



Global Active Stretching (SGA®) Practice for Judo Practitioners' Physical Performance Enhancement

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ABSTRACT

International Journal of Exercise Science 11(6): 364-374, 2018. In order to analyze the Global Active Stretching (SGA®) practice on the physical performance enhancement in judo-practitioner competitors, 12 male athletes from Judo Federation of Sergipe (Federação Sergipana de Judô), were divided into two groups: Experimental Group (EG) and Control Group (CG). For 10 weeks, the EG practiced SGA® self-postures and the CG practiced assorted calisthenic exercises. All of them were submitted to a variety of tests (before and after): handgrip strength, flexibility, upper limbs' muscle power, isometric pull-up force, lower limbs' muscle power (squat-jump – SJ and countermovement jump – CMJ) and *Tokui Waza* test. Due to the small number of people in the sample, the data were considered non-parametric and then we applied the Wilcoxon test using the software R version 3.3.2 (R Development Core Team, Austria). The effect size was calculated and considered statistically significant the values $p \leq 0.05$. Concerning the results, the EG statistical differences were highlighted in flexibility, upper limbs' muscle power and lower limbs' muscle power (CMJ), with a gain of $3.00 \pm (1.09)$ cm, $0.42 \pm (0.51)$ m and $2.49 \pm (0.63)$ cm, respectively. The CG only presented statistical difference in the lower limbs' test (CMJ), with a gain of 0.55 ± 2.28 cm. Thus, the main results pointed out statistical differences before and after in the EG in the flexibility, upper limbs and lower limbs' muscle power (CMJ), with a gain of 3.00 ± 1.09 cm, 0.42 ± 0.51 m 2.49 ± 0.63 cm, respectively. On the other hand, the CG presented a statistical difference only the lower limbs' CMJ test, with a gain of 0.55 ± 2.28 cm. The regular 10-week practice of SGA® self-postures increased judoka practitioners' posterior chain flexibility and vertical jumping (CMJ) performance.

KEY WORDS: Global Active Stretching, judo, strength

INTRODUCTION

At more competitive levels, judo is characterized as a high-intensity combat sport¹. During the combat of the modality, according to Drisd et al. (12), most of the actions applied require strength and coordination to overcome the adversaries with rapid executions of the techniques or blows, requiring of the majority of the muscular groups a performance of contractile forces for projection of the technique. It also involves too much neuromuscular action, which requires the athlete a good level of physical fitness, especially in strength and flexibility (7,15).

Strength training, whether general and/or specific, is undoubtedly prescribed for a best judoka's performance (5,14). In order to train flexibility, there are questions about the relevance of stretching in the intense routine of the judo athlete in high performance, since there is the possibility of obtaining flexibility by resistance training (22). The suggestion of Saraiva et al. (22) is the replacement of stretching by the resistance training in order to valorize the judoka's training time, using a method that contemplates both strength and flexibility.

However, this suggestion ends up disregarding the recommendations on the type, frequency and time for beneficial effects of stretching in the performance, be it acute (3) or chronic (1). Moreover, stretching leads to the creation of sarcomeres in series (27), which increases the speed of contraction and potentiates muscular strength, being fundamental for sports, including judo (11,25).

It is worth mentioning that the mechanical efficiency for the movement depends on the endomysial angulation at the end of the muscle-tendon trajectory (29). In other words, it is not enough to have only a perfectly trained muscle fiber if it is in the wrong position. If it is, according Wisdom et al. (27), the results presented by some methods of stretching are inconsistent to be able to change properties of the connective tissue.

Correlated to these considerations, SGA® is a stretching method that has not been scientifically investigated, yet does not have relevant studies on its effects. Different from other stretching techniques, SGA® proposes to prioritize the active stretching of connective tissue, based on the principles of Global Posture Reeducation (RPG®) as a form of self-posture for prevention, maintenance and physical preparation (24).

According to Grau (16), SGA® self-postures should be practiced based on the biomechanics of the gestures of each modality and the need of each athlete, and the judo athlete is recommended to have general flexibility. Flexibility allows a better contraction and muscle utilization to perform the requested movement more strongly, especially in muscles that make difficult the sports gesture, those that participate in the movement and lead to postural compensations (16).

Thus, the objective of the present study was to verify the chronic effect of SGA® practice on judokas' performance in a battery of physical tests used for evaluation in the modality. Specifically, we analyzed whether SGA® self-posture practice can optimize physical parameters for judo combat.

METHODS

Participants

It was started with 21 male athletes, where 9 were excluded because they met the pre-established exclusion criteria, remaining 12 at the end of the study, enrolled in the Judo Federation of Sergipe, with 22.8 ± 5.5 years old, 75.6 ± 10.3 Kg of body weight and 172 ± 4 cm

of height. It was adopted as inclusion criteria: being a regional-level competitor; having at least three years of experience in the sport; frequency in the training three times a week; being available to perform SGA® self-postures. For exclusion: being or getting injured, using substances and methods permanently prohibited; missing SGA® sessions more than two times.

After screening, volunteer athletes were clarified about the study procedures. From their understanding, all of them signed the informed consent form (ICF). Six athletes were selected randomly to compose the experimental group (EG) and the other six to compose the control group (CG). This study was approved by the Human Research Ethics Committee of the Federal University of Sergipe, numbered 1,586,126 and were conducted in accordance with the Declaration of Helsinki.

Protocol

We conducted the study in the Fighting Room of the Department of Physical Education of the Federal University of Sergipe, divided into 3 stages: 1) Test Battery of tests (pre-intervention); 2) SGA® intervention; 3) Battery of tests (pos-intervention). There was a 60-minute break between each test.

Test Battery (pre and pos-intervention)

Weight measurement: In order to start the tests, the athlete was weighed (Filizola, ID-M 150/4, São Paulo, Brazil) to verify in which category of the modality they were in accordance with the Judo Brazilian Confederation's standard (2016).

Handgrip strength: Using the Jamar® dynamometer (Asimow Engineering, Santa Fe Springs, CA, USA), it was possible to obtain the handgrip strength for both hands. The athlete stood with his shoulder comfortably adducted, arm parallel to the body, without tightness between the arm and the body. The position of the hand was descending and the palm did not force the flexion of the wrist. The athlete made a voluntary force of 5 s that was repeated for 3 times, in order to choose the athlete's best performance (12).

Sitting-reaching test: In order to measure the flexibility of the back and legs, we used the Wells' bench. The athlete positioned himself facing the bench, placing his feet in the support with his knees extended, arms raised with his hands overlapped, bending as much as he could reach, held for 2 s so that it was possible to write the value referring to bench ruler. 3 attempts were made, being considered the highest value (21).

Isometric pull-up force: In order to obtain the isometric pull-up force, a load cell (Kratos 500kg - Kratos Dinamometers Ltda., São Paulo, Brazil) was used, coupled with a digital indicator (Kratos IK15 - Kratos Dinamometers Ltda., São Paulo, Brazil). The protocol used in other studies (8,10), with a simulation on the *judogi* neck and sleeves, that is, providing the *kuzushi* phase (imbalance). The athlete was informed about the simulation of the execution of the *kuzushi* as if he were in a real situation, and he carried out the pull-up after a verbal command

and maintained it during 10 s. The athlete was instructed to perform the maximum isometric force and maintain it for 10 s, which determined the isometric force resistance.

The pull-up force maximum value ($F_{\max.}$) and the maximum force maintenance rate ($FMR_{\max.}$) were considered for the analysis of the pull-up force. For the calculation of $F_{\max.}$, it was considered the highest value obtained in the 1st second. For the calculation of the $F_{\max.}$ maintenance rate, the force values were normalized (after the 1st second) by the $F_{\max.}$, after calculating their mean value. $FMR_{\max.}$ was considered after the 1st second, so that the same maintenance time was maintained for all athletes. Subsequently, for analysis purposes in the group, the values of $F_{\max.}$ were normalized by the athletes' body mass and processed in Kratos IK15 software (Kratos Dinamómetros Ltda., São Paulo, Brazil).

Upper limb muscle power: In order to evaluate the muscle power for upper limbs, we followed the instructions described by Drid et al. (12), and carried out demonstrations for the throwing of a 3-Kg medicine ball (Pretorian Performance), marked with chalk powder, with the athlete positioned sitting on the ground with his back leaning against the wall and the ball at the height of the sternum bone to make a throw with both hands, without removing the back from the wall. The distance of the throwing of the ball was measured from the starting point to where the medicine ball touched the ground. Three throwing attempts were made, with an approximate interval of 2 min. between the trials, being considered the best result obtained.

Lower limb muscle power: By the vertical jump, it was possible to evaluate the athletes' muscle power for the lower limbs. Initially, the athlete performed the familiarization with the warming-up jump, which consisted of jumping for 1 min. on a trampoline. After a resting period of 3 min., they performed three maximum vertical jumps of each model: first Squat Jump (SJ) and then Countermovement Jump (CMJ) on a Jump Test® mat (Hidrofit Ltda., Brazil). The technical procedures for both jumps were based on Bosco's (6) descriptions.

To perform the SJ Test, the athlete positioned himself in a squat with 120° flexion in the knees, remaining in this static position for five seconds, hands fixed to the hip and then performing the maximum jump. Any countermovement was avoided. In the CMJ Test, the athlete stood with knees in 180°. With the hands on the hip, they performed the countermovement technique, which consists of the stretching-shortening cycle, where there was a knee flexion (approximately at the angle of 120°) and then an extension of the knees seeking to push the body up to the maximum and vertically. It was required for both jumps that the knees remained in extension during the jump, and the interval between one trial and another was 10 seconds.

Tokui Waza Test: The specific test used was the *Tokui Waza* test, in order to verify the sequential efficiency to apply a blow for 30 s. The test was performed with 2 judokas (*uke*) positioned 4 m apart, and the test performer (*tori*) positioned 2 m away from each *uke*, exactly in the middle of the two judokas of the same category as the judoka that will execute the test.

For 30 s, *tori* threw opponents with his "favorite" or "best" technique as many times as possible over time (Fig. 1). Performance was determined by the release numbers completed by *tori* (12).

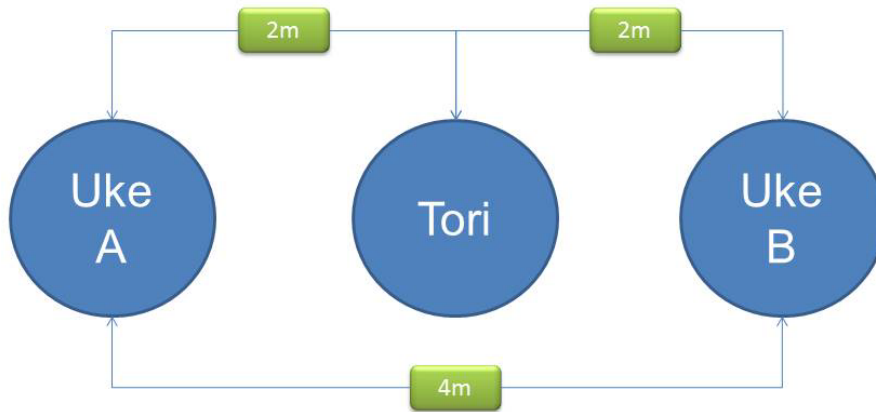


Figure 1. Tokui Waza test.

Intervention

4 self-postures were chosen for this study (Fig. 2), which are recommended for judo according to Grau (16). For 10 weeks, at the beginning of each judo training, with a frequency of 3 times a week and a duration of 15 min. per session, a different self-posture was done among the ones chosen for this study, with some insistences and an assistant's help at the end of each progression, in order to optimize the stretching gaining (23).

In the "standing with the back against the wall" self-posture, the athlete was positioned standing with the back on the wall, knees slightly flexed and arms away at 45°, and progressed to the extension of the forearms. The "lying on back with open arms" self-posture was performed with the athlete positioned lying on the floor with his knees flexed, feet touching the wall and arms at 45°, with knees and arms progressively extended as far as possible. For the execution of the "sitting with legs extended" self-posture, the athlete started sitting, leaning against the wall with knees flexed in adduction as close as possible to his body, progressively performing the extension of the knees. For the "standing with the body leaning forward" self-posture, the athlete was positioned standing, with feet opening at 45°, where the metatarsi were on a rolled up towel, with the knees slowly flexed by approximately 25°, and then flexed the trunk forward with extension of the arms along with the trunk (23).

During all the self-postures, we observed the correct alignment of the head, chest and pelvis in order to avoid possible compensations. Deep exhalation was necessary with each slow movement in the progression of the self-posture.

The athletes of the control group continued performing throughout the intervention period varied calisthenics exercises (jumping jacks, push-ups, sit-ups, squats and others), which compose a conventional judo routine for upper and lower limbs in the first 15 min. of judo training as a form of warm-up.



➡ Progression

➡ 3-second isometric contraction with the guide's support

➡ Stretching gaining

Figure 2. Self-postures performed by the EG: “standing with the back against the wall” (A); “lying on back with open arms” (B); “sitting with legs extended” (C); “standing with the body leaning forward” (D).

Statistical Analysis

Descriptive statistics (mean and standard deviation) were used. Due to the small number of people in the sample, the data were considered non-parametric and then we applied the Wilcoxon test using the software R version 3.3.2 (R Development Core Team, Austria). The effect size was calculated according to Field (13) and values of $p \leq 0.05$ were considered significant.

RESULTS

Table 1 presents the comparison of the means of the results obtained by the groups in the battery of tests (pre and post-intervention).

With the exception of the results obtained in the *Tokui Waza* test, all the other tests presented values within the normality. The difference of the means before and after the EG for the flexibility and lower limbs muscle power (CMJ) tests was considered statistically significant.

Table 1. Comparison of the means of the results obtained by each group, before and after test.

Test	Group	Pre-test	Pos-test	P	ES
Flexibility (cm)	EG	29.16 ± 9.94	32.16 ± 10.02	0.032*	0.30
	CG	33.33 ± 6.74	31.00 ± 7.45	0.057	0.33
Handgrip Strength (kgf)	EG	48.16 ± 8.93	48.83 ± 7.52	0.963	0.08
	CG	44.66 ± 9.45	45.66 ± 11.11	0.587	0.10
ULMP (m)	EG	4.66 ± 0.44	5.08 ± 0.74	0.031*	0.69
	CG	4.81 ± 0.85	4.63 ± 0.97	0.156	0.20
LLMP SJ (cm)	EG	44.36 ± 6.12	45.59 ± 5.31	0.059	0.21
	CG	42.92 ± 7.80	43.68 ± 6.00	0.786	0.11
LLMP CMJ (cm)	EG	47.75 ± 5.04	50.24 ± 5.13	0.031*	0.49
	CG	44.78 ± 7.31	45.33 ± 5.94	0.031*	0.08
Isometric Pull-Up Force F _{max.} (N)	EG	3.02 ± 0.44	3.53 ± 0.69	0.161	0.88
	CG	2.36 ± 0.35	2.55 ± 0.44	0.305	0.48
Maximum force maintenance rate FMR _{max.} (N)	EG	2.34 ± 0.57	2.83 ± 0.62	0.183	0.82
	CG	1.89 ± 0.30	1.99 ± 0.30	0.557	0.33
TW Test	EG	10.16 ± 1.32	10.83 ± 0.75	0.173	0.04
	CG	9.50 ± 0.54	9.60 ± 0.51	0.173	0.23

Note: EG = experimental group; CG = control group; ULMP = upper limb muscle power; LLMP = lower limb muscle power; ES = effect size, TW Test = *Tokui Waza* Test. * Statistically significant values for $p \leq 0.05$.

DISCUSSION

The objective of the present study was to verify the effect of regular practice of SGA® on judo performance in a battery of physical tests used for judo evaluation. Thus, the main results highlighted statistical differences before and after in the EG in lower limb muscle flexibility and power (CMJ), with a gaining of 3.00 ± 1.09 cm and 2.49 ± 0.63 cm, respectively.

Thus, the main results pointed out statistical differences before and after in the EG in the flexibility, upper limbs and lower limbs' muscle power (CMJ), with a gain of 3.00 ± 1.09 cm, 0.42 ± 0.51 m 2.49 ± 0.63 cm, respectively. On the other hand, the CG presented a statistical difference only the lower limbs' CMJ test, with a gain of 0.55 ± 2.28 cm.

Similar response related to the practice of SGA® had already been found in Oliveira and Nogueira's (20) study, with the purpose of investigating the influence of this method on volleyball players' flexibility of the posterior chain and the impulsion of the vertical jumping.

It is noteworthy that both this study and Oliveira and Nogueira's (20) proposed the investigation of the chronic effects, since most of the kinds of stretching tend to be detrimental to the players' performance (3).

The improvement of the EG in upper limbs' muscle power e the lower limb muscle power (CMJ) test may be attributed to the increase in elasticity (passive force restitution) to collaborate with the elastic return of the stretch-shortening cycle. The elastic passive force, along with the direct myotatic reflex, are influential factors for establishing a force-velocity relationship, contributing to the effectiveness of the stretch-shortening cycle (6). Another intramuscular explanation for this improvement would be the creation of sarcomeres in series through regular practice of stretching (27), respecting the training periodization. Therefore, this improvement would be achieved throughout the intervention, but the acute effect still needs to be investigated.

However, some studies (9,19,27) emphasize that stretching presents inconsistent results to change connective tissue properties, altering it only at the muscular level. Nevertheless, it is necessary to clarify that there are methodological distinctions between SGA® and the kind of stretching used in those studies. For example, the maintenance time superior to conventional stretching, the slowness of progressions to avoid the onset of direct myotatic reflex and stretching gaining, especially on the connective tissue through the "creep" (16,24).

"Creep" is a physical phenomenon of the ultimate deformation of a material subjected to constant traction for enough time, which has been adopted and adapted as one of RPG® principles and, consequently, of SGA®. That facilitates the stretching gaining (SG) from the criteria of tractive force (F), time (T) and coefficient of elasticity (&), i.e., the formula ($SG = FT / \&$) to have a gaining through the creep, without needing an exacerbated tractive force, simply increasing the stretching time (16).

Collaborating with the "creep", during the SGA® self-posture practice, active work is performed on low-intensity isometric contractions for approximately 3 seconds, in increasingly eccentric positions, so that the muscle fibers stress the connective tissue, in order to reach plasticity (16,24). This is allowed by reverse myotatic reflex as a proprioceptive means of muscle inhibition, so that it is possible to facilitate movement with the stretching of the retracted muscle-fibrous structures, allowing the improvement of the active force of the shortened muscle and increased elasticity, restitution of the passive force with a chronic training (16).

Saraiva et al. (22) suggest that the practice of stretching, specifically for judokas, should be replaced by strength training because they affirm that strength and flexibility can be obtained through a training mode. However, the CG of the present study, which performed varied calisthenic exercises, such as jumping jacks, push-ups, sit-ups, squats and others that are recommended to substitute stretching as a form of warm-up (2), only presented statistically relevant results in the CMJ test. Considering that the CG performed vertical jump exercises, which are biomechanically closer to the execution of the CMJ test, it would be expected to

obtain some gain. However, the gain of the CG group was lower than the gain of the EG group.

The fact that repetitive and intense efforts with the predominance of concentric muscular action may result in muscle shortening and stiffness (27) may be another possible explanation for the EG's gaining during our intervention. According to Souchard (24), the practice of muscle stretching is indispensable the longer the muscle shortening and stiffness are, since they might be detrimental to the athletes' performance, and might contribute to the increase of the risk of injury as well (16,23).

When a muscle is shortened, the proportion of collagen increases at the perimysium level in 48 h and at the endomysium level in 168 h (17,26). Since the movement depends on the endomysial angulation at the end of its musculous-tendinous trajectory (29), the mechanical efficiency may be impaired due to the increase in collagen level.

Such a requirement for muscular actions on the lower limbs and trunk is observed in essential movements to judo practice, such as the *Morote Seoi Nage* (4). The importance and care for muscular groups such as these were given through the practice of self-postures performed in the present study, which starts from the idea that these groups are not treated in an analytical way, but in a global way (muscular chains) (16,24).

The analytical way of considering the possibility of stretching a muscle alone is recommended according to conventional stretching methods (1,9). This approach ends up disregarding the existence of lateral force transmission through the epimysia (18) and the fact that there is no mechanically independent muscle fiber or muscle (28). Therefore, if the mechanical influence of connective tissue is not considered, that makes the analysis of the case incomplete.

However, it was possible to obtain a study that used a stretching method that enhanced the athletes' flexibility, upper limbs' muscle power and vertical jumping gaining, and it was not detrimental in other tests for judo athletes. This study is showing that there is a possibility of stretching being beneficial for judokas, if it is based on and consistent with the individual's needs and those imposed by the martial art. Therefore, the choice of not practicing stretching for judokas should be rethought if the argument is based on a possible physical injury.

A regular 10-week practice of SGA® self-postures increased posterior chain flexibility, upper limbs' muscle power and CMJ vertical jumping performance. For other strength tests, it was not detrimental to the athletes' performance. Although regular practice of calisthenics exercises increased the vertical jump CMJ, in this case it seems to be more advantageous for the athlete to practice SGA®.

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