

IMPACTS OF AEROBIC EXERCISE ON THE PHYSICAL FITNESS OF SHOT PUT ATHLETES

IMPACTOS DO EXERCÍCIO AERÓBICO NA APTIDÃO FÍSICA DOS ATLETAS DE ARREMESSO

EFFECTOS DEL EJERCICIO AERÓBICO EN LA APTITUD FÍSICA DE LOS ATLETAS DE LANZAMIENTO



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ABSTRACT

Introduction: Shot put is a competitive sport that combines speed, strength, and explosiveness. Training the skill with aerobic exercise has attracted the attention of many coaches and scholars on competitive sports training. Shot put is a fast-powered activity, and its shooting speed is the determining factor for sports performance. It is believed that aerobic exercise can improve the ability of its practitioners. **Objective:** To analyze the impacts of aerobic exercise on the physical fitness of shot put athletes. **Methods:** 18 shot put athletes were randomly selected as volunteers for research that consisted of a random division between experimental and control groups. The experimental group received a protocol involving aerobic training, while the control group received regular training before, during, and after the experiment. The maximal strength and explosive power of the two groups of athletes were tested before and after the intervention, and mathematical-statistical methods were used to process the collected data. **Results:** The maximum strength index of both groups was improved; however, the improvement in the experimental group was statistically relevant ($P < 0.05$). The values of the pressure index, power, and balance of the athletes from the experimental group were statistically altered to those before the experiment ($P < 0.01$). **Conclusion:** The implementation of aerobic exercise in the routine of shot put athletes can effectively improve the performance in the sport and the special abilities of its practitioners. The training method analyzed was also shown to improve specific performance in the shot put athletes. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Athletes; Aerobic Exercise; Sports.

RESUMO

Introdução: O arremesso é um esporte de competição que combina velocidade, força e explosividade. O treinamento da capacidade com exercício aeróbico atraiu a atenção de muitos treinadores e estudiosos sobre treinamento esportivo de competição. O arremesso é uma atividade de potência rápida, e sua velocidade de tiro é o fator determinante para o desempenho esportivo. Acredita-se que o exercício aeróbico possa melhorar a habilidade de seus praticantes. **Objetivo:** Analisar os impactos do exercício aeróbico na aptidão física dos atletas de arremesso. **Métodos:** 18 praticantes de arremesso foram selecionados aleatoriamente como voluntários para uma pesquisa que consistiu na divisão aleatória entre grupos experimental e de controle. O grupo experimental recebeu um protocolo envolvendo o treinamento aeróbico, enquanto o grupo de controle recebeu seu treinamento regular antes, durante e depois do experimento. A força máxima e o poder explosivo dos dois grupos de atletas foram testados antes e após a intervenção, foram usados métodos estatísticos matemáticos para processar os dados coletados. **Resultados:** O índice de força máxima dos dois grupos foi aprimorado, porém a melhoria no grupo experimental foi estatisticamente relevante ($P < 0,05$). Os valores do índice de pressão, potência e balanço dos atletas do grupo experimental foram estatisticamente alterados em relação aqueles anteriores ao experimento ($P < 0,01$). **Conclusão:** A implementação do exercício aeróbico na rotina dos atletas de arremesso pode efetivamente melhorar o desempenho no esporte e as habilidades especiais dos seus praticantes. O método de treinamento analisado também demonstrou melhorar o desempenho específico nos esportistas de arremesso. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descriptores: Atletas; Exercício Aeróbico; Esportes.

RESUMEN

Introducción: El lanzamiento es un deporte de competición que combina velocidad, fuerza y explosividad. El entrenamiento de la capacidad con ejercicios aeróbicos ha atraído la atención de muchos entrenadores y estudiosos del entrenamiento deportivo de competición. El lanzamiento es una actividad de potencia rápida, y su velocidad de tiro es el factor determinante para el rendimiento deportivo. Se cree que el ejercicio aeróbico puede mejorar la capacidad de sus practicantes. **Objetivo:** Analizar los impactos del ejercicio aeróbico en la condición física de los atletas de lanzamiento. **Métodos:** Se seleccionaron aleatoriamente 18 practicantes de lanzamiento como voluntarios para una investigación que consistió en la división aleatoria entre los grupos experimental y de control. El grupo experimental recibió un protocolo de entrenamiento aeróbico, mientras que el grupo de control recibió su entrenamiento habitual antes, durante y después del experimento. Se comprobó la fuerza máxima y la potencia explosiva de los dos grupos



de atletas antes y después de la intervención, y se utilizaron métodos estadísticos matemáticos para procesar los datos recogidos. Resultados: El índice de fuerza máxima de ambos grupos mejoró, aunque la mejora en el grupo experimental fue estadísticamente relevante ($P<0,05$). Los valores del índice de presión, la potencia y el equilibrio de los atletas del grupo experimental estaban estadísticamente alterados en relación con los anteriores al experimento ($P<0,01$). Conclusión: La implementación del ejercicio aeróbico en la rutina de los atletas de lanzamiento puede mejorar efectivamente el rendimiento en el deporte y las habilidades especiales de sus practicantes. El método de entrenamiento analizado también ha demostrado mejorar el rendimiento específico de los atletas de lanzamiento.

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

Descriptores: Atletas; Ejercicio Aeróbico; Deportes.

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INTRODUCTION

Shot put is a fast power event. The speed of the shot is the direct factor that determines the score of the shot put. A good combination of power and speed is necessary to improve release speed. Aerobic metabolism refers to the aerobic oxidation of sugar, protein, and fat in the body with the participation of oxygen to release energy.¹ Aerobic capacity refers to the ability of the human body to perform aerobic work for a long time. The absolute value of maximal oxygen uptake is a classic indicator for evaluating the aerobic capacity of athletes. It refers to the amount of oxygen absorbed and utilized by the body in unit time under total mobilization of cardiopulmonary function and various organ systems. Which reflects the cardiopulmonary function level of the body during extreme load exercise. In this study, the aerobic and anaerobic capabilities of shot-put players were tested and analyzed to explore the characteristics of aerobic capabilities of elite male handball players. This provides the basis for athletes' individualized physical function assessment, the evaluation of training effect, and the individualized training arrangement.

METHOD

General information

This paper selects 18 male shot-put majors from the sports training team of the Institute of Physical Education as the research object. According to the statistical principle, 18 male shot-put players were divided into experimental and control groups by random sampling methods.² There were nine people in the experimental group and nine people in the control group. The experimental group adopted "staged" strength training. The control group used "traditional" strength training. This paper selects bench press, high clean, half squat, and clean and jerk as the maximum strength test indicators. We chose 30s quick clean and jerk (30kg), standing triple jump, back shot put (5kg), and 30m start as the explosive power test indicators. We tested the maximal strength and explosive power of the two groups of athletes

Shot put game throwing model

The throwing model function of the shot-put game is:

$$v_x = v \cdot \cos \alpha \quad (1)$$

$$v_y = v \cdot \sin \alpha \quad (2)$$

v_x is the component of v in the horizontal direction. v_y is the vertical component of v . α is the release angle.³ Then the horizontal and vertical displacements of the weapon are:

$$x = v \cdot \cos \alpha \cdot t \quad (3)$$

$$y = h + v \cdot \sin \alpha \cdot t - \frac{1}{2} \cdot g \cdot t^2 \quad (4)$$

g is the acceleration of gravity. h is the projection height. t is the Javelin runtime. x is the horizontal distance of the javelin throw. y is the horizontal distance of the javelin throw. Eliminating t has:

$$y = h + x \cdot \tan \alpha - \frac{1}{2} g \cdot x^2 \cdot \frac{1}{\cos^2 \alpha} \quad (5)$$

Mathematical Statistics

This paper uses Excel2003 software to perform the statistical calculation on the obtained raw data.⁴ Statistical analysis and processing of the results were carried out in this paper.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Liaoning Normal University and animals.

RESULTS

The results and analysis of the maximum strength of the two groups before and after the experiment

At the end of the first phase, we performed maximal strength tests for the experimental and control groups, respectively.⁵ The results showed that the experimental and control groups' maximum strength index was basically at the same level. (Table 1)

After the second maximal strength training phase, we tested the maximal strength index for the experimental group and the control group, respectively. (Table 2)

Table 1. Maximum strength results (kg) of experimental group and control before staged strength training.

| Group | Bench press | High flip | Half squat | Clean and jerk |
|---------------|-------------|-----------|------------|----------------|
| Test group | 96.7±5.8 | 74.4±6.4 | 150.4±21 | 70.5±14 |
| Control group | 97.2±4.6 | 74.8±6.7 | 152.6±18 | 68.9±14 |

Table 2. The maximum strength results after the first stage of maximum strength development (kg).

| Group | Bench press | High flip | Half squat | Clean and jerk |
|---------------|-------------|-----------|------------|----------------|
| Test group | 131.5±8.4 | 90.9±5.5 | 170.3±33 | 85.8±14 |
| Control group | 113.3±5.3 | 79.3±5.5 | 153.5±15 | 78.5±13 |

From Table 2, it can be seen that the maximum strength index of both groups has been improved to a certain extent.⁶ The bench press, power clean, clean, and jerk index values of the athletes in the experimental group were significantly different from those before the experiment by T-test ($P<0.01$). The index value of the half-squat was significantly different from before the experiment ($P<0.05$). This shows that the athletes' maximal strength has increased to a certain extent after the staged maximal strength training. This provides a good foundation for the next phase of developing the athlete's rapid strength.

The test results and analysis of the explosive power of the two groups before and after the experiment

After the first stage, we tested the experimental and control groups' explosive power index, respectively.⁷ The results showed no significant difference in the explosive power levels between the two groups after the experiment ($P>0.05$). The two groups of athletes were basically at the same level. (Table 3)

The 30s fast clean and jerk of the experimental group after the second period of explosive power transformation was significantly different from that before the experiment ($P<0.01$) (Table 4). This shows that the effect of staged strength training in the experimental group is more prominent.⁸

After the second explosive power transformation period, we performed explosive power tests on the experimental and control groups, respectively. (Table 4)

The results and analysis of the memorable scores of the two groups before and after the experiment

After the first stage (adaptation period), we conducted special performance tests for the two groups.⁹ Both are basically at the same level. (Table 5)

After the last aerobic exercise period (3 weeks), combined with aerobic exercise and unique techniques, we tested the experimental and control groups' exceptional performance. (Table 6)

This stage of training aims to improve the aerobic exercise ability and exceptional technical ability of shot-put players. This is to transform the core physical fitness of the athlete into a unique combat ability.¹⁰ In this experiment, aiming at the essential laws and characteristics of the shot put, the athletes in the experimental group emphasized the route, direction, amplitude, intensity, and neuromuscular control of particular technical movements to complete the exercise. It can be seen from Table 6 that the memorable score of the experimental group after the experiment is significantly different from that before the experiment ($P<0.01$). This shows that the effect of staged strength training in the experimental group is more significant. Moreover, the improvement rate of the experimental group's exceptional score was significantly higher than that of the control group.

Further illustrates the aerobic exercise phase, which is combined with specialized techniques. The experimental group emphasized the organic combination of the temporal and spatial characteristics of particular technical movements.¹¹ This allows athletes to develop their technical style.

DISCUSSION

Based on maximum strength training, we use super isometric, medium-small weight-bearing rapid exercises to develop starting strength, breaking strength, and rapid strength. Fast power has the combined characteristics of speed and power. Developing the ability of athletes to exert muscle force and increasing the speed of muscle contraction is the key to improving the rapid strength of athletes.¹² In this paper, the deep jump followed by multiple fast jumps, the deep jump followed by the multi-step step jump, the light load fast half-squat jump,

Table 3. Test results of explosive power index of experimental group and control group before staged strength training.

| Group | 30s fast clean and jerk (30kg) | Standing triple jump (m) | Shot put after throwing(5kg) (m) | 30m start(s) |
|---------------|--------------------------------|--------------------------|----------------------------------|--------------|
| Test group | 35.5±2.1 | 8.5±0.5 | 14.3±0.5 | 4.1±0.3 |
| Control group | 35.2±2.8 | 8.5±0.6 | 14.5±0.6 | 4.1±0.5 |

Table 4. The test results of the explosive power index of the experimental group and the control group after the second explosive power transformation period.

| Group | 30s fast clean and jerk (30kg) | Standing triple jump (m) | Shot put after throwing(5kg) (m) | 30m start(s) |
|---------------|--------------------------------|--------------------------|----------------------------------|--------------|
| Test group | 40.3±3.5 | 9.0±0.3 | 15.3±0.6 | 4.0±0.1 |
| Control group | 45.3±1.9 | 9.5±0.5 | 15.9±0.9 | 3.8±0.2 |
| Difference | 5.0±1.3 | 0.5±0.3 | 0.7±0.4 | 0.2±0.1 |

Table 5. The results of the particular performance test of the experimental group and the control group before staged strength training.

| Group | Test group | Control group | P |
|-----------|------------|---------------|-------|
| Grade (m) | 12.24±0.26 | 12.26±0.28 | >0.05 |

Table 6. The results of the extraordinary performance test after staged strength training.

| Group | Test group | Control group |
|-------------|------------|---------------|
| Grade (m) | 14.13±0.35 | 13.88±0.37 |
| Improve (%) | 7.7 | 3.9 |

the brief snatch, the 30m sprint run, the fast stand-up, the light load fast continuous squat. Training methods such as rapid and continuous vertical jumps and rapid swings with bells all reflect the characteristics of "quickness." This significantly affects the development of an athlete's starting strength and rapid strength. This is also reflected in the above experiments. Aerobic exercise of shot-put players refers to the ability to overcome resistance produced by the collaborative work of specific muscle groups and psychological regulation mechanisms that directly participate in the completion of particular technical movements.¹³ Aerobic exercise divides the strength training process into several stages according to the essential laws of the project and the characteristics of the athletes. Each stage has a corresponding load structure, training content, and methods. Strength training for shot putters focuses on developing maximum strength during the prep period. Athletes focus on developing explosive and fast power early in the competition. We focus on translating the effects of strength training into specialized techniques during the competition period. Athletes can use "jumping" aerobic exercises. They adjust the training intensity to achieve the best competitive state of the game.

CONCLUSION

After basic strength training, the athlete alternates between maximal strength and explosive strength training in phases. This can improve the body's adaptability during specific strength training within a certain period and avoid overtraining and stagnant performance. Aerobic exercise on the unique skills of shot-put players is more evident than in anaerobic athletes. The memorable score has improved significantly. The aerobic exercise emphasizes the organic combination of time and space characteristics of particular technical movements. This helps the athlete develop a personal "technical style."

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