

EFFECTS OF EXPLOSIVE STRENGTH TRAINING ON LOWER LIMBS IN TAEKWONDO ATHLETES



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EFEITOS DO TREINAMENTO COM FORÇA EXPLOSIVA SOBRE OS MEMBROS INFERIORES EM ATLETAS DE TAEKWONDO

EFFECTOS DEL ENTRENAMIENTO CON FUERZA EXPLOSIVA EN MIEMBROS INFERIORES EN ATLETAS DE TAEKWONDO

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ABSTRACT

Introduction: Taekwondo is a sport of highly competitive intensity, and the gain in physical fitness of its practitioners is a work that involves analysis of combat techniques, sports biomechanics, and theories of physical training. However, studies of current methods, such as explosive strength training, are still superficial. **Objective:** Study the effect of different explosive strength training protocols on the lower limbs of taekwondo athletes. **Methods:** 24 taekwondo athletes were randomly selected as volunteers and divided into experimental and control groups. These were subdivided to perform traditional and different strength training combinations. The experiment lasted eight weeks, with the first four weeks dedicated to strength training adaptation. Data on body shape, maximal strength, explosive strength, and fitness were collected for statistical comparison. **Results:** Through repeated measures analysis of variance to test lower limb explosive strength on exercise level, it can be seen that there is a significant difference between the test data before and after the approach ($P < 0.05$), this difference was not observed in the control group ($P > 0.05$). The mean value of all indexes in the experimental group was higher than in the control group. **Conclusion:** Explosive strength training and its different combinations on lower limbs can significantly improve the physical fitness of taekwondo athletes. The different combinations of strength training presented can be used as an effective resource in the lower limbs athletes' explosive strength gain. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Training, Strength; Lower Limbs; Martial Arts.

RESUMO

Introdução: O Taekwondo Competitivo é um esporte de alta intensidade competitiva e o ganho na aptidão física de seus praticantes é um trabalho que envolve análise das técnicas de combate, biomecânica esportiva e teorias de treinamento físico. Porém, o estudo de métodos recentes, como o treinamento de força explosiva, ainda é superficial. **Objetivo:** Estudar o efeito de distintos protocolos de treinamento de força explosiva sobre os membros inferiores em atletas de Taekwondo. **Métodos:** 24 atletas de taekwondo foram aleatoriamente selecionados como voluntários e divididos em grupos experimental e de controle. Estes foram subdivididos para a execução do treinamento de força tradicional combinado com diferentes combinações de treinamento de força. O experimento durou 8 semanas, sendo as 4 primeiras dedicadas à adaptação do treino de força. Dados sobre forma corporal, força máxima, força explosiva e aptidão física foram coletados para comparação estatística dos resultados. **Resultados:** Através da análise de medidas repetidas de variância para testar a força explosiva dos membros inferiores segundo o nível de exercício, pode-se ver que existe uma diferença significativa entre os dados do teste antes e depois da abordagem ($P < 0,05$), essa diferença não foi observada no grupo controle ($P > 0,05$). O valor médio de todos os índices do grupo experimental foi maior que no controle. **Conclusão:** O treinamento de força explosiva e suas diferentes combinações sobre os membros inferiores pode melhorar significativamente a aptidão física dos atletas praticantes de taekwondo. As diferentes combinações de treinamento de força apresentadas podem ser utilizadas como um recurso eficaz no ganho sobre a força explosiva dos membros inferiores desses atletas. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Treinamento de Força; Membros Inferiores; Artes Marciais.

RESUMEN

Introducción: El Taekwondo Competitivo es un deporte de alta intensidad competitiva y la progresión en aptitud física de sus practicantes es un trabajo que implica el análisis de las técnicas de combate, la biomecánica deportiva y las teorías del entrenamiento físico. Sin embargo, los estudios sobre métodos recientes, como el entrenamiento de fuerza explosiva, siguen siendo superficiales. **Objetivo:** Estudiar el efecto de diferentes protocolos de entrenamiento de fuerza explosiva sobre los miembros inferiores en atletas de Taekwondo. **Métodos:** Se seleccionaron aleatoriamente 24 atletas de taekwondo como voluntarios y se dividieron en grupos experimental y de control. Éstos se subdividieron para realizar un entrenamiento de fuerza tradicional compuesto con diferentes combinaciones de entrenamiento de fuerza. El experimento duró 8 semanas, las 4 primeras dedicadas a la adaptación al entrenamiento de fuerza. Se



recogieron datos sobre la forma corporal, la fuerza máxima, la fuerza explosiva y la forma física para la comparación estadística de los resultados. Resultados: Mediante el análisis de varianza de medidas repetidas para probar la fuerza explosiva de las extremidades inferiores según el nivel de ejercicio, se observa que hay una diferencia significativa entre los datos de la prueba antes y después del abordaje ($P < 0,05$), esta diferencia no se observó en el grupo de control ($P > 0,05$). El valor medio de todos los índices en el grupo experimental fue superior al del grupo de control. Conclusión: El entrenamiento de la fuerza explosiva y sus diferentes combinaciones en las extremidades inferiores pueden mejorar significativamente la forma física de los atletas de taekwondo. Las diferentes combinaciones de entrenamiento de fuerza presentadas pueden utilizarse como un recurso eficaz en la obtención de fuerza explosiva de los miembros inferiores de estos atletas. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Entrenamiento de Fuerza; Extremidades Inferiores; Artes Marciales.

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INTRODUCTION

Competitive Taekwondo is a high-intensity competitive sport. From the perspective of actual combat, consolidating the scientific training methods and means of high-level sports teams and effectively improving the physical fitness of athletes has become an urgent problem to be solved at present, high-level coaches should pay attention to the improvement of training methods and means for young athletes, and constantly absorb new training concepts and means.¹

Since the 21st century, Taekwondo research has mainly focused on the analysis of actual combat techniques and tactics, sports biomechanics and physical training theories, etc., the research on the training methods and methods of professional Taekwondo athletes is still shallow.² The top three most commonly used techniques by Mohamed O are lateral kicks, side kicks and push kicks, the use of relatively stable side kicks and kicks breaks the goal of smooth performance of the opponent's skills and tactics.³ Zhou Y mentioned that the essence of human motion needs to be understood from the perspective of action and energy metabolism, and different action patterns are formed on the basis of the co-contraction of agonist and synergistic muscles.⁴

In general, the athletic ability exhibited by different sports varies, Taekwondo is a sport that requires a mixture of aerobic and anaerobic intermittent ability, rapid bursts and high agility. Therefore, under the existing physical fitness characteristic model and grade evaluation standard, it has become an important task to effectively connect the physical fitness of Taekwondo with the special training ability in combination with a scientific training plan.⁵

METHOD

Research object

The author took the effect of 8 weeks of different combination strength training on the explosive power of the lower limbs of taekwondo athletes as the research object, and took the active athletes of the Taekwondo team of the sports college as the test object. Taking the opportunity of sports teams to prepare for the 2nd National Youth Games in 2019 to conduct intensive intervention on athletes, 24 young taekwondo athletes from the Sports School of Sports Academy were selected as test and experimental subjects, there are 12 athletes with first-level qualifications and 12 people without sports level, they are between the ages of 16 and 18, and the average training period is 5 years, as shown in Figure 1. All subjects were free of injury or illness, before the test experiment, the subjects were uniformly informed of the purpose of the experiment and the experimental test and training intervention.

Documentation method

According to the research object and measurement content. Use the database of Chinese academic journals and Chinese excellent masters



Figure 1. Basic information of the experiment.

and doctorates, with keywords such as "different combination strength training" or "taekwondo" or "lower body explosive power" or "sensitive quality" in Chinese, search documents in journals such as CNKI, Wanfang and VIP, and collect documents in foreign language databases such as different combinations of strength training. With the help of the library of the Institute of Physical Education, books and papers on pedagogy, sports training, physiology and physical training were collected for theoretical evidence-based.⁶

Experimental Design

According to the principle of sequential training, the intensity of training intervention was implemented from low to high, the experimental intervention lasted for 8 weeks, the first 4 weeks were the strength training adaptation period, and the last 4 weeks were the strength training improvement period. Twenty-four taekwondo athletes from the taekwondo team of the sports academy were selected as experimental subjects, including 12 first-level athletes and 12 athletes who did not obtain sports grades. The athletes were divided into groups with exercise level and without exercise level according to their grades, in the pre-test phase, the athletes were tested for body shape, maximum strength (1RM), explosive power and sensitivity related indicators.

Mathematical Statistics

The author used SPSS22.0 to analyze the indicators measured before and after the intervention of the research objects, and used the independent sample T test to analyze the pre-experimental differences of related test indicators between groups, repeated-measures ANOVA and paired-samples T-test were used to analyze the differences of related test indicators within the group before and

after the experiment, all data were expressed as mean \pm standard deviation ($x \pm SD$), and the final result was expressed as $P < 0.05$ was statistically significant.⁷

There is no need for a code of ethics for this type of study.

RESULTS

Comparison and analysis of lower extremity explosive power test scores between the graded experimental group and the control group before the experiment

As shown in Table 1, the CMJ value of the experimental group was 45.6 ± 4.0 ; The SJ value was 44.7 ± 5.4 ; The CMJ value of the control group was 47.0 ± 3.9 ; The SJ value was 45.9 ± 4.3 . The P values of CMJ and SJ in the experimental group with exercise level and the control group after independent sample T test were respectively $P = 0.80 > 0.05$; $P = 0.41 > 0.05$; The P values were all greater than 0.05, indicating that there was no significant difference in the explosive power of the lower limbs between the experimental group and the control group with exercise levels before the experiment, and the samples were statistically significant. The experimental subjects in the two groups have the experimental intervention conditions and will not affect the experimental results, they can undergo group intervention for 8 weeks with different combinations of strength training.

Comparison and analysis of lower extremity explosive power test scores between graded experimental group and control group after the experiment

From the above knowledge, an independent sample T test was performed on the pre-test scores of the experimental group and the control group with exercise levels, and it was found that there was no significant difference in the pre-test between the experimental group and the control group, after the experimental intervention, the post-test scores of the lower extremity explosive power of the two groups were collected.⁸ As shown in Table 2, repeated measures variance analysis was used to analyze the lower extremity explosive power data of each group, and the experimental group and the control group were set as the between-group factors, the pre- and post-measurement is a between-group factor, and the interaction effect is time*group.

Comparison and analysis of lower extremity explosive power test scores between the stepless experimental group and the control group after the experiment

The experimental group and the control group with no exercise level were given different combination strength training for 8 weeks through the results of the pre-experiment test, after the experimental intervention, the lower extremity explosive power of the two groups was post-tested and the results were compared and analyzed, as shown in Table 3, repeated measures analysis of variance was used to examine the post-experimental differences between the experimental group and the control group of athletes with no level of exercise.⁹

DISCUSSION

The research object selected by the author is the different combinations of strength training performed by the taekwondo team members of the competition school, and the impact on the explosive power and sensitive quality of the lower limbs of taekwondo sports as the research object, after the classification, the sample size of each group is small, so it

Table 1. The comparison of lower limb explosive force in the experimental group with exercise level and the control group before the test (M \pm SD).

Test name	Test group	Control group	T	P value
CMJ	45.5 \pm 4.0	47.0 \pm 3.9	-0.27	0.80**
SJ	44.7 \pm 5.4	45.9 \pm 4.3	-0.87	0.41**

Note**: $P > 0.05$ means no significant difference; M=mean; SD=standard deviation; CMJ is counter kinematic jump; SJ is squat jump.

Table 2. Comparative analysis of post-test lower extremity explosive force test in experimental group with exercise level.

Lower body explosiveness	Test group		Control group		Time effect	Between-group effect	Interaction effect
	Pre-test	Post test	Pre-test	Post test			
cMJ	45.6 \pm 4.0	51.2 \pm 3.0	47.0 \pm 3.9	50.6 \pm 4.2	0.00*	0.81*	0.82
SJ	44.7 \pm 5.4	50.0 \pm 3.4	45.9 \pm 4.3	47.3 \pm 3.8	0.00**	0.96	0.00**

Note: * means $P < 0.05$, the difference is significant, ** means $P < 0.001$, the difference is very significant; CMJ is the inverse kinematic jump; SJ is the squat jump. The results are obtained by analyzing the above Table: The time effect of CMJ measurement before and after exercise level was statistically significant ($PCMJ = 0.00$), the interaction effect was not significant ($PCMJ = 0.82$), and the effect between groups was not statistically significant ($PCMJ = 0.81$); The time effect before and after SJ was statistically significant ($PSJ = 0.00$), the effect between groups was not significant ($PSJ = 0.96$), and the interaction effect was significant ($PSJ = 0.00$).

Table 3. Comparative analysis of post-test lower extremity explosive force test in experimental group without exercise level and control group.

Lower body explosiveness	Test group		Control group		Time effect	Between-group effect	Interaction effect
	Pre-test	Post test	Pre-test	Post test			
cMJ	41.9 \pm 6.8	45.4 \pm 6.7	44.5 \pm 5.9	46.8 \pm 4.7	0.13	0.28	0.13
SJ	38.0 \pm 6.3	40.3 \pm 6.4	42.4 \pm 6.6	44.6 \pm 6.2	0.02*	0.004*	0.95

Note: * means $P < 0.05$, the difference is significant, ** means $P < 0.001$, the difference is very significant; $P > 0.05$ means there is no significant difference; CMJ is the reverse movement jump; SJ is the squat jump. The results are obtained by analyzing the above Table: The time effect before and after CMJ without exercise level was statistically significant ($PCMJ = 0.13$), the interaction effect was not significant ($PCMJ = 0.13$), and the between-group effect was not statistically significant ($PCMJ = 0.28$); The time effect of SJ before and after the test was statistically significant ($PSJ = 0.02$), the effect between groups was significant ($PSJ = 0.004$), and the interaction effect was not significant ($PSJ = 0.95$).

is recommended to increase the sample size when studying Taekwondo in the future, reduce the influencing factors that affect the experimental data. It is recommended to pay attention to the growth and development characteristics of young athletes while strengthening relevant physical fitness exercises, and formulate a reasonable training plan to enhance the explosive power of the lower limbs of taekwondo athletes.¹⁰

CONCLUSION

Through training intervention, the lower limb explosive power index of athletes with sports grades was significantly improved; Different combinations of strength training can be used as an effective means to improve the explosive power of lower limbs of advanced taekwondo athletes. After 8 weeks of different combination strength training interventions, the lower body explosive power index of athletes without sports level was significantly improved; Different combinations of strength training can be used as an effective means to improve the explosive power of the lower limbs of Taekwondo stepless athletes.

Ethical Compliance

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

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

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