HIGH-INTENSITY INTERVAL TRAINING APPLIED TO PHYSICAL TRAINING

TREINAMENTO INTERVALADO DE ALTA INTENSIDADE APLICADO AO TREINO FÍSICO

ENTRENAMIENTO POR INTERVALOS DE ALTA INTENSIDAD APLICADO AL ENTRENAMIENTO FÍSICO

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ABSTRACT

Introduction: High-intensity interval training (HIIT) has been widely used in functional physical performance enhancement, with the characteristics of low time demand and fast effects. Currently, many ways and methods are adopted in sports training, but the impact of HIIT training still needs to be determined. Objective: Explore the effect of HIIT on physical training. Methods: The training content includes preparatory activities, intermittent training, and relaxation activities. The preparatory and relaxation activities of the experimental and control groups are completely the same, differentiating only the addition of a protocol with HIIT in the control group. HIIT of medium intensity was adopted. Results: After 10 weeks of intervention, there was no significant difference in vital capacity between the experimental and control groups. Comparing the vital capacity indices of the volunteers in both groups, it was found that the vital capacity levels of the experimental and control groups showed positive differences. Still, the experimental group with HIIT had a greater gain in their vital capacity. Conclusion: HIIT can effectively improve the functional physical performance of athletes. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: High-Intensity Interval Training; Physical Functional Performance; Physical Education and Training.

RESUMO

Introdução: O treinamento intervalado de alta intensidade (HIIT) tem sido amplamente utilizado no campo do aprimoramento do desempenho físico funcional, com as características de baixa demanda de tempo e efeitos rápidos. Atualmente, existem muitas maneiras e métodos adotados no treinamento esportivo, mas o impacto do treinamento com HIIT ainda não é claro. Objetivo: Explorar o efeito do HIIT sobre o treino físico. Métodos: O conteúdo do treinamento inclui atividades preparatórias, treinamento intermitente e atividades de relaxamento. As atividades preparatórias e atividades de relaxamento do grupo experimental e do grupo de controle são completamente as mesmas, diferenciando apenas a adição de um protocolo com HIIT no grupo de controle. Foi adotado o HIIT de média intensidade. Resultados: Após 10 semanas de intervenção, não houve diferença significativa na capacidade vital entre o grupo experimental e o grupo de controle. Comparando os índices de capacidade vital dos voluntários em ambos os grupos, constatou-se que os níveis de capacidade vital do grupo experimental e do grupo controle demonstraram diferenças positivas, porém o grupo experimental com HIIT teve um maior ganho na sua capacidade vital. Conclusão: O HIIT pode efetivamente melhorar o desempenho físico funcional dos atletas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Treinamento Intervalado de Alta Intensidade; Desempenho Físico Funcional; Educação Física e Treinamento.*

RESUMEN

Introducción: El entrenamiento de intervalos de alta intensidad (HIIT) ha sido ampliamente utilizado en el campo de la mejora del rendimiento físico funcional, con las características de baja demanda de tiempo y efectos rápidos. Actualmente, hay muchas formas y métodos adoptados en el entrenamiento deportivo, pero el impacto del entrenamiento HIIT aún no está claro. Objetivo: Explorar el efecto del HIIT en el entrenamiento físico. Métodos: El contenido del entrenamiento incluye actividades preparatorias, entrenamiento intermitente y actividades de relajación. Las actividades preparatorias y de relajación del grupo experimental y del grupo de control son completamente iguales, diferenciándose únicamente por la adición de un protocolo con HIIT en el grupo de control. Se adoptó el HIIT de intensidad media. Resultados: Tras 10 semanas de intervención, no hubo diferencias significativas en la capacidad vital entre el grupo experimental y el grupo de control. Al comparar los índices de capacidad vital de los voluntarios de ambos grupos, se comprobó que los niveles de capacidad vital del grupo experimental y del grupo de control mostraban diferencias positivas, pero el grupo experimental con HIIT tuvo una mayor ganancia en su capacidad vital. Conclusión: El HIIT puede mejorar eficazmente el rendimiento físico funcional de los atletas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Entrenamiento de Intervalos de Alta Intensidad; Rendimiento Físico Funcional; Educación y Entrenamiento Físico.*

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INTRODUCTION

The training mode with short training time but obvious effect is called high-intensity intermittent training. Compared with general sports, this training mode is a scientific training mode with twice the result with half the effort.[1] Therefore, it is loved by many professionals and the public in sports and fitness, and is also regarded as one of the training contents of athletes. This training method also has its role in the rehabilitation of medical disciplines. In the clinical application, there are high-intensity intermittent training programs for different groups to strengthen their physical fitness in the gradual training.[2] For various reasons, people tend to think that high-intensity interval training is specially designed for those with excellent physical quality in the sports and fitness circles. Therefore, only they are suitable for this training. Those who have not received professional training cannot master this training skill, and rash training may lead to a series of dangers. However, this is actually a misunderstanding and prejudice. In fact, if we understand the training mechanism of high-intensity intermittent training and scientifically control the exercise intensity and exercise time, ordinary people can fully implement their own exercise plan through this exercise method to achieve the purpose of improving physical quality and physical function.[3]

In people's traditional concept, whether through repeated training, group training or interval training, it is effective for physical exercise and health maintenance. However, if you are used to using a certain fixed training method, your body will gradually adapt, the training effect will be greatly reduced, and the sports effect will encounter a bottleneck.[4] Therefore, for the majority of people who love fitness and sports, if they want to steadily improve the training effect, they need more scientific and reasonable training methods. By consulting the literature and visiting sports experts and coaches, we can understand that the high-intensity intermittent training method is a training method that is very targeted for the improvement of sports ability in all aspects of training, and has the effect of significantly enhancing the physical quality and physical ability of trainers.[5] As the name implies, the characteristics of high-intensity interval training are as follows: first, the intensity of training is high, second, the duration is short, and third, the interval time of sports is short. The above three points make the total amount of training smaller, but the total effect of training is the same, and even improved.[6] Therefore, it is a highly cost-effective training method. In addition, high-intensity intermittent training has many advantages. Correct training can enable athletes to have physical and psychological adaptability to high-intensity competition, so they can play stably or even supernormal in the high-intensity actual competition environment.[7] This is because during the training interval of high-intensity exercise, the blood lactic acid concentration in the blood is always in a high state, and it is continuously delivered to each muscle cell to fully exchange energy with the intracellular environment and carry out a series of complex oxidation reactions, that is, the cardiovascular system and respiratory system are always at a high operating level. On the basis of this physical state, if continuous high-intensity exercise stimulation is carried out, it can enhance the transport and chemical ability of various functions of the body, improve the anti lactic acid ability to a certain extent, enhance the anaerobic glycolysis function, prolong the time of exercise fatigue, and significantly improve the training efficiency.[8] Under the guidance of scientific training thought, people can also monitor various physiological states and physical indicators during training in combination with the characteristics of high-intensity intermittent training, so as to better understand their own sports conditions and carry out quantitative analysis on the training effects, and provide reliable supporting data for the training effects and physical conditions.

METHOD

In this study, 100 students from a school were randomly selected, all of whom were boys. The study and all the participants were reviewed and approved by Ethics Committee of Anhui Normal University (NO.2018AHNU36). All the subjects were randomly divided into experimental group and control group, with 50 students in each group. There is no significant difference in the age, height, weight and time of physical training among the subjects selected in this study. Each subject has good health, without chronic disease, cardiovascular disease and other diseases. The basic conditions of the subjects are shown in Table 1.

The intervention duration of this experimental study was 10 weeks. Before and after the intervention, the functional indexes and physical indexes of the experimental group and the control group were measured. The functional indexes were vital capacity, body weight and blood lactate concentration. The physical indexes were 12min run, 30m sprint run, 40m sprint run, yoyo interval run, jumping height and Illinois test.

The two groups received intervention training twice a week. The training time was Monday and Wednesday, and the training duration was 40 minutes. The training contents include preparatory activities, intermittent training and relaxation activities. The preparatory activities and relaxation activities of the experimental group and the control group are completely the same. In intermittent training, the experimental group adopts high-intensity intermittent training and the control group adopts medium-intensity intermittent training.

RESULTS

Functional index test results

After 10 weeks of intervention, the comparison results of vital capacity indexes between the experimental group and the control group are shown in Table 2. It can be seen from Table 2 that before the experimental intervention, the average vital capacity of the experimental group was 3734.09, and the standard deviation was 923.32; the average vital capacity of the control group was 3617.51, and the standard deviation was 934.85. After t-analysis of independent samples, the p value was 0.590, $P > 0.05$. The results showed that there was no significant difference in the vital capacity data before the experiment.

After the intervention, the average vital capacity of the experimental group was 3815.59, and the standard deviation was 911.68. The average vital capacity of the control group was 3677.74, and the standard deviation was 904.23. After independent sample t-analysis, the p value was 0.511, $P > 0.05$. The results showed that there was no significant difference in the vital capacity data after the experiment.

The comparison results of the weight index before and after the intervention experiment are specifically shown in Table 3.

Table 1. Basic information of research objects.

Group	Test	Control	P
Age	15.29±2.43	15.49±2.13	>0.05
Height (cm)	176.85±4.66	177.76±3.44	>0.05
Weight (kg)	66.41±5.16	66.20±3.64	>0.05
Sports training time (year)	3.49±0.36	3.35±0.25	>0.05

Table 2. Venture volume index results.

Group	Test	Control	P
Before the experiment	3734.09±923.32	3617.51±934.85	0.590
After the experiment	3815.59±911.68	3677.74±904.23	0.511

Table 3. Body weight index results.

Group	Test	Control	P
Before the experiment	69.14±14.57	67.44±7.88	0.184
After the experiment	67.62±13.93	67.10±7.67	0.002

The physiological function indexes of the experimental group and the control group were recorded and analyzed in this paper. The comparison results of blood lactate concentration indexes are shown in Table 4. Before the experimental intervention, the average value of blood lactate concentration difference in the experimental group was 19.63 mmol / L, and the standard deviation was 0.47. The average value of blood lactate concentration difference in the control group was 19.49 mmol / L, and the standard deviation was 0.35. After the data analysis, the p value was 0.558, which showed no significant difference. After the experimental intervention, the average value of blood lactate concentration difference in the experimental group was 23.07 mmol / L, and the standard deviation was 1.24. The average value of blood lactate concentration difference in the control group was 21.40 mmol / L, and the standard deviation was 1.08. After data analysis and comparison, the p value was 0.021, which can be seen to have statistical significance.

Table 4. Blood lactate concentration index results.

Group	Test	Control	P
Before the experiment	19.63±0.47	19.49±0.35	0.558
After the experiment	23.07±1.24	21.40±1.08	0.021

Physical fitness index test results

Before the experimental intervention, the physical indexes of the experimental group and the control group were tested. The specific index test results are shown in Table 5.

Table 5. Test results of physical indexes before intervention.

Group	Test	Control	P
12min Run (m)	3053.00±.54	3043.48±62.32	0.732
30M sprint run (s)	4.48±0.09	4.51±0.04	0.247
40M sprint run (s)	5.57±0.09	5.66±0.10	0.045
YOYO intermittent running (level)	16.92±0.28	17.01±0.27	0.487
Bounce height (cm)	63.75±2.07	63.09±2.28	0.506
Illinois test (s)	23.45±1.00	23.64±0.86	0.675

After 10 weeks of experimental intervention, the physical indexes of the two groups of subjects were tested and analyzed. The specific test results are shown in Table 6. The six indexes of the experimental group were analyzed. The p value of the 12min run was 0.000, the p value of the 30m sprint run was 0.066, the p value of the 40m sprint run was 0.005, the p value of the yoyo interval run was 0.000, the p value of the bounce height was 0.002, and the p value of the Illinois test was 0.004. Except for the 30m sprint run, there were significant differences in the other five indexes. The six indexes of the control group were analyzed. The p value of 12 min running was 0.000, and the p value of YOYO interval running was 0.004. The above two indexes had significant differences, and the other four indexes had no significant differences.

Table 6. Test results of physical indexes after intervention.

Group	Test			Control		
	Before	After	P	Before	After	P
12min Run (m)	3053.01±55.56	3116.39±7.23	0.000	3043.47±62.33	3144.22±39.26	0.000
30M sprint run (s)	4.490.08±	4.440.10±	0.066	4.520.05±	4.470.05±	0.176
40M sprint run (s)	5.58±0.10	5.47±0.10	0.005	5.67±0.11	5.67±0.10	0.682
YOYO intermittent running (level)	16.93±0.29	17.31±0.32	0.000	17.00±0.26	17.16±0.22	0.004
Bounce height (cm)	63.76±2.05	65.65±2.41	0.002	63.08±2.27	63.42±2.07	0.214
Illinois test (s)	23.44±0.99	22.78±0.95	0.004	23.63±0.87	23.55±0.86	0.521

DISCUSSION

Strength is the basic quality of an athlete's physical quality. Other qualities such as speed, endurance and flexibility need to be established on the basis of strength quality to play an effective role. At the same time, strength quality is also the guarantee for athletes to use technical actions on the field. The improvement of strength quality is of great significance for the improvement of competitive level and the prevention of injuries. According to the results of this study, the vertical springing height (measured by touching height in situ) of the experimental group increased significantly after 10 weeks of intensive intermittent training ($P < 0.05$), while the springing height of the control group had no significant difference before and after the intervention ($P > 0.05$). Based on the results of this study and previous studies, it can be found that the research results are not consistent with the role of high-intensity intermittent training in improving the jumping ability. The reason for the different results may be related to the shorter intervention time. This study believes that long-term high-intensity intermittent training may be beneficial to improve the lower limb explosive power of athletes, but there may be a gap between the effect and the special strength training.

In addition to aerobic ability, anaerobic ability and strength quality, sensitivity is also one of the qualities that athletes must have. According to the results of this study, the Illinois test results of the athletes in the experimental group after the intervention were significantly better than those before the intervention ($P < 0.05$), while the results of the athletes in the control group were not significantly different before and after the intervention ($P > 0.05$). It can be seen that high-intensity interval training may improve the athletes' sensitive quality. This study believes that whether the high-intensity intermittent training has a significant effect on the improvement of athletes' sensitivity quality needs to be further verified by future studies with larger samples and longer intervention time. After 10 weeks of intervention, the results of 12-minute run, 40-m sprint run, yoyo interval run, standing vertical jump and Illinois sensitivity test of the athletes in the experimental group were significantly improved ($P < 0.05$); After the intervention of the control group, the results of only 12 minutes running and yoyo interval running were significantly improved ($P < 0.05$).

CONCLUSION

At present, studies have proved that high-intensity intermittent training can improve the athletes' aerobic endurance, anaerobic endurance and other special abilities. Therefore, high-intensity intermittent training methods can be widely used in the sports training of athletes. However, because physical training is affected by many factors, the research results are not the same. In this paper, we conducted a comparative test of medium-intensity intermittent training and high-intensity intermittent training for physical training. Through the analysis and study of the physical and functional indexes of the subjects, we can see that high-intensity intermittent training can reduce the weight of the subjects, effectively improve the vital capacity of the subjects, and effectively improve the physical level of the subjects, especially in 12-min run, 40-m sprint run, yoyo interval run, bounce height and Illinois test.

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