

# ANALYSIS OF ALTERNATIVE STRATEGIES FOR PHYSICAL RECOVERY AND MUSCLE STRENGTH AFTER BASKETBALL TRAINING



ORIGINAL ARTICLE  
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ANÁLISE DE ESTRATÉGIAS ALTERNATIVAS PARA RECUPERAÇÃO FÍSICA E FORÇA MUSCULAR APÓS O TREINO DE BASQUETEBOL

ANÁLISIS DE ESTRATEGIAS ALTERNATIVAS PARA LA RECUPERACIÓN FÍSICA Y LA FUERZA MUSCULAR TRAS EL ENTRENAMIENTO DE BALONCESTO

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## ABSTRACT

**Introduction:** The need to increase muscle strength and optimize physical recovery is essential for athletes' maximum performance in basketball competitions. However, alternative interventions are still little explored for the physical recovery process. **Objective:** Explore the effect of muscle strength training in basketball and alternative strategies for physical recovery. **Methods:** After basketball strength training, the control group adopted the traditional stretching method, while the experimental group combined yoga and music for a gradual warm-up and body relaxation. In this process, we measured changes in blood lactate content during exercise. Within 5 minutes, 15 minutes, and 30 minutes after exercise was used to analyze the effect of muscle recovery between the groups. **Results:** Muscle strength training can comprehensively improve performance indicators of all aspects of basketball. Still, many biochemical parameters of muscle strength, especially of the shoulder and back, showed no significant effect in the control group. The relative total work (TWP), average power (AP), and relative average power (APP) indicators showed a significant impact after the alternative intervention in the experimental group. **Conclusion:** Muscle strength training can effectively improve multiple qualities in athletes, providing gains in strength development and motor skills with an acceleration in the physical recovery stage.

**Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Basketball; Athletic Performance; Muscle Strength.

## RESUMO

**Introdução:** A necessidade do aumento de força muscular e otimização da recuperação física é imprescindível para o máximo desempenho dos atletas em competições de basquetebol. Contudo, intervenções alternativas ainda são pouco exploradas para o processo de recuperação física. **Objetivo:** Explorar o efeito do treinamento de força muscular no basquete e estratégias alternativas de recuperação física. **Métodos:** Após o treinamento de força do basquete, o grupo controle adotou o método tradicional de alongamento, enquanto o grupo experimental combinou yoga e música para desaquecimento gradual e relaxamento corporal. Nesse processo, foi utilizada a medição de alterações no teor de lactato sanguíneo durante o exercício e dentro de 5 minutos, 15 minutos e 30 minutos após o exercício, visando analisar o efeito da recuperação muscular entre os grupos. **Resultados:** O treinamento de força muscular pode melhorar de forma abrangente os indicadores de desempenho de todos os aspectos do basquete, mas muitos dos parâmetros bioquímicos da força muscular, principalmente do ombro e das costas não apresentaram efeito significativo no grupo controle. O trabalho total relativo (TTR), indicadores de potência média (PM) e potência média relativa (PMR) demonstraram um impacto significativo após a intervenção alternativa no grupo experimental. **Conclusão:** O treinamento de fortalecimento da força muscular pode melhorar efetivamente as múltiplas qualidades dos atletas, proporcionando ganhos no desenvolvimento de força e habilidades motoras com uma aceleração na etapa de recuperação física. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Basquetebol; Desempenho Atlético; Força Muscular.

## RESUMEN

**Introducción:** La necesidad de aumentar la fuerza muscular y optimizar la recuperación física es esencial para el máximo rendimiento de los atletas en las competiciones de baloncesto. Sin embargo, las intervenciones alternativas están todavía poco exploradas para el proceso de recuperación física. **Objetivo:** Explorar el efecto del entrenamiento de la fuerza muscular en el baloncesto y las estrategias alternativas para la recuperación física. **Métodos:** Tras el entrenamiento de fuerza de baloncesto, el grupo de control adoptó el método de estiramiento tradicional, mientras que el grupo experimental combinó el yoga y la música para el calentamiento gradual y la relajación del cuerpo. En este proceso, se utilizó la medición de los cambios en el contenido de lactato en la sangre durante el ejercicio y a los 5 minutos, 15 minutos y 30 minutos después del ejercicio, con el objetivo de analizar el efecto de la recuperación muscular entre los grupos. **Resultados:** El entrenamiento de la fuerza muscular puede mejorar ampliamente los indicadores de rendimiento de todos los aspectos del baloncesto, pero muchos de los parámetros bioquímicos de la



fuerza muscular, principalmente del hombro y la espalda, no mostraron un efecto significativo en el grupo de control. Los indicadores de trabajo total relativo (TTR), potencia media (PM) y potencia media relativa (PMR) mostraron un impacto significativo tras la intervención alternativa en el grupo experimental. Conclusión: El entrenamiento de la fuerza muscular puede mejorar eficazmente múltiples cualidades en los atletas, proporcionando ganancias en el desarrollo de la fuerza y las habilidades motoras con una aceleración en la etapa de recuperación física.

**Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptor:** Baloncesto; Rendimiento Atlético; Fuerza Muscular.

DOI: [http://dx.doi.org/10.1590/1517-8692202329012022\\_0158](http://dx.doi.org/10.1590/1517-8692202329012022_0158)

Article received on 03/15/2022 accepted on 05/31/2022

## INTRODUCTION

At present, in order to make the basketball game more enjoyable, basketball is closely related to speed, strength confrontation and skills.<sup>1</sup> Because basketball is extremely physical, in the process of basketball, athletes have strong muscle strength and can recover their physical fitness as soon as possible during the rest time, so they can occupy a certain dominant position in the field, Prevent the failure of the game caused by late exhaustion. For basketball coaches, strengthening the muscle strength training of athletes can effectively improve their confrontation ability, so as to obtain greater advantages in the process of competition. Strengthening the physical recovery after training can grasp the rest stage in time, adjust the physical state of athletes, and obtain stronger endurance ability.<sup>2</sup>

In order to comprehensively improve the basketball level of athletes, we should start from improving muscle strength and improving technical training. Muscle strength is divided into static force and dynamic force according to its external performance characteristics. This process shows the static force of the muscle. In short, dynamic force is the force generated in the process of dynamic contraction, and the body moves obviously. The muscle strength in the process of basketball training belongs to dynamic strength. The muscle strength of shoulder and arm enables athletes to complete a series of action skills and the basis of confrontation. Therefore, in the process of selecting muscle strength, this paper focuses on the improvement of basketball players' shoulder and neck muscle strength, so as to improve their special strength, Overcome the shortcomings in the process of sports and promote the improvement of athletes' competition level.<sup>3</sup>

## METHOD

### Type of study

Firstly, through the method of literature research, this paper collects and arranges the relevant data of basketball muscle strength and physical recovery, so as to have a more systematic understanding of the research content of this paper. Then, through the experimental method, the relevant experiments of basketball training are designed to explore the changes of muscle strength and related indicators before and after the experiment, so as to have a stronger understanding of muscle strength training. Then, through the changes of different indexes and muscle strength in the physical recovery period, this paper studies the physical recovery of basketball training, so as to obtain relevant practical data.

### Data collection

In this paper, 25 athletes were selected and divided into control group and experimental group. The study and all the participants were reviewed and approved by Ethics Committee of Yangtze University (NO. 20182263). The control group was composed of 5 athletes and the experimental group was composed of 20 athletes. In order to reduce the interference of human factors, 20 athletes in the experimental group were divided into experimental group A, experimental group B, experimental group C and experimental group D. the muscle strength experiment and physical recovery experiment of basketball training were designed as follows:

### 1. Experimental design of muscle strength in basketball training

In order to study the influence of basketball strength training on various quality indexes in basketball, the standing long jump score, pull-up score, one minute sit ups score, double pole arm flexion and extension score, arm flexion and suspension score and in-situ vertical jump score of athletes were measured and sorted out before the experiment, and measured again after four weeks of experiment, So as to judge the basketball muscle strength training from the perspective of basketball achievement index.

### 2. Experimental design of physical energy recovery after basketball training

In order to save human and material resources and reduce the number of experiments, after basketball strength training, a group of control group and four groups of experimental group were relaxed in different ways. The control group used the traditional stretching method, while the experimental group combined yoga with music, adjusted breathing, and adjusted all parts of the body with the stretching action of yoga. Combined with soothing music, let the body gradually return to calm. In this process, the blood lactic acid measuring instrument is used to detect the changes of blood lactic acid content during and within 5 minutes, 15 minutes and 30 minutes after exercise, so as to be used as an index of physical recovery. Then, the muscle strength in quiet state before exercise and 30 minutes after physical recovery are measured to judge the effect of physical recovery in muscle.

## RESULTS

### Influence of basketball strength training on various quality indexes in basketball

The change of muscle strength is most intuitively shown in the scores of various quality indicators of basketball. Therefore, this paper selects the standing long jump score, pull up score, one minute sit ups score, double pole arm flexion and extension score, arm flexion and suspension score and in-situ vertical jump score as the evaluation criteria to integrate and compare the scores of the four experimental groups of ABCD before and after, the results are shown in Figure 1.

As shown in Figure 1, the standing long jump score has been significantly improved before and after basketball training. Although the original score basis and the improvement range after training are different in the four ABCD groups, the score shows a trend of increasing on the whole,  $P < 0.05$ , indicating that there is a significant difference. This shows that the core strength and shoulder back strength of basketball training can help and promote the improvement of standing long jump scores.

As shown in Figure 2, before and after basketball training, the pull-up scores of each group have been significantly improved and the increase is close,  $P < 0.05$ , indicating that there is a significant difference, which proves the effectiveness of shoulder back strength training from the side.

## Effect of basketball strength training on muscle biochemical indexes

It can be seen from the experimental results in 3.1 that muscle training focusing on shoulder and back, taking into account core strength and flexibility, can improve the ability of all aspects of basketball, but there are certain differences in the improvement effect. Therefore, in order to further strengthen the research on basketball muscle training, this paper measured its biochemical indexes, and used the method of comparison before and after the measurement process. The indexes of 25 athletes before and after training were measured.

As shown in Table 1, the shoulder flexor parameters of 60°/s isokinetic muscle strength before and after basketball training are shown. Among them, the peak torque (P-T) and relative peak torque (p-t-p (%)) show a downward trend, while the total work (T-W), relative total work (t-w-p), average power (A-P) and relative average work rate (a-p-p) show an upward trend, with P values greater than 0.05, indicating that before and after basketball muscle strength training. Although many indicators have improved slightly, there is no significant difference.

As shown in Table 2, the shoulder extensor parameters of 60° / s isokinetic muscle strength before and after basketball training are shown. Among them, the indexes of peak torque (P-T), relative peak torque (p-t-p (%)), total work (T-W) and relative total work (t-w-p) show a downward trend, while the indexes of average power (A-P) and relative average work rate (a-p-p) show an upward trend, and the P values are > 0.05, indicating that before and after basketball muscle strength training. Although many indicators rise and fall slightly, there is no significant difference.

Through the experimental research results of the above four tables, it can be seen that although the score indexes before and after basketball

strength training have increased to a certain extent, many have no significant impact on the biochemical parameters of shoulder and back muscle strength,  $P > 0.05$ , and the indexes of total work (T-W), relative total work (t-w-p), average power (A-P) and relative average power (a-p-p) are  $p < 0.05$ , There is a significant impact, so that it has been significantly improved. The reason may be that the current experimental design of basketball training is not in place, which can only have a significant impact on part of the biochemical parameters of muscle movement. Therefore, it is necessary to continue to improve the muscle training scheme of basketball.

## Analysis of physical recovery effect after basketball training

As shown in Figure 3, the changes of blood lactic acid content in the physical recovery stage are shown. The experimental group ABCD adopts the form of Yoga combined with music for physical recovery, and the control group adopts the traditional stretching method. It can be seen from Figure 3 that the content of bleeding lactic acid gradually decreases after sports training. The decrease rate and range of blood lactic acid of the five groups of athletes are relatively consistent within 5 minutes. In the control group, there is no more significant change in blood lactic acid content from 5 minutes to 30 minutes, showing a very slow downward trend, indicating that the rapid physical recovery stage of the control group has ended at this time.

The physical recovery rate of the four experimental groups of ABCD was almost the same, showing a rapid downward trend before 5 minutes, and the downward rate from 5 minutes to 30 minutes was almost 1 / 3 of the original, showing a stable downward trend. The final blood lactate value was significantly lower than that of the control group. This shows that the form of Yoga combined with music has a more lasting effect on the recovery of blood lactic acid, and in the same time, the recovery effect of Yoga combined with music group is better than that of traditional stretching group.

As shown in Table 3, the muscle strength after physical recovery is compared with that in quiet state. 20 athletes in four experimental groups of ABCD are selected for intra group comparison before and after sports training. It can be seen from table 3 that the average value

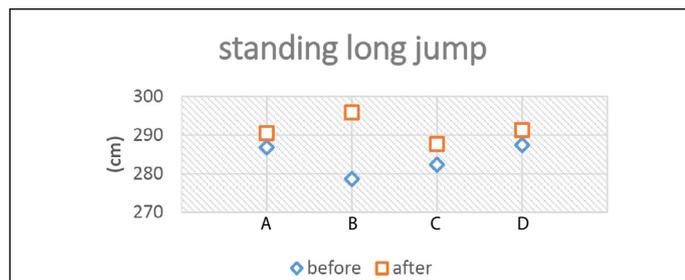


Figure 1. Comparison of standing long jump scores before and after basketball training.

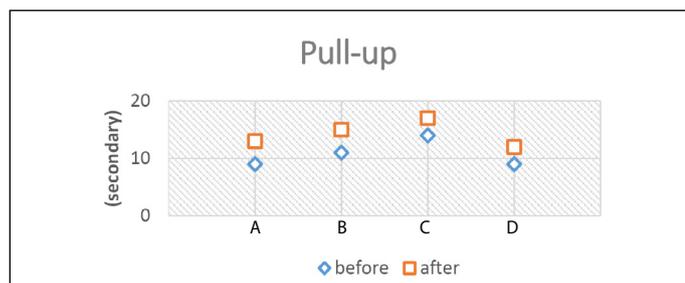


Figure 2. Comparison of pull-up scores before and after basketball training.

Table 1. Analysis of shoulder flexor parameters with 60°/s isokinetic muscle strength before and after basketball training.

Option	Before	After	P
Peak moment (P-T)	62.74±16.24	59.50±17.69	0.5425
Relative peak torque (P-T-P (%))	87.14±19.78	85.30±20.62	0.4701
Total work (T-W)	110.20±26.84	111.30±31.11	0.3892
Relative total power (T-W-P)	141.30±29.98	163.66±48.21	0.3846
Average power (A-P)	42.14±13.17	48.40±12.81	0.0758
Relative average power (A-P-P)	63.17±17.10	70.50±19.26	0.0706

Table 2. Analysis of shoulder extensor parameters of 60°/s isokinetic muscle strength before and after basketball training.

Option	Before	After	P
Peak moment (P-T)	79.98±31.21	78.25±27.86	0.5359
Relative peak torque (P-T-P (%))	117.11±42.98	116.49±41.25	0.6593
Total work (T-W)	145.61±53.21	142.59±52.36	0.3127
Relative total power (T-W-P)	211.17±76.84	201.98±72.65	0.2735
Average power (A-P)	59.31±21.19	63.24±23.81	0.1583
Relative average power (A-P-P)	86.95±31.97	91.57±33.89	0.1742

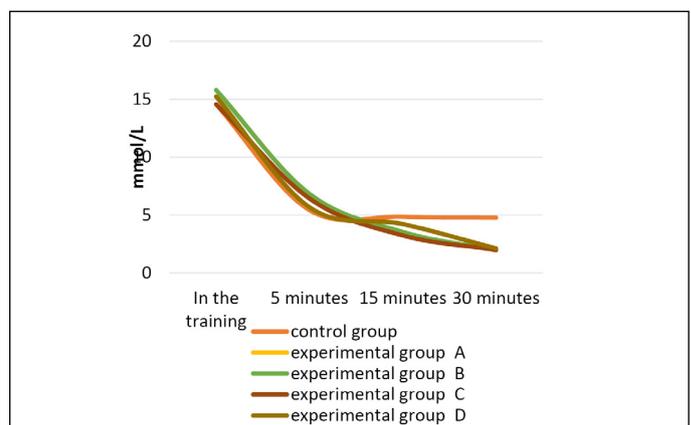


Figure 3. Changes of blood lactic acid content during physical recovery.

**Table 3.** Comparative analysis of muscle strength after physical recovery and in quiet state (kg).

Content	N	Mean	SD	t	p
Under quiet	20	46.1225	6.1173	1.7426	p> 0.05
Physical recovery	20	44.0834	4.3695		

of muscle strength in quiet state is about 46.1225kg, and the average value of muscle strength 30 minutes after physical recovery is about 44.0834kg,  $P > 0.05$ , indicating that there is no significant difference. However, the average value of muscle strength 30 minutes after physical fitness recovery is significantly lower than that in the quiet state, which indicates that the physical fitness of the human body has not recovered to the peak state within 30 minutes after sports training, so the muscle strength decreases slightly, which also has a certain impact on the physiological state of athletes' training. Therefore, it is necessary to master the physical fitness in the process of sports training, Recover the time configuration between and exercise training, so as to obtain better exercise effect.

## DISCUSSION

For the daily training with plenty of time, the basketball strength training program includes four steps: basic technical training, strength endurance training, maximum strength training and fast strength training. Strengthening athletes' mastery of the basic knowledge of basketball through basic technical training can not only enhance muscle memory and obtain the maximum training benefit, but also prevent sports injury caused by improper action, but also serve as a warm-up activity of muscle strength training. Followed by strength endurance training, which is simply to strengthen the cultivation of muscle circumference, so as to improve the anti fatigue ability of muscles, reduce the generation of sports fatigue as much as possible, and lay a good physical foundation for long-term competition. The maximum strength training is to enhance the absolute strength of athletes, so as to improve the confrontation ability in the process of basketball training and competition, and enhance the overall strength foundation. The last is fast strength training. In short,

it is to train the explosive power of muscles. By actively transforming the form of muscle contraction, improve the high explosive power in a short time, cooperate with the skill training of athletes, and complete the breakthrough in the competition.<sup>4,5</sup>

In the basketball muscle strength training program, basic technical training can be arranged by coaches according to the actual situation of athletes. Strength endurance training most often adopts the circular continuous training method, which focuses on aerobic metabolism for a long time, completes the training with relatively small load intensity and basically without intermission, so as to improve the ability of basketball players to complete muscle contraction of corresponding intensity for many times in the process of sports. The maximum strength training adopts the cyclic intermittent training method. Through the way of glycolysis and metabolism, the intermittent and insufficient cyclic movements are completed with a large load intensity, so as to improve the ability of the athlete's muscle to exert the maximum force in the random contraction and enhance the speed endurance and strength endurance.<sup>6</sup> The rapid strength training adopts the cyclic repeated training method, which applies the energy supply of phosphate metabolism with the maximum load intensity to complete the intermittent and sufficient cyclic training, so as to improve the speed and explosive power of athletes and give full play to their strength in the shortest possible time.<sup>7,8</sup>

## CONCLUSION

Through the research of this paper, it can be seen that strengthening the muscle strength training of basketball players can improve the movement and strength indexes of basketball, and further improve the athletes' sports skills, so as to promote the improvement of their competition level. Compared with the traditional stretching method, the combination of yoga and music can promote the physical recovery of athletes from both physiological and psychological aspects, and achieve better recovery effect and greater physical recovery in a shorter time.

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The author declare no potential conflict of interest related to this article

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**AUTHORS' CONTRIBUTIONS:** Every author has made an important contribution to this manuscript. XL: writing and execution.

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