CORE STRENGTHENING IMPACT ON THE PHYSICAL FITNESS IN YOUNG JUDO PRACTITIONERS

IMPACTO DO FORTALECIMENTO DO CORE NA APTIDÃO FÍSICA EM JOVENS PRATICANTES DE JUDÔ

IMPACTO DEL FORTALECIMIENTO DEL CORE EN LA APTITUD FÍSICA EN JÓVENES PRACTICANTES DE JUDO

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Xiuli Yang[1,2]
(Physical Education Professional)

1. Chengdu Sport University, Chengdu, Sichuan, China.
2. Capital University of Physical Education and Sports, Beijing, China.

Correspondence:
Xiuli Yang
Sichuan, China. 610041.
yangxiuli@cupes.edu.cn

ABSTRACT

Introduction: To master judo skills, athletes must maintain maximum flexibility, agility, speed, and endurance. It is known that strength training can improve athletes' competitive abilities and physical conditioning. Still, there is no consensus in the literature about the impacts of the CORE strengthening on the physical fitness of young judo practitioners. Objective: Analyze the influence that CORE strengthens on the physical fitness of young judo practitioners. Methods: 18 young athletes were randomly divided into a control training group, with routine activities, and an experimental training group, in which a protocol of core strengthening was also inserted. The article uses mathematical statistics to analyze the relationship between the physical conditioning of judo athletes and the structural characteristics of their technical training. Results: No significant differences were identified between the two groups regarding muscle activation time or amplitude changes in the electrocardiogram (P>0.05). There was a significant difference in the results of the two groups in the static suspension test (P<0.05). The level of forearm endurance in the elite judokas group was higher than that in the common judo group(P<0.05). There is no apparent interaction between the forearm strength data (P>0.05). Conclusion: It was found that strengthening the CORE can help improve the physical fitness of young judo athletes. More attention is recommended to young judo athletes by inserting CORE strengthening in their regular training. ***Evidence Level II; Therapeutic Studies - Investigating the result.***

Keywords: Judo; Training, Strength; Physical Fitness Testing; Athletes.

RESUMO

Introdução: Atletas de judô precisam dominar as habilidades do esporte que exigem flexibilidade, agilidade, velocidade e resistência. Sabe-se que o treinamento de força pode melhorar as habilidades competitivas dos atletas e o condicionamento físico, porém não há consenso na literatura sobre os impactos do fortalecimento do core na aptidão física dos jovens praticantes de judô. Objetivo: Analisar quais são as influências que o fortalecimento do core pode provocar sobre a aptidão física nos jovens praticantes de judô. Métodos: 18 jovens atletas foram divididos aleatoriamente em grupo de treino controle, com as atividades rotineira e um grupo de treino experimental, no qual foi inserido também um protocolo de fortalecimento do core. O artigo utiliza estatísticas matemáticas para analisar a relação entre o condicionamento físico dos atletas de judô e as características estruturais de suas formações técnicas. Resultados: Não foram identificadas diferenças significativas entre os dois grupos quanto ao tempo de ativação muscular ou as alterações de amplitude no eletrocardiograma (P>0,05). Houve diferença significativa nos resultados dos dois grupos no teste de suspensão estática (P<0,05). O nível de resistência do antebraço no grupo dos judocas de elite foi superior ao do grupo de judô comum(P<0,05). Não há interação óbvia entre os dados de força no antebraço (P>0,05) Conclusão: Verificou-se que o fortalecimento do core pode ajudar a melhorar o condicionamento físico de jovens atletas de judô. Recomenda-se maior atenção aos jovens atletas de judô inserindo o fortalecimento de core em seus treinos regulares. **Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.**

Descritores: *Judô; Treino de Força; Testes de Preparo Físico; Atletas.*

RESUMEN

Introducción: Para dominar las habilidades del judo, los atletas deben mantener los niveles máximos de flexibilidad, agilidad, velocidad y resistencia. Se sabe que el entrenamiento de fuerza puede mejorar las habilidades competitivas de los atletas y la condición física, sin embargo, no hay consenso en la literatura sobre los impactos del fortalecimiento del core en la condición física de los jóvenes practicantes de judo. Objetivo: Analizar cuáles son las influencias que el fortalecimiento del core puede provocar sobre la aptitud física en los jóvenes practicantes de judo. Métodos: 18 jóvenes atletas fueron divididos aleatoriamente en un grupo de entrenamiento de control, con actividades rutinarias, y un grupo de entrenamiento experimental, en el que también se insertó un protocolo de fortalecimiento del núcleo. El artículo utiliza la estadística matemática para analizar la relación entre la condición física de los atletas de judo y las características estructurales de su entrenamiento técnico. Resultados: No se identificaron diferencias significativas entre los dos grupos en cuanto al tiempo de activación muscular o los cambios de amplitud en el electrocardiograma (P>0,05). Hubo una diferencia significativa en los resultados de los dos grupos en la prueba de suspensión estática (P<0,05). El nivel de fuerza del antebrazo en el grupo de judocas de élite fue superior al del grupo de judo común (P<0,05). No hay una interacción evidente entre los datos de la fuerza del antebrazo (P>0,05) Conclusión: Se encontró *que el fortalecimiento del core puede ayudar a mejorar la condición física de los jóvenes atletas de judo. Se recomienda prestar más atención a los jóvenes atletas de judo insertando el fortalecimiento del core en sus entrenamientos regulares.* ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Judo; Entrenamiento de Fuerza; Test de Esfuerzo; Atletas.*

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INTRODUCTION

Judo events are two-person confrontation events. Athletes maintain the balance of body muscle strength, and body control ability is the basic principle of the project. Long-term judo grip training will produce adaptive changes in the judo athlete's forearm.[1] This article aims to understand the forearm strength of judo and non-judo athletes. The research theory in this article provides scientific training methods for sports teams. At the same time, we collect the physiological parameters of the athletes through electromyography and the grip meter. At the same time, we compare the difference in forearm muscle strength between judo athletes and non-judo athletes.

METHOD

Research object

We selected the research objects of 9 outstanding male judo athletes from competitive sports schools.[2] The athletes have reached the national first-level black belt level. At the same time, we selected 9 ordinary college students without sports training experience to participate in the study. (Table 1) Among them, ordinary college students belong to the non-judo group. Participants did not perform regular forearm muscle exercises, nor did they participate in sports-related to the strength of forearm muscles. The two groups of subjects had no upper limb muscle injuries or fractures in the past six months.

Experimental method

The athlete adopts a sitting position during the forearm strength test and keeps the torso upright. The athlete's feet are flat on the ground, and the elbow joints are close to the torso and maintained at 90°. The handle distance of the dynamometer should be following the proper distance of the force. When the test person prepared the password, the subject concentrated on observing the LED indicator light in front of him. When it emits red light, the subject quickly exerted force to hold the grip meter to its maximum value and maintained it for 5 seconds.[3] No other body shaking is allowed during the force exertion process. Take the maximum value of three tests on each side, and rest for 15 seconds during this period.

The forearm muscles selected for the EMG test are the superficial finger flexors and the finger extensors. The judo suit is used to measure the static drape of the subject in the grip of the suit to collect electromyographic data. This can reflect the strength and endurance level of the forearm. The subject is encouraged to keep it as long as possible during the test until it can't be maintained. Static grip and drape test once.[4] If the subject fails to grasp the GI suit during the test, the test will be repeated after a 15-minute rest.

Table 1. The body shape of subjects (Mean ± SD).

	Judo Group	Normal group
Age	19.10±1.55	19.87±0.96
Height (cm)	175.27±6.28	174.63±2.83
Weight (kg)	73.88±7.79	68.06±5.69
Forearm circumference (cm)	29.00±0.56	26.2±1.20
Non-excellent forearm circumference (cm)	28.70±0.63	25.2±1.15

EMG test indicators

The signal indicator is realized by the synchronization box in the electromyography instrument. The EMG data interface will be marked as a point.[5] When the subject exerted a strong grip, the electromyographic timing data changed.

(1) Maximum grip strength: The final maximum grip strength value can be directly obtained from the grip strength meter. (2) Time to muscle activation: the time from the mark to 15% $iEMG_{\max}$ of the muscle. (3) Time to peak: the time from the mark point to the peak of muscle EMG. (4) Static drape time: from the beginning of static drape to the inability to sustain the release and record the time. (5) Center frequency CF: CF shifts to low frequency when muscle fatigue and has a good correlation with muscle fatigue. (6) E/T ratio of myoelectricity to muscle strength: an index for evaluating muscle fatigue. The EMG value is the time-domain integrated EMG. Muscle strength in this experiment is its gravity.

An adaptive human-computer interaction control method of EMG signal

We choose characteristic values MAV, RMS and WA at the joint limit position. At this time, we calculate the maximum and minimum values of the eigenvalues and mark them as A_i^{max}, A_i^{min}, B_i^{max}, B_i^{min}, where A_i^{max} $(i = 1, 2, 3)$ and A_i^{min} $(i = 1, 2, 3)$ represent the maximum and minimum values of the MAV, RMS, WA eigenvalue corresponding to channel 1. B_i^{max} and B_i^{min} respectively represent the maximum and minimum MAV, RMS, WA eigenvalues corresponding to channel 2.

In addition, we collected a group of $sEMG$ in the relaxed state separately. At the same time, we also need to calculate the mean value of the 3 sets of eigenvalues of channel 1 and channel 2. We denote them as A_i^{snooze} $(i = 1, 2, 3)$ and B_i^{snooze} $(i = 1, 2, 3)$ respectively.[6] The average value collected here is used for the threshold setting of motion intention recognition.

At a certain moment k, the characteristic value MAV, RMS, WA of the tibialis anterior muscle $sEMG$ is obtained and recorded as a_i (k). The characteristic value MAV, RMS, WA of the gastrocnemius sEMG is denoted as b_i (k). The normalization algorithm is as follows:

$$\overline{a}_i(k) = \left| \frac{a_i(k) - A_i^{\min}}{A_i^{\max} - A_i^{\min}} \right| \quad (1)$$

$$\overline{b}_i(k) = \left| \frac{b_i(k) - B_i^{\min}}{B_i^{\max} - B_i^{\min}} \right| \quad (2)$$

$\overline{a}_i$ $(k)(i = 1, 2, 3)$ and $\overline{b}_i$ $(k)(i = 1, 2, 3)$ respectively represent the normalized MAV, RMS, WA feature value of tibialis anterior muscle and gastrocnemius muscle $sEMG$ at time k. We set a threshold as the criterion for online classification.[7] Assume that the characteristic values MAV, RMS, WA of the anterior tibialis muscle and the gastrocnemius muscle correspond to the threshold values a_i $(i = 1, 2, 3)$ and $\beta_i(i = 1, 2, 3)$, respectively.

$$\alpha_i = \eta^* \left| \frac{A_i^{snooze} - A_i^{\min}}{A_i^{\max} - A_i^{\min}} \right| \quad (3)$$

$$\beta_i = \eta^* \left| \frac{B_i^{snooze} - B_i^{\min}}{B_i^{\max} - B_i^{\min}} \right| \quad (4)$$

Among them, η is defined as the threshold relationship coefficient. We choose $\eta = 2$. On the one hand, this can reduce the threshold and improve the responsiveness of the algorithm.[8] On the one hand, it removes the interference of data fluctuations in the relaxed state and plays a filtering effect.

Data processing analysis

The data we measured are processed by SPSS19.0 statistical software and EXCEL software. The experimental data adopts a two-factor analysis of variance and is expressed as mean ± standard deviation (Mean ± SD). An independent-sample T-test was performed on index data between groups.[9] The index data of the dominant side and non-dominant side within the group used paired T-test. The significant difference is represented by P<0.05. The very significant difference is represented by P<0.01.

RESULTS

The test of this research (Table 2) found that the non-dominant side grip strength index has no obvious distinction between the judo group and the non-judo group. However, there is a significant difference in this index between the dominant side (P<0.05). The size of the grip strength can indirectly reflect the strength of the forearm muscle flexor muscle group.[10] There was a significant difference between the forearm circumference of the dominant side of the judo group and the non-judo group (P<0.05). There was no significant difference in forearm circumference on the non-dominant side between the two groups. Therefore, there was no significant difference in the maximum grip strength on the non-dominant side between the two groups.

Tables 3 and 4 are the average and standard deviation of forearm muscle strength and endurance between the judo and non-judo groups. Before the static drape test, there was a significant difference in the maximum grip value of the dominant side between the judo group and the non-judo group (P<0.05). And this index has a significant correlation with the circumference of the dominant side forearm.[11] There was no significant difference in the maximum grip strength of the non-dominant side among the groups (P>0.05). There was no significant difference between the forearm muscle activation time, and the EMG amplitude reached the maximum value between the groups. Still, there was a significant difference between the two groups in the static sag test.

The E/T and CF groups have the same changing trend in EMG indicators. There is a significant difference between the two groups (P<0.05). This shows that the judo group has a higher forearm strength endurance than the non-judo group. There is no obvious interaction between the data of forearm strength indicators (P>0.05).

Table 2. There are differences in forearm circumference and grip strength between the dominant side and non-dominant side of the judo group and the non-judo group.

		Judo Group	Normal group	F	P
Dominant side	Forearm circumference (cm)	29.11±1.56	26.2±1.21	62.964	0.000
	Maximum grip strength (kg)	55.21±4.67	48.85±5.93	6.119	0.027
Non-dominant side	Forearm circumference (cm)	25.2±1.15	28.71±1.63	39.782	0.000
	Maximum grip strength (kg)	49.78±7.49	45.11±7.11	1.828	0.198

Table 3. The average and standard deviation of the grip index for judo players and non-judo players.

Grip strength index	Judo Group		Non-judo group	
	Dominant side	Non-dominant side	Dominant side	Non-dominant side
Maximum grip strength (kg)	55.21±4.67	48.78±7.48	48.85±5.81	45.01±7.01
Muscle activation time (t)	0.141±0.012	0.147±0.014	0.148±0.011	0.151±0.008
Time to reach the maximum value (t)	1.77±0.88	1.71±0.86	1.88±0.88	1.12±0.80
Grip endurance time (t)	50.28±11.42		15.48+10.51	
Maximum grip strength after endurance (kg)	46.11±8.11	45.04±10.68	42.61±6.61	17.45±5.57

Table 4. The average and standard deviation of forearm electromyography indexes the CF and E/T of judo and non-judo players.

Grip strength index		Center frequency CF (Hz)	E/T ratio of myoelectricity to muscle strength (v/kg)
Judo Group	Start	98.463±5.835	3.494±1.489
	Finish	86.914±8.399	3.451±1.809
Non-judo group	Start	104.59±9.364	3.199±1.445
	Finish	84.099±8.046#	5.604±1.431

DISCUSSION

The contraction time of the forearm muscles represents the activation efficiency of the athletes neuromuscular. Contraction time manifests the transmission of neural reflex arcs and the processing speed of the central nervous system to stimulus signals. In the EMG analysis, the integrated EMG value of the superficial finger flexor muscle reaches 15% of the maximum integrated EMG amplitude value as muscle activation. The time starts from the signal indicator until the EMG of the superficial finger flexor reaches its maximum. This period is defined as when the grip strength reaches its maximum value. The experimental results show that there is no difference between the dominant side and the non-dominant side between the judo group and the non-judo group.

Strength endurance refers to the ability of muscles to maintain muscle tension for a long time during static or dynamic strength exercises without reducing the effectiveness of the work. The body can perform continuous muscle work for a long time. This calculation method is also used to evaluate the body's ability to resist fatigue. Strength endurance is divided into static strength endurance and dynamic strength endurance. Static endurance is divided into maximum strength endurance.

CONCLUSION

Judo athletes and non-judo athletes clearly distinguish between the dominant side's maximum grip strength, and there is no big difference between the non-dominant side. The research results suggest that judo athletes should develop in a balanced manner between the dominant side and the non-dominant side in long-term sports training. There is no significant difference between the groups in forearm grip response time, but it is still an important indicator in evaluating the level of judo players. The forearm strength and endurance of judo athletes are significantly higher than that of non-judo athletes. Forearm strength endurance level can be used as an important index to evaluate the gripping ability of judo players. Research theory provides direction for athlete selection and scientific training.

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

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