The purpose of this study is to carry out a 16-week aerobic exercise intervention, take HRV as an effective index to evaluate the regulation of autonomic nerve on sinus node, explore the influence of aerobic exercise on female college students' HRV, and provide a theoretical basis for college students' exercise.

Overview of HRV

The time R-R interval between heartbeats is inconsistent, which is mainly regulated by the nervous system to adapt to changes in the environment. The double regulation and mutual restriction of cardiac sympathetic nerve and cardiac vagus nerve lead to the irregularity of heart rate change in cardiac rhythm.[4,5] Generally speaking, the sympathetic nerve has a large active area, and it often participates in the reaction with the whole system. Its main function is to prompt the body to quickly adapt to the sudden changes in the environment. Sympathetic stimulation takes effect and recovers slowly, while parasympathetic stimulation takes effect and recovers quickly. The essence of HRV is the common regulation of nervous system.

HRV refers to the slight difference between successive cardiac cycles. The heart rate changes, and the wave-by-wave variation of the heart cycle becomes more and more obvious. The research object of HRV is only the time difference of successive cardiac cycles. Listing the differences between each cardiac cycle of human body can show many seemingly disordered parameters, which reflect the continuous instantaneous fluctuation of heart rate. The fluctuation of heart rate is not accidental, but a response made by many factors such as nerves and body fluids in order to adapt to different physiological conditions or some pathological states.

With the increase of age, the activity of vagus nerve will decrease, and the sympathetic nerve will control the autonomic cells of sinoatrial node. Therefore, the risk of cardiovascular diseases will gradually increase with the increase of age. Physiological factors have certain influence on HRV, including:[6,7] Weight, temperature, breathing, age, sex and other factors. With the increase of body weight, HRV decreases, the HRV of obese people is lower, and the activity of vagus nerve decreases significantly. HRV is influenced by psychological factors. Good mood can increase HRV, while sad mood can decrease HRV. Psychological diseases also have many influences on heart rate variability. In patients with depression and anxiety, vagus nerve activity decreases, sympathetic nerve activity increases, and autonomic nerve dysfunction causes HRV decrease and increases the risk of cardiovascular diseases.

Because HRV provides the index of parasympathetic nervous system, and parasympathetic nervous system is related to many aspects of psychophysiology, such as self-regulation mechanism related to cognitive, emotional, social and health phenomena, HRV has become the focus of psychophysiology research.[8] HRV is influenced by many factors, such as age, sex, height, weight, health status, alcohol, tobacco, stimulants, physiological conditions such as biological rhythm, sleep cycle, body temperature, metabolic rate, environmental factors such as noise, temperature, humidity, test time, test instruments, calculation methods, sampling frequency, and body posture of the subjects during the test.

Research method

Research objects

10 ordinary male college students were randomly selected as the research objects. Exercise intervention of 6-week aerobics for 6 weeks, 3 times a week, 90min minutes each time, with moderate intensity (60%-70% of the maximum heart rate).

Literature data method

According to the needs of this paper, during the research process, the related literatures were consulted, including: the concept of HRV, physiological mechanism, the influence of exercise on HRV, the application of HRV indicators in sports and other related materials. The related materials were screened, classified and sorted out, which laid the foundation for this research.

Experimental method

HRV test: Before and after the experiment, all the subjects' HRV tests were carried out by step-by-step increasing load function experiment, and the indexes of HRV before, during and after exercise were collected. During the 6-week aerobics class, the subjects took 4 tests. The test indexes in this paper include the basic information of the subjects (age, height, weight); Test indicators of HRV include: time domain indicators: SDNN(standard deviation of the NN interval), RMSSD (root mean square of SDs between adjacent NN intervals), RR(two adjacent heart beats), Frequency domain indicators are: VLF(very low frequency), HF(high frequency), TP(total power), LF(low frequency), LF/HF.

Physical fitness test: Physical fitness test adopts Students' Physical Fitness Health Standard. Including vital capacity, grip strength, sit-ups, sitting body flexion. Body composition test was performed with a body composition instrument made in Korea. Other instruments mainly include electronic spirometer, electronic sitting body flexion meter, electronic eye-closed one-legged standing tester, reaction time tester, electronic grip strength meter and electronic vertical jump meter. Test the above items twice, and get the best value. The above instruments are all from domestic physical health testing system.

The study is Purely observational studies which no need to registry ID of ICMJE, and all the participants were reviewed and approved by Ethics Committee of Guangzhou Sport University, China (NO. 2022005)

Mathematical statistics

In this study, Excel and spss26.0 statistical software were used to process the data. Data of normal distribution or approximate normal distribution are expressed as mean ± standard deviation, and data of non normal distribution are expressed as median and quartile. Data are expressed as mean ± standard deviation. $P < 0.05$ is a significant difference, $P < 0.01$ is a very significant difference, and $P > 0.05$ is no difference.

RESULT

Analysis on the changes of HRV time domain and frequency domain indexes before and after aerobics training

As shown in Table 1, after 6 weeks of HIIT, the HRV indexes of the subjects were compared before and after, and the statistical results of one-to-one paired sample T-test showed that the SDNN indexes had significant differences before and after the intervention ($p < 0.05$); There was no significant difference in RMSSD indicators before and after intervention ($p < 0.05$). There were significant differences in SDSD

Table 1. Comparison of HRV before and after in-subjects.

	Before intervention	After intervention	t	P
SDNN(ms)	55.36±12.1	69.38±7.51**	4.35	0.001
RMSSD(ms)	55.01±13.14	68.15±11.24*	2.28	0.021
SDSD(ms)	74.14±17.35	88.93±14.98*	2.36	0.033
TP(ms^2)	1054.66±432.18	1428.07±705.11**	5.04	0.001
HF(ms^2)	581.24±336.98	701.39±369.21	1.06	0.332
LF(ms^2)	389.75±225.16	522.17±363.82*	2.66	0.028
LF/HF	4.21±2.26	1.02±0.63*	1.33	0.014

There is a significant difference before and after "*" ($p<0.05$) and before and after "* *" ($p<0.01$).

indexes before and after intervention ($p <0.05$). There were significant differences before and after TP intervention ($p <0.05$). There was no significant difference before and after HF intervention ($p>0.05$). There were significant differences before and after LF intervention ($p <0.05$). LF/HF has significant difference before and after aerobics ($P<0.05$).

To sum up, the results show that 6-week high-intensity interval training can effectively improve the HRV of college athletes.

Changes of physical fitness indexes before and after intervention

With the strong beat of aerobics music, the combination of rhythm and intensity is highlighted. The rhythmic changes of movement frequency and load intensity will produce fruitful exercises for ligament muscles. A lively movement composed of walking, running, jumping, basic movements, difficult movements and other maneuvers.

It not only promotes the development of muscles and strength directly involved in activities, but also promotes the improvement of internal organs and nervous system. Practice has proved that the comprehensiveness and balance of fitness is the biggest feature of aerobics. It is a whole-body, fast-paced and heavy-load exercise, which has a series of effects and influences on human body. The activities of the head, shoulders, waist, legs and joints are beneficial to the coordination and flexibility of the body.

From Table 2, it can be seen that there are significant differences in vital capacity, grip strength, sit-ups, sitting body flexion before and after aerobics exercise ($P < 0.01$), and the indicators show a trend of getting better; There is a significant difference in the results of sitting flexion test after exercise ($P<0.01$), and it is better after training than before. Other physical indexes have been improved in different degrees, but there is no significant difference before and after the experiment ($P>0.05$).

DISCUSSION

Physical exercise can promote students' physical health as well as their mental health. Different types, loads (time and intensity of activities) and organizational forms of physical exercise and fitness activities have different effects on the development of students' mental health.[9] According to the characteristics of different students, multi-factor research design is adopted to quantitatively study the effects of physical exercise types, organizational forms, loads and other factors on students' physiological and psychological benefits. Scientifically designing students' physical exercise and fitness courses is helpful to bring the best physiological and psychological benefits of physical exercise into play.

The research results of mid-time domain indicators in this paper show that: after 6 weeks of aerobics exercise, the HRV indicators of

Table 2. Changes of physical fitness indexes before and after aerobics training.

Test index	Before intervention	After intervention
Vital capacity (ml)	3603.8±388.37	3928.66±367.01*
Grip strength (n)	33.11±4.55	36.28±4.33*
Sit-ups (times /min)	25.28±11.06	30.12±10.26*
Sitting body flexion (cm)	8.96±8.14	10.11±8.91**

subjects are compared before and after, and the statistical results of one-to-one paired sample T-test show that there are significant differences between the SDNN indicators before and after the intervention ($P < 0.05$); There was no significant difference in RMSSD indicators before and after intervention ($P < 0.05$). There were significant differences in SDSD indexes before and after intervention ($p <0.05$). It is suggested that long-term aerobic exercise can increase the tension of vagus nerve, and the increased tension of vagus nerve will increase the threshold of ventricular fibrillation, thus protecting the heart.[10] Under the same load exercise, the activity of vagus nerve increased significantly, the activity of sympathetic nerve decreased, the ratio of vagus nerve to sympathetic nerve decreased, and the autonomic nervous system reached a new balance. The inhibition of vagus nerve to sympathetic nerve is enhanced, and the ability of autonomic nerve to regulate the heart is significantly improved. This suggests that aerobic exercise can improve cardiovascular function and prevent sympathetic nerve excitability from being enhanced during exercise, leading to cardiovascular diseases.

The regularity of physical exercise means that the rhythm, time interval and amount of exercise should be scientific. The time, frequency and amount of exercise for male college students to participate in aerobics should be guaranteed. Besides the 90-minute physical education class exercise once a week, at the same time, at least one organized extracurricular exercise should be added.[11] After taking part in aerobics exercise, there are significant differences in vital capacity, grip strength, sit-ups, and body flexion before and after aerobics exercise ($P<0.01$), and the indicators show a better trend. It shows that long-term adherence to calisthenics exercises can obviously promote the physique of male college students. Teachers in colleges and universities should actively carry out research on other projects, and find suitable sports projects and intensity for different types of students, so as to improve their physical self-esteem and mental health.

CONCLUSION

After 6 weeks of HIIT, subjects' HRV indexes were compared before and after, and the statistical results of paired samples T-test showed that SDNN, RMSSD, SDSD, LF and LF/HF had significant differences before and after aerobics exercise ($P<0.05$), indicating that 6 weeks of high-intensity interval training effectively improved the HRV of college athletes. In the physical index test of the subjects, there are significant differences in vital capacity, grip strength, sit-ups, and sitting body flexion before and after aerobics exercise ($P < 0.01$), and the indexes show a trend of improvement. It is suggested that aerobics training can improve people's heart function and physical condition.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Yu`an Sun: writing and performing surgeries; Hao Jiang: data analysis and performing surgeries, article review and intellectual concept of the article.

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