

# SPORTS TRAINING TO DETECT THE HEART RATE AND BODY TEMPERATURE OF ADOLESCENTS

TREINAMENTO ESPORTIVO PARA DETECTAR A FREQUÊNCIA CARDÍACA E A TEMPERATURA CORPORAL DE ADOLESCENTES

ENTRENAMIENTO DEPORTIVO PARA DETECTAR LA FRECUENCIA CARDÍACA Y LA TEMPERATURA CORPORAL DE ADOLESCENTES



ORIGINAL ARTICLE  
ARTIGO ORIGINAL  
ARTÍCULO ORIGINAL

Xiugang Pan<sup>1</sup>   
(Physical Education Professional)  
Mengying Song<sup>1</sup>   
(Physical Education Professional)  
Xingan Pan<sup>2</sup>   
(Physical Education Professional)

1. Sports Center of Xi'an Jiaotong University, Xi'an, China.  
2. Xi'an New Target Training Center, Xi'an, China.

## Correspondence:

Mengying Song  
Xi'an, China, 710049.  
MengyingSong2@126.com

## ABSTRACT

**Introduction:** Due to the increase in the number of only children in China, mental illness in adolescents is on the rise, which affects the development of students' physical and mental health. **Objective:** To study the effect of exercise training on the heart rate of adolescents. **Methods:** The students in the badminton and tai chi optional courses in the school's second grade were randomly selected for moderate-intensity badminton and tai chi training. **Results:** The mood score of the moderate-intensity tai chi test was between 44 and 51 points, and that of the moderate-intensity badminton experiment was between 42 and 49 points. The heart rate of the moderate-intensity tai chi test was 90 ~ 117 beats/min, and that of the moderate-intensity badminton test was 121 ~ 142 beats/min. Therefore, moderate-intensity badminton training has a significant influence on adolescents' heart rate and mood. **Conclusions:** Moderate-intensity badminton exercise can improve adolescents' health and mood. It also has a positive effect on maintaining and stabilizing adolescents' mental health. **Level of evidence II; Therapeutic studies - investigation of treatment results.**

**Keywords:** Sports; Heart Rate; Detection.

## RESUMO

**Introdução:** Graças ao aumento no número de filhos únicos na China, doenças mentais entre adolescentes têm se tornado mais frequentes, o que afeta o desenvolvimento da saúde mental e física dos estudantes. **Objetivo:** Estudar o efeito de treinamento físico na frequência cardíaca de adolescentes. **Métodos:** Estudantes secundários que participam das aulas optativas de tai chi chuan e badminton foram selecionados aleatoriamente para treinos de intensidade moderada em tai chi chuan e badminton. **Resultados:** A pontuação dos participantes no quesito disposição variou de 44 a 51 entre os alunos que participaram do teste de intensidade moderada em tai chi chuan, variando de 42 a 49 entre aqueles que participaram do teste de badminton. Para aqueles que praticaram tai chi chuan, a frequência cardíaca foi de 90~117 bpm, enquanto para os praticantes de badminton, foi de 121~142 bpm. Portanto, o treino de badminton de intensidade moderada teve influência significativa na frequência cardíaca e na disposição dos adolescentes. **Conclusões:** Badminton de intensidade moderada pode melhorar a disposição e a saúde de adolescentes, além de ter um efeito positivo na manutenção e estabilização de sua saúde mental. **Nível de evidência II; Estudos terapêuticos – investigação do resultado de tratamentos.**

**Descritores:** Esportes; Frequência cardíaca; Detecção.

## RESUMEN

**Introducción:** Gracias al aumento en el número de hijos únicos en la China, enfermedades mentales entre adolescentes se han tornado más frecuentes, lo que afecta el desarrollo de la salud mental y física de los estudiantes. **Objetivo:** Estudiar el efecto del entrenamiento físico en la frecuencia cardíaca de adolescentes. **Métodos:** Los estudiantes de secundaria que participan en las clases optativas de tai chi chuan y bádminton fueron seleccionados aleatoriamente para entrenamientos de intensidad moderada en tai chi chuan y bádminton. **Resultados:** La puntuación de los participantes en la categoría de la disposición varió de 44 a 51 entre los alumnos que participaron en la prueba de intensidad moderada en tai chi chuan, variando de 42 a 49 entre aquellos que participaron en la prueba de bádminton. Para aquellos que practicaron tai chi chuan, la frecuencia cardíaca fue de 90~117 ppm, mientras que, para los participantes de bádminton, fue de 121~142 ppm. Por lo tanto, el entrenamiento de bádminton de intensidad moderada tuvo influencia significativa en la frecuencia cardíaca y en la disposición de los adolescentes. **Conclusiones:** El deporte bádminton, de intensidad moderada, puede mejorar la disposición y la salud de adolescentes, además de tener un efecto positivo en la mantención y estabilización de su salud mental. **Nivel de evidencia II; Estudios terapéuticos – investigación del resultado de tratamientos.**

**Descriptorios:** Deportes; Frecuencia cardíaca; Detección.



## INTRODUCTION

The healthy physique of young people is the basic prerequisite for serving the motherland and the people, it is a manifestation of the vigorous vitality of the Chinese nation. School education should implement the sustainable development concept of "all for students, health first", effectively strengthen sports work. Let every student feel the joy of sports, so as to enrich campus life, promote the harmonious development of students' physical and mental health. The 2006 national school sports work conference and the ministry of education, state administration of recreation and recreation, the central committee of the communist youth league issued the spirit of the notice on developing sunshine sports for hundreds of thousands of students.<sup>1-3</sup> Its purpose is to strengthen school sports work, stimulate students' interest in sports, develop students' exercise habits, promote students in physical, psychological and social adaptability are healthy and harmonious development. Therefore, study the physical health of teenagers, monitor the potential risks in physical education, to protect the physical and mental health of students, provide it with a solid scientific research guarantee, it also has great practical significance, a lot of work needs to be invested. When the body exercises in a hot environment, heat stress occurs, thus heat acclimatization occurs.<sup>4</sup> Thermal acclimatization can regulate the body's body temperature, water and electrolyte metabolism and cardiovascular function have improved, thereby improving the body's thermal tolerance. However, when the body's heat stress is excessive, it will cause heat damage, causes the body to have symptoms of syncope and even shock, the harm caused by the thermal environment has already started from life, learn, housing affects people in many ways. The heart rate during moderate-intensity physical activity exercises is between 120~150 beats/min, mood is a certain emotional state that a person persists for a long time.<sup>5</sup>

## METHOD

### Research object

Random selection of badminton and Tai Chi optional classes in the second grade of the school, 168 people in the badminton class are the experimental group, 174 people in the Tai Chi option class were the control group\*\*. The 261 people who did not participate in sports activities in the third grade were the control group\*\*\*. (Table 1)

### Research methods

The main test indicators of the body composition analyzer: Body water content, protein content, inorganic salt content, skeletal muscle content, body fat content, body mass parameters, waist to hip fat ratio, percent body fat. The stopwatch records the time of badminton training, and measure your heart rate after running, 10 minutes of blood pressure, 20 minutes, the 30th minute. Dr. Pulse is used to measure the heart rate and blood pressure before and after badminton training. The temperature and humidity meter measures the temperature and humidity of actual weather. Step 1: Select badminton and Tai Chi students, collect relevant information: Gender, age, height, weight, heart rate at rest, blood pressure. Step 2: Explain to students the basic rules for the use of body components, students are required to take body composition measurements to wear as little as possible, and before and after the test to ensure that the wear is consistent, drinking water is prohibited during the test period. Step 3: Precursor components for badminton training (Moisture content, body fat content, skeletal muscle content, inorganic salt content, protein content) test.

**Table 1.** Basic Statistics of Test Objects (n=46).

Group	Gender	Height	Weight
badminton	16.66±1.18	168.1±4.32	50.23±4.23
Tai chi chuan	15.23±1.19	165.23±5.69	49.56±2.61

Step 4: Explain the requirements of badminton training, do preparatory activities before running.

Step 5: After the badminton training, the body composition was measured again.

### 1. Literature data method

According to China academic journal network, library and other materials, provide a theoretical basis for the study of this article.

### 2. Questionnaire survey method

State of Mood Scale (POMS) (Zhu Beili, revised in 1994).

### 3. Mathematical Statistics

## RESULTS

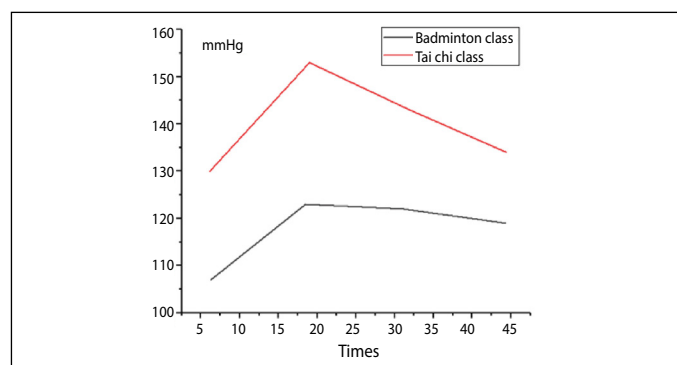
The statistical results show: activity, experimental group\*average heart rate>control group\*\*>control group\*\*\*; Average heart rate after activity, experimental group\*average heart rate>control group\*\*>control group\*\*\*. Table 2: Control group\*\* three sets of static average heart rate> two sets> one set; Control group \*\*three sets of average heart rate during exercise>two sets>one set; The control group\*\* the average heart rate of the three sets after exercise>the second set>the one set.

The heart rate of the moderate-intensity Tai Chi test is between 90 and 117 beats/min, the heart rate of the moderate-intensity badminton experiment is between 121 and 142 beats/min, therefore, medium-intensity badminton exercise is an extremely meaningful aerobic exercise. In the non-exercising group, its heart rate is maintained between 81~102 beats/min, the experimental heart rate of moderate-intensity badminton exercise is between 121 and 142 beats/min. Moderate-intensity badminton exercise can promote and improve the heart rate and cardiovascular function of young people, it has a positive meaning for enhancing the heart function of adolescents.<sup>6</sup> The mood changes of men and women before and after physical activity are basically the same, teenagers are anxious after the event, depression, fatigue, negative emotions such as irritability gradually decrease, more energetic. The mood score of the moderate-intensity Tai Chi test is between 44 and 51 points, the mood score of the moderate-intensity badminton experiment is between 42 and 49 points, therefore, moderate-intensity badminton exercise has a health-promoting function for the mood of young people, it has a positive effect on maintaining and stabilizing the mental health of adolescents.<sup>7</sup>

From Figure 1, before badminton training in hot environment, the systolic blood pressure of the badminton class is higher than the systolic blood pressure of the Taijiquan class; The change trend of systolic blood

**Table 2.** Control group \*\* Heart rate values during one set, two sets, and three sets of continuous exercises ( $\bar{x} \pm s$ ).

state	Practice a set of	Exercise two sets of	Practice three sets of
static	90.64±10.42	96.3 ±5.4	99.0±8.04
In the movement	96.64±10.07	104.37±13.11	107.54±13.04
After a workout	93.41±14.32	98.55±11.21	99.46 ±9.09

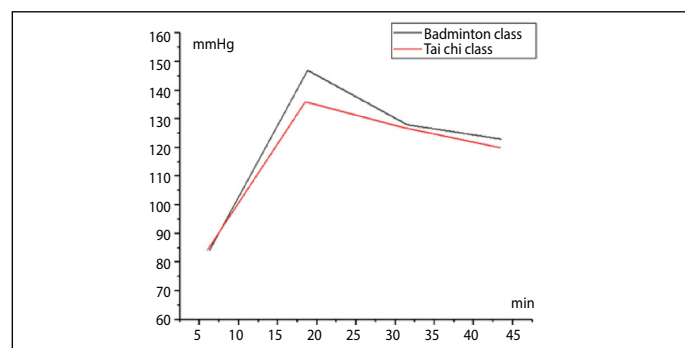


**Figure 1.** The change trend of systolic blood pressure in badminton training under thermal environment.

pressure after training has dropped significantly in badminton classes, Tai Chi class is gentler than badminton class, the decline is small; In the third minute of training, the systolic blood pressure of the Tai Chi class returned to the systolic blood pressure before running, in the Tai Chi class, the systolic blood pressure was returned from the pre-run systolic blood pressure in the 3rd minute after the run. There is a distance. Therefore, the recovery of systolic blood pressure before and after badminton training in a hot environment is better in badminton classes than in Tai Chi classes.

The sample difference t test was performed on the diastolic blood pressure before and after badminton training in a hot environment, the results show that, the diastolic blood pressure of boys in the first minute before and after badminton training in a hot environment is significantly different from the diastolic blood pressure before running ( $P < 0.01$ ), there was no significant difference between the diastolic blood pressure in the 2nd and 3rd minutes after training and the diastolic blood pressure before running ( $P \geq 0.05$ ); The diastolic blood pressure of girls at the first minute and the third minute after 12 minutes of running in a hot environment is significantly different from the pre-running diastolic blood pressure ( $0.01 \leq P < 0.05$ ), the diastolic blood pressure in the second minute after running was significantly different from that before running ( $P < 0.01$ ).

It can also be seen from Figure 2, the quiet heart rate of girls before badminton training in hot environment is higher than that of boys; At the 5th minute after training, the heart rate did not return to the state of resting heart rate before running; the change trend of girls between the 10th and 20th minutes after training was faster than that of boys,



**Figure 2.** Heart rate change trend of badminton training in hot environment.

there is no significant difference in the trend between the 20th minute and the 30th minute. Therefore, in hot environment, the heart rate of men and girls in badminton training cannot return to the quiet state before running within 10 minutes; The recovery of the heart rate of girls is better than that of boys within 20 minutes after running.

## DISCUSSION

Heart rate refers to the regular pulsation of the arterial blood vessel wall with the contraction and relaxation of the heart, it is a commonly used measurement index in sports practice.<sup>8</sup> For every 1°C increase in body temperature, the heart rate can be increased by 12-18 beats per minute.<sup>9</sup> Exercise in a hot environment, the body's heat dissipation cannot offset the large amount of heat generation, increase the central temperature, the heart rate is higher at the same exercise intensity than at room temperature, the difference can reach 10 times/min, therefore, the excessively high evaluation of exercise intensity also reflects that the exercise intensity of exercise in a hot environment is lower than the exercise intensity in a normal temperature environment, forcibly requiring students to reach the exercise intensity of normal temperature exercise in a hot environment can easily cause sports injuries or fever.<sup>10</sup> Therefore, heart rate can be used as an indicator of exercise intensity for endurance exercise in a hot environment.

## CONCLUSION

In sports activities and strength, different human heart rates and emotions have different influences, medium intensity badminton activities can improve people's health, adjust the excellent effects of the soul, medium-inten heart rate SITY badminton sports group higher than Tai Chi Group and Non-exercise group; medium intensity badminton movement helps improve the emotions of young people. Medium intensity physical activities can adjust the heart, improve emotions, improve their enthusiasm, benefit from physical activity.

## ACKNOWLEDGMENT

Teaching reform project of Xi'an Jiaotong University, Project No.:20SJZX40.

Regular topics of Shaanxi Provincial Sports Bureau, Project No.:2021151.

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

**AUTHORS' CONTRIBUTIONS:** Each author made significant individual contributions to this manuscript. Xiugang Pan: writing and performing surgeries; Mengying Song: data analysis and performing surgeries; Xingan Pan: article review and intellectual concept of the article.

## REFERENCES

- Lazzer S, Tringali G, Caccavale M, De Micheli R, Abbruzzese L, Sartorio A. Effects of high-intensity interval training on physical capacities and substrate oxidation rate in obese adolescents. *Journal of Endocrinological Investigation*. 2017;40(2):217-26.
- Kim J, Son W, Headid R. Corrigendum to: The effects of a 12-week jump rope exercise program on body composition, insulin sensitivity, and academic self-efficacy in obese adolescent girls. *Journal of Pediatric Endocrinology and Metabolism*. 2020;33(5):681.
- Morrisey C, Montero D, Raverdy C. Effects of Exercise Intensity on Microvascular Function in Obese Adolescents. *International Journal of Sports Medicine*. 2018;39(6):450-5.
- Milano-Gai GE, Furtado-Alle L, Mota J, Lazarotto L, Milano GE, Lehtonen RR et al. 12-Week aerobic exercise and nutritional program minimized the presence of the 64Arg allele on insulin resistance. *Journal of pediatric endocrinology & metabolism: JPEM*. 2018;31(9):1033-42.
- Winn C, McNarry M, Stratton G, Wilson AM, Davies GA. P151 Withdrawn: Effect of high-intensity exercise on lung function, aerobic performance and airway inflammation in asthma. *Thorax*. 2016;71(3):A165.2-A165.
- Ostman C, Jewiss D, Smart NA. The Effect of Exercise Training Intensity on Quality of Life in Heart Failure Patients: A Systematic Review and Meta-Analysis. *Cardiology*. 2016;136(2):79-89.
- Mathunjwa ML, Mugandani SC, Kappo AP, Ivanov S, Djarova-Daniels T. Effect of 4weeks high-intensity intermittent taekwondo training on body composition and physical fitness in zulu descent, south african taekwondo athletes. *British Journal of Sports Medicine*. 2016;50(22):e4.15-e4.
- McNarry MA, Lester L, Ellins EA, Halcox JP, Davies G, Winn CON et al. Asthma and high-intensity interval training have no effect on clustered cardiometabolic risk or arterial stiffness in adolescents. *European Journal of Applied Physiology*. 2021;121(7):1-12.
- Lahart IM, Metsios GS. Chronic Physiological Effects of Swim Training Interventions in Non-Elite Swimmers: A Systematic Review and Meta-Analysis. *Sports Medicine*. 2017;48(1):1-23.
- Elsner VR, Basso C, Bertoldi K, Ferreira de Meireles LC, Cechinel LR, Siqueira IR. Differential effect of treadmill exercise on histone deacetylase activity in rat striatum at different stages of development. *The Journal of Physiological Sciences*. 2016;67(3):1-8.