EFFECTS OF HIGH-INTENSITY TRAINING ON BASKETBALL PLAYERS

EFEITOS DO TREINAMENTO DE ALTA INTENSIDADE SOBRE JOGADORES DE BASQUETE

EFECTOS DEL ENTRENAMIENTO DE ALTA INTENSIDAD EN LOS JUGADORES DE BALONCESTO

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Juncong He[1]
(Physical Education Professional)
Wenmei Jiang[2]
(Physical Education Professional)

1. Yunnan University of Finance and Economics, Department of Physical Education, Kunming, Yunnan, China.
2. Yunnan Polytechnic College, Kunming, Yunnan, China.

Correspondence:
Wenmei Jiang
Kunming, Yunnan, China. 650304.
405767889@qq.com

ABSTRACT

Introduction: Basketball represents much more than a high-intensity exercise. Like most ball games, it is a continuous movement system. Objective: Study the effect of high-intensity interval training (HIT) on the aerobic metabolism of young basketball players. Methods: The author randomly divided male basketball players into an upper limb HIT group, lower limb HIT group, and control group by experimental method and statistical analysis, the control group received routine training, and aerobic exercise capacity was measured by increasing load test before and after the experiment. Results: During the lower extremity experiment, the mean power (MP) and peak power (PP) of the 4th full-force pedal stroke in the lower extremity HIT group increased (P<0.05), and the T/C ratio of the lower extremity HIT group was also implemented (P<0.05). There was no significant change in the indices of the control group (P>0.05). Conclusion: Upper extremity HIT in young male basketball players improved only upper extremity aerobic exercise capacity. In contrast, lower-extremity HIT improved both upper-extremity aerobic exercise capacity and lower-extremity anaerobic exercise capacity. ***Level of evidence II; Therapeutic studies - investigating treatment outcomes.***

Keywords: High-Intensity Interval Training; Basketball; Endurance Training.

RESUMO

Introdução: O basquetebol representa muito mais do que um exercício de alta intensidade, como a maioria dos jogos de bola, trata-se de um sistema de movimento contínuo. Objetivo: Estudar o efeito do treinamento em intervalos de alta intensidade (HIT) sobre o metabolismo aeróbico de jovens jogadores de basquetebol. Métodos: O autor dividiu aleatoriamente os jogadores masculinos de basquetebol em grupo HIT para membro superior, grupo HIT para membro inferior e grupo de controle através de método experimental e análise estatística, o grupo de controle recebeu o treinamento de rotina, e a capacidade de exercício aeróbico foi medida através de um teste de carga crescente antes e depois do experimento. Resultados: Durante o experimento de extremidade inferior, a potência média (MP) e a potência de pico (PP) da 4ª pedalada de força total no grupo HIT de extremidade inferior aumentou (P<0,05), e a relação T/C do grupo HIT de extremidade inferior também foi implementada (P<0,05). Não houve mudança significativa nos índices do grupo de controle (P>0,05). Conclusão: O HIT para membro superior em jogadores jovens de basquete masculino melhorou apenas a capacidade de exercício aeróbico do membro superior, enquanto o HIT do membro inferior melhorou tanto a capacidade de exercício aeróbico do membro superior quanto a capacidade de exercício anaeróbico do membro inferior. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Treinamento Intervalado de Alta Intensidade; Basquetebol; Treino Aeróbico.*

RESUMEN

Introducción: El baloncesto representa mucho más que un ejercicio de alta intensidad, como la mayoría de los juegos de pelota, es un sistema de movimiento continuo. Objetivo: Estudiar el efecto del entrenamiento interválico de alta intensidad (HIT) sobre el metabolismo aeróbico de jóvenes jugadores de baloncesto. Métodos: El autor dividió aleatoriamente a los jugadores de baloncesto masculinos en el grupo de HIT para el miembro superior, el grupo de HIT para el miembro inferior y el grupo de control mediante un método experimental y un análisis estadístico, el grupo de control recibió un entrenamiento rutinario, y la capacidad de ejercicio aeróbico se midió mediante una prueba de carga creciente antes y después del experimento. Resultados: Durante el experimento de la extremidad inferior, la potencia media (MP) y la potencia máxima (PP) del cuarto golpe de pedal de fuerza completa en el grupo de HIT de la extremidad inferior aumentó (P<0,05), y la relación T/C del grupo de HIT de la extremidad inferior también se implementó (P<0,05). No hubo cambios significativos en los índices del grupo de control (P>0,05). Conclusión: El HIT de las extremidades superiores en jóvenes jugadores de baloncesto masculinos mejoró sólo la capacidad de ejercicio aeróbico de las extremidades superiores, mientras que el HIT de las extremidades inferiores mejoró tanto la capacidad de ejercicio aeróbico de las extremidades superiores como la capacidad de ejercicio anaeróbico de las extremidades inferiores. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Entrenamiento de Intervalos de Alta Intensidad; Baloncesto; Entrenamiento Aeróbico.*

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INTRODUCTION

Basketball is a form of high-intensity interspersed with low-intensity exercise, like most ball games, it is an intermittent movement pattern, with short (≤6 seconds) secondary or high-intensity efforts, interspersed with it, it consists of a recovery period of intense (≤60 s) moderate to low-intensity effort.[1] The performance requirements of basketball include aerobic and anaerobic metabolism, of which anaerobic metabolism is considered to be the main energy system. If the recovery period is relatively brief and remains elevated until the next sprint, aerobic metabolism will be used instead to generate adenosine triphosphate.[2] High-intensity movements, such as rapid changes in direction, speed, and repetitive jumps, are considered key elements of successful performance in basketball games.[3]

High-intensity interval training is a training method that can improve anaerobic and aerobic capacity at the same time, high-intensity interval training can increase the activity of glycolysis and oxidative enzymes at the same time, enhancement of short-duration high-intensity exercise performance and VO2 max, the reason for these adaptations is that the intermittent approach reduces the contribution of anaerobic metabolism to ATP production, improves the contribution of aerobic metabolism to energy production, interspersed with recovery periods between high-intensity exercise periods, the aerobic metabolic pathway promotes the oxidation of lactate and the resynthesis of creatine phosphate, thereby enhancing the ability of the aerobic energy metabolism system.[4] For basketball players, the help of aerobic capacity to maintain performance in the late game, as well as the speed and vertical jump in power are quite important to the game, and HIT is considered to be a kind of efficiency, it can improve the training methods of aerobic and anaerobic energy metabolism at the same time; Studies have shown that high-intensity interval training can increase endurance exercise performance, muscle capacity, fat oxidation rate, aerobic capacity and anaerobic threshold, etc.; The uphill running is a training method that can increase the load on the lower limbs. Therefore, the author discusses the combination of high-intensity interval training and uphill running to improve the aerobic capacity of basketball players, at the same time, it can improve the power of the lower limbs. Therefore, high-intensity interval training uphill is a beneficial training method for coaches and athletes.[5] Taylor J L et al asked wrestlers to perform 4 weeks of HIT (35m full sprint, 10s interval, 2 times/week) after VO2max (5.4%) and the peak power (36.5%) and average power (9.4%) during the experiment. 1%) were significantly improved, serum creatine kinase (CK) at rest increased by 20.3%, suggesting that HIT-induced muscle damage occurred; In addition, the peak lactate concentration and testosterone/cortisol ratio increased after the experiment, indicating that endocrine and metabolic functions were improved.[6] Sarlis V et al. performed ultra-high-intensity HIT programs for wrestlers and karate respectively, and found that VO2max increased by 4.6% and 5.4%, respectively, during the lower extremity incremental load test.[7] A study by Zambrano M C and others reported that after 4 weeks of HIT, the ventilatory threshold of cyclists in the lower extremity incremental load test increased by about 16% to 24%, which was basically consistent with the increase in PLT (17.5%) in the study.[8]

Because the upper body (dribbling, confrontation) and lower body (explosive power, agility) need to cooperate in basketball games, athletes often use power bicycles to develop cardiopulmonary ability, upper and lower body strength and explosive power during training, however, little attention has been paid to whether the HIT effect is site-specific, and in-depth research on this has guiding significance for pre-competition scientific training.[9] The purpose of this study was to investigate the effects of different parts of HIT (upper extremity HIT, lower extremity HIT) on aerobic and anaerobic exercise capacity, physiological adaptation and muscle damage of basketball players. It is speculated that the incorporation of HIT into routine training can further improve the athletic ability of athletes, and the training effects of different HIT programs are site-specific.

METHOD

Research object

Forty-five male basketball players from a sports school (athletic level 1, 17-30 years old) voluntarily participated in this experiment, and signed informed consent before the experiment. The subjects were healthy, without various acute or chronic diseases, and had no recent medication history. The training plan for each athlete is basically the same, that is, weekly training 5-6d, special training 2-3h/d, 4 times/week, and strength training 3 times/week. The subjects were randomly divided into upper extremity HIT group, lower extremity HIT group and control group, 15 people in each group; The control group received routine training, while the upper limb HIT group and the lower limb HIT group received 4-week upper limb or lower limb HIT program training on the basis of routine training, respectively. The general characteristics of the subjects are shown in Table 1, there were no significant differences in baseline variables such as age, height, body mass, body mass index, body fat percentage and training years before the experiment among the three groups (P>0.05).

Experimental Design

Subjects performed a total of 9 tests and 4 weeks of training.

1st time: Familiarize yourself with the laboratory environment and test procedures and perform the measurement of body morphological indicators (height, body mass, body mass index, body fat percentage).

The 2nd time: Perform an upper body power cycling incremental load experiment, record VO2max, maximum aerobic power (maximalaerobicpower, MAP), maximum heart rate (maximum heart rate, HRmax) and lactic acid threshold (LT) power (PLT) and oxygen uptake volume (VO2LT).

The 3rd time: A lower limb power cycling incremental load experiment was performed, and VO2max, MAP, HRmax, PLT and VO2LT were recorded respectively.

The 4th time: An upper limb Wingate experiment was performed to record the peak power (peakpower, PP), mean power (meanpower, MP) and total work (totalwork, TW).

The fifth time: A lower limb Wingate experiment was performed. In addition to recording PP, MP and TW, venous blood was taken at rest and after the Wingate experiment to measure muscle injury markers and blood lactic acid (Bla). The above adjacent tests are at least 1d apart and completed within 2 weeks. The subjects were then trained for 4 weeks, and the 6th to 9th tests were performed 48 hours after the last training, and the test contents corresponded to the above 2nd to 5th tests respectively. All tests were performed between 7:00-9:00 am to reduce the influence of biological rhythms, and the test order was random.

Statistical processing

All data are expressed as "mean ± standard deviation". SPSS 20.0 was used for statistical processing of data, paired t-test was used for

Table 1. General characteristics of subjects.

	Upper limb HIT group (n=15)	Lower extremity HIT group (n=15)	Control group (n=15)
age (y)	23.6±5.5	25.5±7.1	22.8±5.0
Height (n)	1.92±0.04	1.87±0.06	1.90±0.07
Body mass (kg)	82.4±7.6	80.6±9.1	79.3±7.5
Body mass index (kg/m2)	22.4±2.0	23.1±3.3	22.0±2.6
Body fat percentage (%)	11.5±1.7	12.0±1.1	10.9±1.9
Years of training (years)	11.6±2.1	10.7±1.9	12.0±2.3

intra-group comparison before and after the experiment, one-way analysis of variance was used for inter-group comparison, and time-course changes in blood lactate and anaerobic exercise capacity were analyzed by repeated measures.[10]

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Yunnan University of Finance and Economics and Yunnan Polytechnic College, following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Changes in body weight and body fat percentage

There were no significant changes in body mass, body mass index and body fat percentage in the three groups after the experiment (P>0.05). The specific data are shown in Table 2.

Changes in anaerobic exercise capacity and physiological response during lower limb Wingate experiment

The changes of anaerobic exercise capacity and physiological response in the lower limb Wingate experiment are shown in Figure 1 and Figure 2. There was no significant difference in TW between the three groups and the comparison within the group before and after the experiment (P>0.05); MP and PP in the lower limb HIT group increased at the fourth full-force pedaling (P<0.05), ΔBla decreased at the third and fourth full-force pedaling (P<0.05); There was no significant change in all parameters in the upper limb HIT group (P>0.05).

DISCUSSION

The main finding of this study was that basketball players who performed short-term (4 weeks) low-load (2 times/week) HIIT on top of their regular training: (1) The PLT of the lower extremity HIT group increased during the upper extremity incremental load exercise test; (2) The MP and PP of the lower extremity HIT group increased during the 4th full-force pedaling of the lower extremity Wingate test; (3) The T/C ratio of the lower extremity HIT group was up-regulated; (4) The ΔBla of the lower extremity HIT group decreased during the third and fourth full-force pedaling of the lower extremity Wingate test. There was no significant change in each index in the control group. The results of the study suggest that the training effects of different HIT programs are site-specific, that is, upper extremity HIT only improves upper extremity aerobic exercise capacity, while lower extremity HIT improves both upper extremity aerobic exercise capacity and lower extremity anaerobic exercise capacity.

CONCLUSION

The training effect of short-term HIT on the basis of routine training of young male basketball players is site-specific, that is, upper extremity HIT only improves upper extremity aerobic exercise capacity, while lower extremity HIT improves both upper extremity aerobic exercise capacity and lower extremity anaerobic exercise capacity. The research results have certain guiding significance for the scientific training of basketball players before the game, that is, the use of HIT as an auxiliary training method before the game to further improve the athletic ability, among them, lower extremity HIT can improve the movement ability of upper and lower extremities at the same time, so it is the main training method of HIT.

Table 2. Changes in body weight and body fat percentage.

	Upper limb HIT group (n=15)		Lower extremity HIT group (n=15)		Control group (n=15)	
	Before experiment	After the experiment	Before experiment	After the experiment	Before experiment	After the experiment
weight (kg)	82.4±7.6	79.0±8.0	80.6±9.1	82.0±7.6	79.3±7.5	79.5±7.1
Body mass index (kg/m2)	22.4±2.0	21.5±2.3	23.1±3.3	23.5±2.3	22.0±2.6	22.1±2.8
body fat percentage (%)	11.5±1.7	11.2±1.9	12.0±1.1	11.8±1.3	10.9±1.9	10.9±2.2

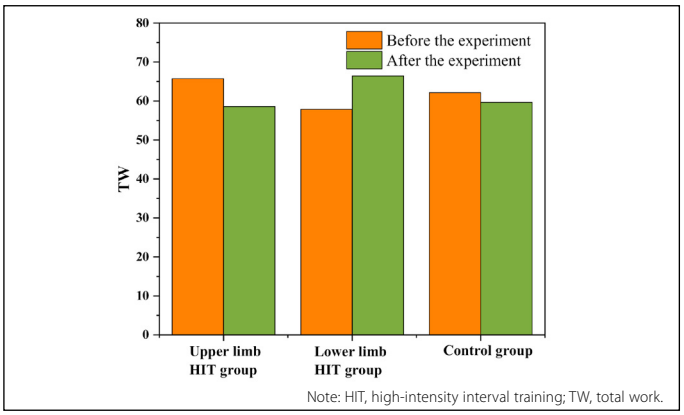

Figure 1. Changes of TW during the lower limb Wingate experiment.

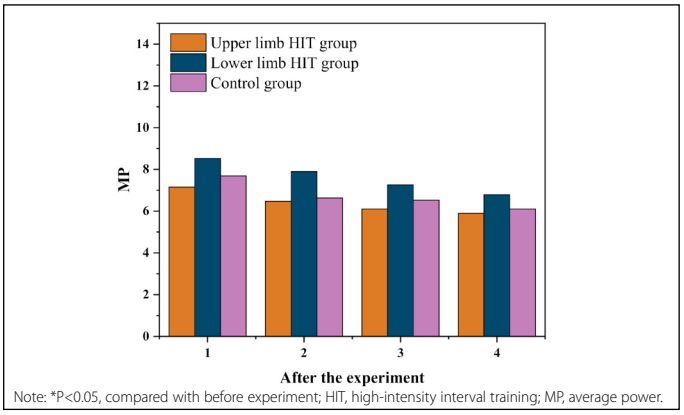

Figure 1. Changes of MP during the lower limb Wingate experiment.

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

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REFERENCES

1. Epstein LH, O'Donnell S, Biondillio M, Hostler D, Roemmich JN. Comparing the reinforcing value of High Intensity Interval Training versus Moderate Intensity Aerobic Exercise in Sedentary Adults. Physiol Behav. 2021;238(2):113468.
2. Zhou N. Assessment of aerobic exercise capacity in obesity, which expression of oxygen uptake is the best?. SMHS. 2021;3(3):138-47.
3. Magalhães F, Aguiar PF, Tossige-Gomes R, Magalhães SM, Ottone VO, Fernandes T, et al. High-intensity interval training followed by postexercise cold-water immersion does not alter angiogenic circulating cells, but increases circulating endothelial cells. Appl Physiol Nutr Metab. 2019;45(1):101-11.
4. Nytrøen K, Rolid K, Andreassen AK, Yardley M, Gude E, Dahle DO, et al. Effect of High-Intensity Interval Training in De Novo Heart Transplant Recipients in Scandinavia. Circulation. 2019;139(19):2198-211.

5. Ramarao J, Yadav S, Satyam K, Suresh S. N-Heterocyclic carbene (NHC)-catalyzed oxidation of unactivated aldimines to amides via imine umpolung under aerobic conditions. RSC Adv. 2022;12(13):7621-5.
6. Taylor JL, Keating SE, Holland DJ, Finlayson G, King NA, Gomersall SR, et al. High intensity interval training does not result in short- or long-term dietary compensation in cardiac rehabilitation: Results from the FITR heart study. Appetite. 2021;158(6):105021.
7. Sarlis V, Chatziilias V, Tjortjis C, Mandalidis D. A Data Science approach analysing the Impact of Injuries on Basketball Player and Team Performance. Inf Syst. 2021;99:101750.
8. Zambrano MC, Pawlak JJ, Daystar J, Ankeny M, Goller CC, Venditti RA. Aerobic biodegradation in freshwater and marine environments of textile microfibers generated in clothes laundering: Effects of cellulose and polyester-based microfibers on the microbiome. Mar Pollut Bull. 2020;151:110826.
9. Lamina S, Musa DI. Ergogenic effect of varied doses of coffee-caffeine on maximal aerobic power of young African subjects. Afr Health Sci. 2020;9(4):270-4.
10. Wei FU, Chen W, Wang X, et al. Effects of Different Lactic Acid Bacteria Agents and Their Combinations on Nutritional Value, Microorganisms Number and Aerobic Stability of Sweet Sorghum Silage. 2021;33(11):6245-56.