EFFECTS OF HIGH-INTENSITY TRAINING ON ENDURANCE IN BASKETBALL PLAYERS

EFEITOS DO TREINAMENTO DE ALTA INTENSIDADE NA RESISTÊNCIA DOS JOGADORES DE BASQUETEBOL

EFECTOS DEL ENTRENAMIENTO DE ALTA INTENSIDAD EN LA RESISTENCIA DE LOS JUGADORES DE BALONCESTO

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ABSTRACT

Introduction: The aerobic endurance training of sports athletes has become the focus of research in institutions and related units. One of the recent proposals is high-intensity interval training to develop athletic aerobic endurance. Objective: Study the effect of high-intensity interval training on aerobic endurance in basketball players. Methods: Fifteen athletes from a university were randomly selected and divided into a high-intensity interval training group, a moderate-intensity continuous training group, and a low-intensity continuous training group, with the control of external influence factors. The indicators analyzed were the average aerobic endurance index of maximal oxygen consumption, average anaerobic capacity, and average maximal power output. The data were obtained before and after the experiment. They were compared and discussed using statistical analysis. Results: The average maximal oxygen consumption in the three training groups increased significantly, and the effect was most evident under the high-intensity intermittent training conditions. This training method could increase the maximal exercise time of the normal groups by up to two times. Conclusion: Intermittent high-intensity training can effectively improve the aerobic endurance of basketball players. *Level of evidence II; Therapeutic studies - investigation of treatment outcomes*.

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

RESUMO

Introdução: O treinamento da resistência aeróbica dos atletas esportivos tornou-se o foco na pesquisa de instituições e unidades relacionadas. No intuito de desenvolver a resistência aeróbica atlética, uma das propostas recentes é o treinamento intervalado de alta intensidade. Objetivo: Estudar o efeito do treinamento intervalado de alta intensidade sobre a resistência aeróbica nos jogadores de basquetebol. Métodos: Foram selecionados aleatoriamente 15 atletas de uma universidade, que foram divididos em um grupo de treinamento de intervalo de alta intensidade, com o controle dos fatores de influência externa. Entre os indicadores analisados estão o índice de resistência aeróbica média de consumo máximo de oxigênio, a capacidade anaeróbica média e a potência máxima média. Os dados foram obtidos antes e após o experimento. Foram comparados e discutidos através de análise estatística. Resultados: O consumo máximo médio de oxigênio nos três grupos de treinamento aumentou significativamente, e o efeito foi mais evidente sob as condições de treinamento intermitente de alta intensidade. Este método de treinamento apresentou o potencial de aumentar o tempo máximo de exercício dos grupos normais em até duas vezes. Conclusão: O treinamento intermitente de alta intensidade pode efetivamente melhorar a resistência aeróbica dos jogadores de basquete. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Treinamento Intervalado de Alta Intensidade; Basquetebol; Resistência Física.

RESUMEN

Introducción: El entrenamiento de la resistencia aeróbica de los atletas deportivos se ha convertido en el centro de la investigación en instituciones y unidades relacionadas. Para desarrollar la resistencia aeróbica atlética, una de las propuestas recientes es el entrenamiento de intervalos de alta intensidad. Objetivo: Estudiar el efecto del entrenamiento interválico de alta intensidad sobre la resistencia aeróbica en jugadores de baloncesto. Métodos: Se seleccionaron aleatoriamente quince atletas de una universidad y se dividieron en un grupo de entrenamiento por intervalos de alta intensidad, un grupo de entrenamiento continuo de intensidad moderada y un grupo de entrenamiento continuo de baja intensidad, con el control de los factores de influencia externos. Entre los indicadores analizados estaban el índice medio de resistencia aeróbica de consumo máximo de oxígeno, la capacidad anaeróbica media y la potencia máxima media. Los datos se obtuvieron antes y después del experimento. Se compararon y discutieron mediante un análisis estadístico. Resultados: El consumo medio máximo de oxígeno en los tres grupos de entrenamiento aumentó significativamente, y el efecto fue más evidente en las condiciones de entrenamiento intermitente de alta intensidad. Este método de entrenamiento presentaba el potencial de aumentar el tiempo máximo de ejercicio de los grupos normales hasta dos veces. Conclusión: El entrenamiento intermitente de alta intensidad puede mejorar eficazmente la resistencia aeróbica de los jugadores de baloncesto. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento**.



Descriptores: Entrenamiento de Intervalos de Alta Intensidad; Baloncesto; Resistencia Física.

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INTRODUCTION

At present, the aerobic endurance training of sports athletes, it has become the research focus of institutions and related units, in order to better develop the aerobic endurance of athletes, the high-intensity interval training method is proposed.¹ This training method is also a conventional training method for athletes at present, which refers to the use of alternating rest and training in training, breakthrough training for individual athlete's aerobic endurance.²

Ricci J M believes: "In basketball training, any training program that lacks aerobic endurance content is unsystematic and unscientific. At the same time, it is also the basis of technical training and improving the ability to resist fatigue in various competitions".³ In general, more than 70% of the training content for aerobic endurance. The maximum intensity of anaerobic endurance training should be controlled within 10%, and the proportion of high-intensity anaerobic training should be within 20%."Furtado RL believes that: "In the daily training of the basketball program, according to the characteristics of the project and training goals, the training should be carried out under the aerobic endurance training intensity of blood lactate lower than 2mmol/L, 65% VO2 max, and heart rate of about 150 beats/min.⁴ At this stage, the maximal oxygen uptake, anaerobic threshold and other indicators are commonly used internationally to evaluate the aerobic capacity of skeletal muscle.

Athletes take short breaks after high-intensity training, therefore, the high-intensity interval training method can effectively avoid the damage caused by overtraining to the athlete's body. The author will study the effect of high-intensity interval training on the aerobic endurance of athletes, so as to provide reference for coaches to formulate standardized training programs.⁵

METHOD

Research objects

Select 15 first-year athletes from a sports major in a university, and the inclusion criteria are as follows: Athletes are between 18 and 20 years old; They usually participate in regular sports training for at least 1 month; No bad habits such as smoking and alcoholism; No infectious diseases in the past 2 months; No chronic diseases such as hypertension and hyperglycemia, and no other definitely diagnosed diseases; No drug use in the last 2 months; The athlete voluntarily signed the informed consent; His physical condition can meet the conditions for completing one or more high-intensity interval training.⁶

Research methods

According to the author's research needs, the selected 15 research subjects were divided into equal groups, five of the athletes received high-intensity interval training; The other five received moderate-intensity continuous training; The remaining 5 athletes received low-intensity continuous training. In the process of experimental exploration, it is ensured that there is no significant difference between the athletes' average aerobic endurance indicators, such as maximum oxygen uptake, average aerobic capacity, athlete's average age, and total athlete's training time, that is, the P values are all greater than 0.05., as shown in Table 1 below.

Within 2 hours after breakfast, all the research subjects were allowed to sit still in the experimental environment for 30 minutes, and the matters needing attention in the training process were explained to the research subjects, so that they were fully familiar with the whole experimental process. In the actual training process, each athlete needs to wear a breathing mask and a heart rate meter, and perform incremental load exercise on the K1852-160 gas cardiopulmonary function test device. The control exercise power starts from 0W and

| Age | Height (cm) | Weight (kg) | Training years |
|-----|-------------|-------------|----------------|
| 18 | 188 | 62 | 6 |
| 19 | 183 | 61 | 5 |
| 18 | 185 | 63 | 5 |
| 18 | 180 | 62 | 2 |
| 20 | 183 | 69 | 2 |
| 20 | 182 | 68 | 3 |
| 18 | 188 | 68 | 4 |
| 19 | 182 | 64 | 5 |
| 20 | 180 | 67 | 5 |
| 18 | 181 | 65 | 4 |
| 18 | 185 | 67 | 3 |
| 19 | 186 | 69 | 3 |
| 18 | 183 | 68 | 5 |
| 20 | 182 | 65 | 4 |
| 19 | 180 | 61 | 5 |

increases by 5.0W every 10s until the athlete stops exercising when exhaustion occurs. The basis for judging whether an athlete is exhausted is: First, in the process of incremental exercise, the oxygen uptake gradually reached the peak, and then showed a significant downward trend, or still increased but the amplitude was less than 125ml/min or 1.5ml/kg/min; Secondly, the respiratory quotient of female athletes is greater than or equal to 1.25, and the respiratory quotient of male athletes is greater than or equal to 1.05; The maximum heart rate of male and female athletes exceeded 175 beats/min; Finally, male and female athletes were unable to continue exercising and persisted in stopping the experiment after being encouraged. After completing the exercise, record the data results obtained from the K1852-160 gas cardiopulmonary function test device, and convert the maximum oxygen uptake into relative values that are all integers. The values of 50%, 75% and 100% of peak power in high-intensity interval training, moderate-intensity continuous training, and low-intensity continuous training male and female athletes were recorded, respectively, take it as the training intensity of each group.^{7,8} For the aerobic endurance index, the maximum oxygen uptake was measured and recorded once before and after exercise.

When using the K1852-160 model gas cardiopulmonary function test device to measure, each exercise training consists of a 10min warm-up session, an exercise training session and a 5min relaxation activity session, the frequency of training was set to 1 time per day, and the entire study lasted for 5 weeks, with a total of 18 training sessions completed. The high-intensity interval training group was prescribed 2 minutes of 100% peak power intensity to step on the power bike and 2 minutes of complete interval time, a total of 45 minutes. Intensity continuous training: Step on the power car at 75% of the peak power intensity, with 5 minutes as a group, 5 groups each time, and the rest time between groups is 2 minutes. Low-intensity continuous training: Step on the power intensity, with 5 minutes as a group, 5 groups each time, and the rest time between groups each time, and the rest time between groups is 2 minutes.

Statistical analysis

SPSS17.0 statistical tool was used to carry out statistical analysis on the obtained relevant experimental results. The paired sample t test was used within the experimental group, and the multiple comparisons of the data in the same group were completely randomized. If the unilateral factor difference is expressed as one→way (anova), the comparison between the two experimental groups is carried out in the way of SNP→q for the final result test, when P<0.05, it indicates that the experimental result data has significant difference.⁹

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Hangzhou Vocational and Technical College and Harbin Institute of Petroleum following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Before training, through investigation, recording and calculation, a variety of indicators of male and female athletes have been identified, such as the average aerobic endurance index maximum oxygen uptake of athletes, the total training time of athletes, etc., there was no significant difference in each index, after completing the training according to the above research methods, the data obtained after each exercise of the athletes under the three training conditions were compared with those before training. From the research results, it can be concluded that, male and female athletes under the condition of high-intensity interval training have the most obvious improvement in aerobic endurance, and related indicators also show a clear trend of change.

As shown in Table 2, Table 3, and Table 4, the fluctuation errors of the average value are all within the controllable range and will not affect the overall results. Indicators 2 to 5 in the high-intensity interval training group, indicators 1 and 2 in the moderate-intensity continuous training group, and indicators 1 and 2 in the low-intensity continuous training group, compared with the data before and after training, there is a significant difference, that is, the P value is less than 0.05. The rest of the data were calculated, and there was no significant difference, that is, the P values were all greater than 0.05.

DISCUSSION

Based on this study, it can be seen that, compared with low-intensity interval training and medium-intensity interval training, high-intensity interval training has a more significant effect on improving the physical fitness and aerobic endurance of athletes. And through the experimental results, it can be concluded that: Changes in oxygen uptake require that athletes continue to train for more than 6 weeks, and the number of training sessions per week should be performed no less than 15 times.¹⁰ Based on the research results of relevant researchers, it is found that: Athletes should continue to train for more than 2 weeks, and the number of training method can increase the maximum exercise time of normal groups by 1.0 to 2.0 times, but has no significant effect on anaerobic capacity.

Table 2. Results of the effect of high-intensity interval training on aerobic endurance of athletes.

| Index | High-intensity interval training set | |
|--|---|----------------|
| | Before training | After training |
| Mean aerobic endurance index VO2 max | 45.2 | 56.2 |
| Average anaerobic capacity of athletes | 32.2 | 39.5 |
| Athlete's average maximum power | 10.3 | 13.5 |
| Athlete's average anaerobic power lapse rate | 0.2 | 0.3 |
| Average power | 7.6 | 9.2 |

Table 3. Effects of moderate-intensity interval training on aerobic endurance of athletes.

| index | Moderate Intensity Interval Training Group | |
|--|---|----------------|
| | Before training | After training |
| Mean aerobic endurance index VO2 max | 46.2 | 51.2 |
| Average anaerobic capacity of athletes | 31.2 | 34.7 |
| Athlete's average maximum power | 10.4 | 12.4 |
| Athlete's average anaerobic power lapse rate | 0.2 | 0.2 |
| Average power | 7.2 | 8.0 |

Table 4. Results of the effect of low-intensity interval training on aerobic endurance of athletes.

| Index | Low-intensity interval training group | |
|--|--|----------------|
| | Before training | After training |
| Mean Aerobic Endurance Index VO2 Max | 46.5 | 50.2 |
| Average anaerobic capacity of athletes | 30.8 | 31.6 |
| Athlete's average maximum power | 10.5 | 11.0 |
| Athlete's average anaerobic power lapse rate | 0.2 | 0.2 |
| Average power | 7.3 | 7.7 |

CONCLUSION

High-intensity interval training has the characteristics of high training intensity, short training time and good training effect, in daily training, the proportion of high-intensity interval training should be appropriately increased to improve the aerobic metabolism of basketball players, according to the characteristics of basketball sports, a high-intensity interval training program is designed. Due to the high intensity of high-intensity interval training, the training intensity and interval time should be strictly arranged, pay attention to the athlete's ability to bear, and adjust the training content in time, fully prepare for the activities before training, relax in time after training, and prevent the occurrence of sports injuries.

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