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Original

TÉCNICA DE SECUENCIAS DE BRACING SOBRE EL RENDIMIENTO DEL KARATE Y LA ESTABILIDAD DEL CORE

BRACING SEQUENCES TECHNIQUE ON KARATE PERFORMANCE AND CORE STABILITY

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RESUMEN

El objetivo de este estudio fue determinar el efecto de la técnica de secuencias de bracing en la estabilidad del core y el rendimiento en kata de karatecas. 38 deportistas masculinos de karate participaron en el estudio divididos en un grupo experimental (n=21) y un grupo de control (n=17). La prueba de rendimiento del deportista y la prueba de estabilidad del core se realizaron en pretest y postest posterior a 8 semanas de programa de estabilidad del core (técnica de secuencias de bracing). El grupo experimental mostró una mejora significativa en la prueba de rendimiento del atleta ($p < 0,001$) y en la prueba de estabilidad del core con ($p < 0,05$). Hubo una correlación positiva muy fuerte entre la prueba de rendimiento del atleta y el cinturón del karateca ($\rho = 0.780$), una correlación positiva considerable entre la prueba de estabilidad del core y el cinturón del jugador ($\rho = 0.604$), una correlación positiva considerable entre la prueba de rendimiento del atleta y la edad del jugador ($\rho = 0.554$), y una correlación positiva media entre la prueba de estabilidad del core y la edad del jugador ($\rho = 0.481$). En conclusión, los karatecas mostraron una gran mejora en el rendimiento del kata y en el nivel de estabilidad del core después del programa de técnicas de secuencias de bracing.

Palabras clave: fuerza del tronco, rendimiento deportivo, torso, fuerza, artes marciales.

ABSTRACT

The aim of this study was to determine the effect of bracing sequences technique on core stability and kata performance of karate athletes. 38 male karate athletes participated in the study divided into the experimental group (n=21) and the control group (n=17). The athlete performance test and core stability test were done at pre-test and post-test after 8 weeks of a core stability program (bracing sequences technique). The experimental group showed significant improvement in athlete performance test ($p < 0.001$) and in core stability test with ($p < 0.05$). There was very strong positive correlation between athlete performance test and player belt ($r = 0.780$), considerable positive correlation between core stability test and player belt ($\rho = 0.604$), considerable positive correlation between athlete performance test and player age ($\rho = 0.554$), and average positive correlation between core stability test and player age ($\rho = 0.481$). In conclusion, karate athletes showed great improvement in kata performance and core stability level after bracing sequences technique program.

Key Words: trunk strength, athlete performance, torso, strength, martial arts.

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INTRODUCTION

Karate will make its first appearance as an Olympic sport at the 2020 Summer Games in Tokyo (Franchini et al., 2018; Molinaro et al., 2020). The competition consists of two sport disciplines; kumite and kata, kumite is noncontact ritualistic fight and kata is a determine series of karate movements (Doria et al., 2009). Different training methods have been used to improve performance in karate such as stabilization and equilibrium training, virtual reality training, functional strength training, plyometric training and core training (Pal et al., 2020). The athletes need to develop dynamic control of body stability, explained as core stability to express efficiency in kata and kumite disciplines (Cavanagh & Landa, 1976; Cesari & Bertucco, 2008).

Core stability programs target muscular strengthening and motor control of the core musculature (Pal et al., 2020; Wirth et al., 2016). The use of these exercises has been mainly with low back pain patients (Lee & McGill, 2017), injury prevention and sport conditioning programs to improve athlete performance (Araujo et al., 2015; Kibler et al., 2006; Okada et al., 2011; Shinkle et al., 2012; Stanton et al., 2004).Thus, it is suggested that proximal stability by the core muscles allows for better distal mobility like a tennis serve (R. N. Marshall & Elliott, 2000), handball throw (Atle Hole Saeterbakken et al., 2011), or baseball throw (Hirashima et al., 2002), which are directly related to athlete performance (Kibler et al., 2006; Shinkle et al., 2012). Many authors have investigated and reported the effectiveness of the core training, Kamal (2015), explores the effects of core strength training on spinning wheel kick and certain physical variables for young female athletes and showed a statistically significant differences between the post measurements for the experimental groups in all variables of performance (Kamal, 2015). Tantawi (2011), demonstrated that some physical variables and the level of compulsory Kata performance improve after a core stability program (Sh Tantawi, 2011).

On the other hand, many studies show no improvement in different athletic field performance. Stanton et al., (2004) found an improvement of core stability tests without a significant difference of running economy throughout Swiss ball training. Okada, Huxel & Nesser (2011) showed weak and no relationship between core stability and athlete performance. Araujo et al., (2015) investigated capoeira athletes after six weeks of core stability training and mention improvement in landing kinetics without improving jump height (Araujo et al., 2015; Okada et al., 2011; Stanton et al., 2004).

Regarding the differences of the relationship between core stability and athletic performance, Nesser et al., (2008) has mentioned two reasons for these different results: "core stability effectiveness" tests are not specific to one sport and core stability only plays a minor role in sport performance (Nesser et al., 2008).

In order to train core stability, there are many training techniques or programs such as swiss ball exercises (P. W. Marshall & Murphy, 2005; Stanton et al., 2004), unstable resistance training (Behm et al., 2010), core strength (Kamal, 2015), bracing sequences technique (Koh et al., 2014; Starrett & Cordoza, 2013). Few studies have observed core stability with karate athlete performance and injury prevention (Baban et al., 2015; Cesari & Bertucco, 2008; Sh Tantawi, 2011) however, only Sh Tantawi (2011) used a training program to improve core stability. Cesari & Bertucco (2008), suggesting that dynamical body stability should have a special attention in training sessions (Cesari & Bertucco, 2008). Tantawi (2011) concluded that the programs that include core stability exercises in physical preparation improved the level of some physical variables and Kata performance. Moreover the karate athletes improved the level of flexible spine, power endurance of abdominals, stable balance, explosive leg power and explosive arms power variables (Sh Tantawi, 2011).

On the other hand, Cesari & Bertucco (2008), also studied the change of the center of pressure (CoP) when performing specific kata skills and showed that the most expert karatekas better controlled the migration of the CoP (Cesari & Bertucco, 2008). Kamal (2015), revealed a significant difference between the experimental group which performed core strength training and the control group which performed traditional exercise, in spinning wheel kick tests and certain physical variables (balance-core strength-power-reaction speed)(Kamal, 2015).

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Therefore, the aim of this study was to determine the effect of bracing sequence techniques on core stability and kata performance of karate athletes. It was hypothesized that bracing sequence techniques would increase core stability level and kata performance level.

METHODS

Experimental approach of the study

A repeated measures test/retest design of both the experimental and control groups were used to evaluate the differences after twenty-four sessions (three session per week) of core stability and different aspects of athlete performance.

Subjects

Forty-two young karate players participated from two different clubs (13.6± 3.12 years, 47.2 ± 16.6 Kg mass and 1.50 ± 0.15m height). All participants were divided randomly into an experimental group (n=21) and a control group (n=21). Four karate athletes in the control groups were excluded, two because they didn't attend all of the sessions and the other two due to musculoskeletal injuries. Five of the participants compete in high-level national championships.

Before participating in the study, the athletes were informed about the purpose and procedures of the study to ensure that the participants completely understood it they were informed that they were free to withdraw from the study at any time. All participants signed an informed consent to participate in the study. This study was approved by the institution's ethics committee.

The inclusion criteria for the study participant were that one year of experience, more than 10 years and free of injuries (low back pain, hip injuries and other injuries that affect the performance) for more than one year.

Procedures

Participants were selected from two karate clubs after an agreement with the Palestinian karate federation. The evaluation was separated into three evaluations day, first day was to obtain socio-demographic data and separate the sample into two groups randomly, controlling of the age variable. And the second and the third days were to perform the pretest and the posttest respectively.

After a general warm-up of 20 minutes, core stability was tested using Wisbey´s method (Wisbey-Roth & Allingham, 1996) and athletes' performances were evaluated by specialized judges. The experimental group followed the bracing sequences technique (20 minutes after the warm-up in every session) however, the control groups continued normal karate training.

Bracing sequences technique

Bracing sequences technique consists of four phases and each phase consists of two parts. The first part applies it to walking and the second part applies it to basic karate movements. The participant can move to the next phase when they are able to perform it perfectly (Starrett & Cordoza, 2013).

a) Phase one: Squeeze your gluteus as hard as you can. First, the athlete sets the pelvis in a neutral position (by comparing the anterior superior iliac spine and the posterior superior iliac spine at the same level) without anterior or posterior tilting, then he/she screws their feet on the ground while positioning the feet directly under the hips and maximally contracts the gluteus muscle in order to stabilize the pelvis at the neutral position. In this phase the stabilization comes from the gluteus and the abdominal muscles are relaxed.
b) Phase two: Pull your ribcage down. At the same time the pelvis stabilizes, the athletes must pull their ribcage down to be proximally over the pelvis. In order to achieve this, the players train to do it in different positions (flexion, neutral, extension and later pending).
c) Phase three: Athletes must hold their abdomen tight. After that, the pelvis must be placed in a neutral position and the ribcage has to be parallel to the pelvis without tilting. Additionally, in this phase, the abdomen muscles must engage to maintain balance to feel the connection between the abdomen muscles and pelvic position. T he contraction of abdomen and gluteus shouldn't be hard in this phase, to allow the player to move while stabilizing the pelvis.
d) Phase four: Set your head in a neutral position and set your shoulders into a stable position. After controlling the core of the body and placing the feet in straight alignment with the shoulders,

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the head is placed foreword due to ribcage pressing, so the athletes have to screw the shoulder back and set the head into the same erect position.

Instrumentation

-Core stability test

The core stability evaluation was on Wisbey's method (Wisbey-Roth & Allingham, 1996) and follow the next grading system from zero to five. Grade zero: the athlete isn't able to keep an isometric contraction without compensatory movement of the core, throughout a position aimed to facilitate the stabilizing role of key muscles. Grade one: the athlete is able to keep an isometric contraction (10 to 20 seconds) without compensatory movement of the core, throughout a position aimed to facilitate the stabilizing role of key muscles. Grade two: the athlete is able to keep an isometric contraction (for 20 seconds) without compensatory movement of the core, throughout slow movement of the limbs. Grade three: the athlete is able to keep an isometric contraction (for 20 seconds) without inappropriate movement of the core, throughout performing slow movements of the trunk itself. Grade four: the athlete is able to keep an isometric contraction (for at least 20 seconds) without compensation /inappropriate movement of the core, throughout performing fast movements of the limbs. Grade five: the athlete is able to keep an isometric contraction (for at least 20 seconds) without compensation/inappropriate movement of the core, throughout performing: a) fast movements of the trunk - if appropriate to activity required, with joint angle specific positioning and muscle function specific; b) fast movements of the limbs in joint angle specific postures and muscle function specific ; c) against increased resistance/increased load in joint angle specific postures and muscle function specific positioning; this is sport/activity specific.

-Athlete performance test

A specific evolution sheet was used to evaluate the performance of the athletes through HIEN-NI-DAN kata. The evolution depends on different aspects: speed of the movements, technique timing, technique accuracy and player posture, therefore the total evolution from 20 (Table1).

The examiners of the players are officially considered as international judge of kata from the World Karate Federation and the Palestinian Karate Federation. Three judges from three positions have evaluated and the sum of their results has been recorded.

Statistical analysis

Descriptive statistics (mean and standard deviation) were calculated for each of the variables. Data normality was checked and confirmed by Shapiro-Wilk and Levene tests. An independent sample t test was used to measure the differences between the experimental and control group and a paired sample t test was used to measure the differences between pretest and posttest.

The Spearman's correlation coefficient (ρ) was used to analyze the relationship between the variables. G*power 3.2.9.2 program has been used to measure the effect size. All analyses were performed using SPSS version 20 and the significant level was set on ($p < 0.05$).

RESULTS

After 8 weeks of a training program the experimental group showed improvements in the athlete performance test and core stability test. The athlete performance pre-test showed no significant differences between control and experimental groups ($p = 0.781$) and the athlete performance post-test showed significant differences improvement of the experimental group with ($p = 0.001$) (Figure 1).

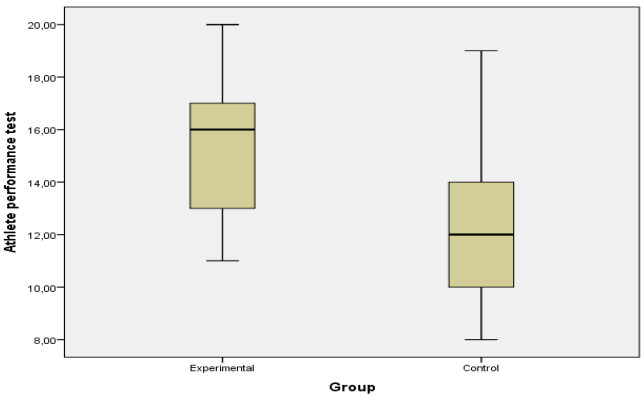

Figure 1: Post-test result of athlete performance test. On the y axis the result of performance test and on the X axis studies groups.

However, there were significant improvements ($p < 0.001$) in each group between pre-test and post-test

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Table 1: Karate Performance evaluation sheet

	Total timing		Speed of movements
1	The player finishes it with more than 7 seconds deferent	1	The player uses un proper speed for more than five movements
2	The player finishes it with 5-6 seconds deferent to the needed time	2	The player uses un proper speed for four or five movements
3	The player finishes it with 3-4 seconds deferent to the needed time	3	The player uses un proper speed for two movements.
4	The player finishes it with 2 seconds deferent to the needed time	4	The player uses un proper speed for only one movement
5	The player finishes it at the needed time	5	The player uses the proper speed for each movement
	Player posture		Technique accuracy
1	The player has major posture deviation in one or more parts of the body(head, trunk , upper limbs and lower limbs) during the technique	1	There is luck of accuracy of four movements and more
2	The player has medium posture deviation in one or more parts of the body(head, trunk , upper limbs and lower limbs) during the technique	2	There is luck of accuracy of three movements
3	The player has slight posture deviation in two parts of the body(head, trunk , upper limbs and lower limbs) during the technique	3	There is luck of accuracy of two movements
4	The player has slight posture deviation in one part of the body (head, trunk, upper limbs and lower limbs) during the technique.	4	There is luck of accuracy of one movement
5	The player has perfect posture during the technique of all parts.	5	There is no luck of the accuracy in all moments

1
2

Table 2: Result of cross tables analyze for pre-test and post-test of core stability**.**

	Pre-test of core stability			**Total**	**Post-test of core stability**			**Total**
	2	**3**	**4**		**2**	**3**	**4**	
Experimental	11	9	1	21	0	9	12	21
	55%	56,3%	50%	55,3%	0%	42,9%	85,7%	55,3%
Control	9	7	1	17	3	12	2	17
	45,0%	43,8%	50,0%	44,7%	100,0%	57,1%	14,3%	44,7%
Total	20	16	2	38	3	21	14	38
	100%	100%	100%	100%	100%	100%	100%	100%

with differences in the effect size. The experimental group mean increased from 10.67 to 15.43 and control group had a smaller change from 10.35 to 12.12.

The result of core stability pre-test demonstrated non-significant differences between both groups ($p > 0.05$). However, there was a significant improvement in the experimental group at post-test ($p < 0.05$). In addition, cross table tests explain the differences between both groups at pre-test and post-test (Table 2).

There was a significant correlation between athlete belt and the age of the athlete with athlete performance and core stability tests (Table 3). There was very strong positive correlation between athlete performance test and player belt (ρ =0.780) and a considerable positive correlation between core stability test and player belt (ρ =0.604). Additionally, there was a considerable positive correlation between athlete performance test and player age (ρ =0.554), and average positive correlation between core stability test and player age (ρ=0.481).

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DISCUSSION

The first aim of this study was to determine the effect of 8 weeks of bracing sequences technique program on kata performance in karate athletes. After applying the program, the experimental group showed significant improvement ($p < 0.001$).

Table 3: Spearman's correlation coefficient (ρ) (n = 38)

	Value (ρ)	Significance (p-value)
Belt with Athlete performance test	0.780	.000
Belt with core stability test	0.604	.000
Age Athlete performance test	0.554	.000
Age with core stability test	0.481	.002

The result of the current study corroborated with another study of a core stability program (Nagla, 2011) that demonstrated a significant effect of kata performance variable ($p < 0.05$) and the effect size improved from 15.66 to 16.65 in Gankaku Kata performance level (degree). The study of Nagla (2011), has evaluated the athlete performance test with 5 referees and our study has evaluated it with 3 referees. However, the study of Nagla (2011) did not show the performance evaluation sheet to follow the evolution and there was no control group to explain if the improvement was due to core stability program or regular karate training (Nagla, 2011).

Core stability programs have been applied in different sports field but the previous investigation did not focus on karate. Therefore, fighting sports studies, such a capoeira, judo and martial arts, consider the most applicable studies to karate investigations (Araujo et al., 2015; Barbado et al., 2016; Lee & McGill, 2017). Araujo, et al. (2015) applied 6 weeks of core stability program on 16 capoeira females 27.3 ±3.7 years and reported a significant improvement in landing kinetics during a drop jump test (Araujo et al., 2015). In addition, Yoon, Sung & Park (2015) applied 8 weeks of a core stability program on 13 taekwondo males 20.10 ± 1.60 years and showed significant improvements in balance ability (p <0.05) (Yoon et al., 2015).

The second aim of this study was to determine the effect of 8 weeks of bracing sequences technique on core stability of karate kata athletes. The experimental group showed significant improvement ($p < 0.05$) on core stability. Table 2 reports the explanation of the improvement, only one player from experimental group and one player from control group scored a 4 on core stability test at pre-test. While at post-test, the experimental group showed 12 players with score of 4 on the core stability test, the control group had only two players with score of 4 on the core stability test. This improvement of the experimental group shows the actual effect on the athletes level after applying the bracing sequences technique. In addition, there was no player with 0 or 1 score at core stability scale due to our inclusion criteria that did not contain athletes with less than one year of experience and perhaps in a year of karate training the core stability improves.

The Nagla (2011) study demonstrated significant ($p < 0.05$) improvement of the abdominal muscle test between pre-test 16.5 and post-test 26.5 which matched our research results. Both of Nagla´s studies and our study, measured the athlete in two tests, one core specific and one performance specific test (Nagla, 2011).

The majority of the studies that investigated core stability program effects on athlete performance have evaluated only sport performance without evaluating core stability (Butcher et al., 2007; Imai et al., 2015; Pedersen et al., 2006; Atle H Saeterbakken et al., 2011).On the other hand, a small number of studies have evaluated sport performance and core stability (Nagla, 2011; Stanton et al., 2004).

Regarding the correlation of results athlete performance tests demonstrated stronger correlations than core stability tests, considering both player belt (player experience) and player age (Table 3). In addition, the player belt showed stronger correlation than player age in both's athletic performance test and core stability test. However, a study of Cesari & Bertucco (2008) on martial art athletes reported non-significant differences in performance variable between expert groups and novice groups. It is suggested that expert players have better physical abilities which explains the positive correlation between players experiences both tests (Cesari & Bertucco, 2008). Moreover, our study sample consists of young and adult players and player ages showed positive correlation with both tests. It is

suggested that adult players have a more mature physical body more than young players.

There are a few potential limitations regarding the generalization of our results. First, the study samples consist of only male participants. Second, the study does not contain kumite participants and contains only kata participants. In addition, the actual study presents their strong points first; apply adequate power, analyze through sufficient samples with a control group compared to previous studies in the area. Second, the study evaluated the players with a core stability test and athlete performance test to proof the source of the improvement.

Although this investigation has achieved the aim of the study, future studies should investigate kata and kumite players, contain international expert players to differentiate between international and expert and novice levels. Also collecting an equal number of samples between both genders allows the generalization of future studies.

CONCLUSIONS

In conclusion, after 8 weeks of training programs the experimental group showed a significant improvement of athlete performance test ($p < 0.001$). The study demonstrated positive significant correlation between player experimental and age of the player with athlete performance test and core stability test.

Practical application

This study demonstrates that bracing sequences technique has an important role in improving kata performance by improving core stability. Therefore, karate couches should include the bracing sequences technique through strength and conditioning programs.

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