CHANGES IN EXPLOSIVE MUSCLE STRENGTH IN SHUTTLECOCK TRAINING

ALTERAÇÕES DA FORÇA MUSCULAR EXPLOSIVA NO TREINAMENTO COM SHUTTLECOCK

CAMBIOS EN LA FUERZA MUSCULAR EXPLOSIVA EN EL ENTRENAMIENTO CON SHUTTLECOCK

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ABSTRACT

Introduction: Shuttlecock is a popular sport in China. Its level of competition depends on the athlete's body shape, strength, technique, tactics, and mentality, among other factors that require the mastery of the shuttlecock with all body parts except the hands. The physical preparation for this sport requires the explosive strength of specific muscles for its total domination. Objective: To explore the changes in explosive muscle strength in shuttlecock players after short-term physical training. Methods: College students in two shuttlecock elective classes were selected as volunteers for the research. The experiment divided the two classes into experimental and control groups. The conventional training method was used in the control group. The experimental group used a combination of a physical and routine training protocol. The groups were tested for fitness before and after the experimental intervention. The data obtained were statistically analyzed and discussed. Results: The experimental group's specific muscle strength and explosive power after physical training were better than the control groups. The scores of the experimental and control groups were significantly different in terms of physical flexibility, the number of kicks, and motor skill assessment (P<0.05). There was no statistical significance in the number of push-ups between the two groups (P>0.05). Conclusion: Physical training significantly affects the physical quality of college students and their number of shots. Physical training is essential to improve shuttlecock practitioners' muscular strength and explosive power. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Exercise; Muscle Strength; Research Design; Resistance Training.

RESUMO

Introdução: O shuttlecock é um esporte com peteca popular entre os chineses. Seu nível de competição depende da forma corporal do atleta, força, técnica, tática, mentalidade, entre outros fatores que exigem o domínio da peteca com todas as partes do corpo exceptuando as mãos. A preparação física com este esporte solicita a força explosiva de músculos específicos para o seu total domínio. Objetivo: Explorar as alterações de força muscular explosiva nos jogadores de shuttlecock após o treinamento físico de curto prazo. Métodos: Selecionou-se universitários em duas aulas eletivas de shuttlecock como voluntários para a pesquisa. O experimento dividiu as duas classes em grupos experimentais e grupos de controle. O método de treinamento convencional foi usado no grupo de controle. O grupo experimental utilizou uma combinação de um protocolo de treinamento físico associado ao treinamento de rotina. Os grupos foram testados quanto a aptidão física antes e após a intervenção experimental. Os dados obtidos foram analisados estatisticamente e discutidos. Resultados: A força muscular específica do grupo experimental e o poder muscular explosivo após o treinamento físico foram melhores do que os do grupo de controle. As pontuações dos grupos experimental e de controle foram significativamente diferentes em termos de flexibilidade física, número de chutes e avaliação das habilidades motoras (P<0,05). Não houve significância estatística no número de flexões entre os dois grupos (P>0,05). Conclusão: O treinamento físico afeta significativamente a qualidade física dos estudantes universitários e o seu número de tacadas. O treinamento físico é essencial para melhorar a força muscular e o poder explosivo dos praticantes de shuttlecock. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Exercício físico; Força Muscular; Projetos de Pesquisa; Treinamento de Força.*

RESUMEN

Introducción: El shuttlecock un deporte con volante popular entre los chinos. Su nivel de competición depende de la forma corporal del atleta, la fuerza, la técnica, la táctica, la mentalidad, entre otros factores que exigen el dominio del volante con todas las partes del cuerpo excepto las manos. La preparación física con este deporte requiere la fuerza explosiva de músculos específicos para su total dominio. Objetivo: Explorar los cambios de la fuerza muscular explosiva en jugadores de shuttlecock tras un entrenamiento físico de corta duración. Métodos: Se seleccionaron como voluntarios para la investigación estudiantes universitarios de dos clases optativas de shuttlecock. El experimento dividió las dos clases en grupos experimentales y de control. En el grupo de control se utilizó el método de entrenamiento convencional. El grupo experimental utilizó una combinación de un protocolo de entrenamiento físico junto con un entrenamiento rutinario. Los grupos fueron sometidos a pruebas de aptitud física antes y después de la intervención experimental. Los datos obtenidos se analizaron y discutieron estadísticamente. Resultados: La fuerza muscular *específica del grupo experimental y la potencia muscular explosiva después del entrenamiento físico fueron mejores que las del grupo de control. Las puntuaciones de los grupos experimental y de control fueron significativamente diferentes en términos de flexibilidad física, número de patadas y evaluación de las habilidades motoras (P<0,05). No hubo significación estadística en el número de flexiones entre los dos grupos (P>0,05). Conclusión: El entrenamiento físico afecta significativamente a la calidad física de los estudiantes universitarios y a su número de disparos. El entrenamiento físico es esencial para mejorar la fuerza muscular y la potencia explosiva de los practicantes de shuttlecock.* ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Ejercicio Físico; Fuerza Muscular; Proyectos de Investigación; Entrenamiento de Fuerza.*

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INTRODUCTION

Physical training is important training content for shuttlecock players. Scientific and adequate physical exercise plays an essential role in the shuttlecock. The physical fitness of athletes is the foundation and guarantee of all sports activities. Good physical fitness is essential to ensure the shuttlecock game's success. In shuttlecock competitions, athletes must have the good physical fitness to meet the requirements of physical confrontation, technical and tactical execution, etc. Shuttlecock fitness training can help reduce the chance of injury to shuttlecock players.[1] The causes of shuttlecock injuries include sports injuries caused by external factors, strains, and sprains caused by the physical exertion of the athletes themselves. In addition, good shuttlecock physical fitness also significantly improves athletes' self-confidence in learning. Shuttlecock has factors such as the game's intensity, the high degree of confrontation, and the game's tension at critical moments. Athletes usually need to strengthen physical training to ensure the comprehensive development of their skills. This article is based on the difference in physical quality of beginner athletes in the elective shuttlecock course in shuttlecock kicking and kicking.[2] After the athletes performed physical training, the indicators, such as the differences in flexibility and physical strength related to shuttlecock kicking and abduction kicking, were analyzed. In this way, we are looking for a quick way to improve kicking skills. The research results of this paper provide a theoretical basis for shuttlecock teaching in China.

METHOD

General information

This paper selects two college students from elective shuttlecock classes as research objects. The experiment divided the two classes into experimental groups and control groups. There are 50 students in each of the two classes.[3] At the same time, neither the experimental nor the control group had previously learned to play shuttlecock. Before the experiment, this paper tested the sitting forward bending, the number of kicks, and the assessment of movement skills of the two classes of students.

The independent sampling t-test of the four items (sitting forward bending, the number of kicks and the evaluation of movement skills) found that the P values were 0.593, 0.295, 1.042, p>0.05. There was no significant difference between the experimental and control groups before the test.[4] Under the premise of the same teaching environment and content, the subjects met the requirements of the teaching experiment.

Table 1. Comparative analysis of the test data comparison of the two classes before the experiment.

	Sitting forward bend	Number of kicks	Action skill review
Control group	16.01±4.271	5.333±3.76	68.802±5.677
Test Group	16.302±6.177	4.563±2.594	67.792±5.677
T	-0.594	1.125	0
P	0.593	0.295	1.042

Test plan

This paper conducts a 6-week experimental study on students in two classes of shuttlecock classes. The experiment divided the two classes into the experimental group and the control group. The frequency of teaching is one session of shuttlecock a week. The duration is 90 minutes per session.[5] The conventional training method was used in the control group. The experimental group used a combination of physical training and routine training.

Speed algorithm model of shuttlecock throwing action

The size of the throwing action speed can be obtained according to the speed curve. However, the direction of the shuttlecock throw cannot be determined only by the speed. When projected, its velocity is the tangent of the straight line. The projection motion is fitted in this paper using the space curve.[6] At the same time, this paper takes the tangent of the projected instantaneous space curve as the movement speed. *Steinicke F* uses the following dynamic equations to handle the projected virtual position equation:

$$\begin{cases}\alpha(\delta)=\alpha_0+\dfrac{\mu_{\alpha_0}}{\delta}(1-e^{-\delta\cdot\delta})\\ \theta(\delta)=\theta_0+\dfrac{\mu_{\theta_0}}{\delta}(1-e^{-\delta\cdot\delta})\\ \lambda(\delta)=\lambda_0+\dfrac{\mu_{\lambda_0}}{\delta}(1-e^{-\delta\cdot\delta})\end{cases} \tag{1}$$

After a lot of experiments, the following modes are selected in this paper. This paper gives the parametric formula of the spatial distribution of projectile motion:

$$\begin{cases}\alpha=A1*\delta^3+A2*\delta^2+A3*\delta+A4\\ \theta=B1*\delta^3+B2*\delta^2+B3*\delta+B4\\ \lambda=C1*\delta^3+C2*\delta^2+C3*\delta+C4\end{cases} \tag{2}$$

This model is a polynomial function. This method not only simplifies the nonlinear equation of *Steinicke F* but also quickly obtains its parameters, thereby improving the real-time performance.[7] The method to obtain the relevant results in this paper is the same as the reasonable rate in the plane. This paper uses the coordinate system of 10 spatial position points for three-dimensional fitting. Assuming that the selected group of position points is $(a_1,\theta_1,\lambda_1),\cdots,(a_{10},\theta_{10},\lambda_{10})$, the corresponding parameter δ value is $1,2,\cdots,10$.

$$\begin{cases}\alpha_i=A1*\delta_i^3+A2*\delta_i^2+A3*\delta_i+A4\\ \theta_i=B1*\delta_i^3+B2*\delta_i^2+B3*\delta_i+B4\\ \lambda_i=C1*\delta_i^3+C2*\delta_i^2+C3*\delta_i+C4\end{cases} \tag{3}$$

Record:

$$X=\begin{pmatrix}\delta_1^3 & \delta_1^2 & \delta_1 & 1\\ \delta_2^3 & \delta_2^2 & \delta_2 & 1\\ \vdots & \vdots & \vdots & \vdots\\ \delta_{10}^3 & \delta_{10}^2 & \delta_{10} & 1\end{pmatrix}, Y=\begin{pmatrix}\alpha_1 & \theta_1 & \lambda_1\\ \alpha_2 & \theta_2 & \lambda_2\\ \vdots & \vdots & \vdots\\ \alpha_{10} & \theta_{10} & \lambda_{10}\end{pmatrix} \quad (4)$$

Equation (4) is $Y = X\Theta$. From the best-estimated linear model:

$$\Theta = (X^T X)^{-1} X^T Y \quad (5)$$

Then the regression coefficients are tested for significance. If the conclusion of the test rejects the initial assumption, then Y depends on the independent variables $X_1,\cdots, X_p$ and $X_1,\cdots, X_p$ is a column vector of X.

Data Analysis

This paper uses the data processing program of SPSS21.0 to describe the correlation between the experimental and control groups.[8] The significant difference level was controlled at 0.05.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Department of Dance, Zhengzhou Preschool Education College following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Comparative analysis of pretest and post-test results in the control group

The comparative analysis in Table 2 shows the following conclusions: The post-test average sitting and forward bending is higher than the pretest. This indicated an improvement in the controls' overall seated forward flexion index (P>0.05). The average number of kicks in the post-test is higher than in the pretest. This indicates a substantial improvement in the overall number of kicks in the control group.[9] (P>0.05). The average post-test is higher than the pretest in terms of movement skills. This indicates that the overall performance assessment of the control group has dramatically improved. There was a significant difference (p<0.05) between the pretest and post-test of motor skills in the control group in a separate T-test.

Comparative study of the experimental group before and after the test

The comparative analysis in Table 3 shows the following conclusions: The post-test average sitting and forward bending is higher than the pretest. This indicated an improvement in the experimental group's overall seated forward flexion index.[10] There was a significant difference in comparing indicators before and after the experiment by a separate T-test (P < 0.05). The average number of kicks in the post-test is higher than in the pretest. This shows that the overall number of kicks in the experimental group has dramatically improved. The average post-test is higher than the pretest in terms of movement skills. This shows that the experimental group's overall performance has improved dramatically. There was a significant difference between the pretest and post-test of motor skills in the experimental group in a separate T-test (p<0.01).

Table 2. Statistical analysis of the pre-and post-test results of the control group.

	Sitting forward bend	Number of kicks	Action skill review
Pretest	16.01±4.271	5.333±3.76	68.802±5.677
Post-test	17.74±4.302	10.677±8.74	80.656±6.271
T	-1.865	-3.698	-9.229
P	0.079	0.001	0

Table 3. Comparison table of pre-and post-test comparison results in the experimental group.

	Sitting forward bend	Number of kicks	Action skill review
Pretest	16.302±6.177	4.563±2.594	67.792±5.677
Post-test	20.76±4.365	21.802±17.125	97.844±8.135
T	-3.531	-6.552	-12.365
P	0.001	0	0

DISCUSSION

The movements of the shuttlecock are the lower limbs as the main content. The strength, speed, and endurance of the leg and waist muscles are crucial to sports performance. Because the intensity, time, and a load of shuttlecock sports are higher than typical sports, this sport is mainly based on aerobic exercise, supplemented by anaerobic exercise.[11] During exercise, the activity of lipase increases to oxidize, metabolize, and release heat in the body. In this way, the purpose of training is achieved. Flexibility refers to the elasticity and stretching ability of the athlete's joint range of motion, ligaments, tendons, muscles, and skin. The increased flexibility will increase the body's flexibility, making the body more flexible and the movements more coordinated, accurate, and graceful. Short-term training is beneficial for enhancing the athlete's muscle strength. Athletes store energy sources such as adenosine triphosphate, creatine phosphate, muscle glycogen, and fat in their bodies.[12] Physical training can enhance athletes' energy conversion, oxygen consumption capacity, and athletic performance. Shuttlecock players should be coordinated, relaxed, and labor-saving in technical application. You can maximize your physical fitness, skills, and expertise. The main attacker should master the backhand and front foot attack skillfully and stably but also master good defensive skills and passing skills. Defensive players should have offensive skills while fully mastering defense and passing techniques. This way, the technology is comprehensive, and there are no apparent flaws.

CONCLUSION

There was no significant difference in the index before and after the experiment. The average level of the number of kicks in the post-test was higher than that in the pretest. The performance evaluation has a significant difference between the pretest and the post-test. In the experimental group, there were significant differences in the number of seated forward bends, the number of kicks, and the assessment of movement skills before and after the experiment. The technical level of the experimental group has been dramatically improved compared with the control group. The experimental group's specific muscle strength and explosive power after physical training were better than those of the control group.

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

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