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## THE INFLUENCE OF KIHAP ON THE IMPACT OF DOLIO-CHAGUI KICKS IN TAEKWONDO

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### INTRODUCTION

Taekwondo is a martial art that originated in Korea during the twentieth century from the Taekkyon [1]. Although both hands and feet may be used for hitting the opponent [2], frequently in combat, all the points counted for an athlete have been earned through kicks [3-6].

Similar to other sports activities that require muscle power, taekwondo athletes yell during a hit, with the aim of performance enhancement [7]. Several martial arts for centuries have used the yell, which in Korean martial arts like taekwondo is called kihap.

Studies that have verified the use of yells in force production are inconclusive. Martial arts practitioners enhanced their force production during handgrips when the yell was performed [8], and trained subjects produced higher force when performing elbow flexion during the repetition with the yell [9]. However, during the performance of deadlifts by experienced and inexperienced subjects, no difference was found between situations with or without the yell [10]. In addition, the influence of the yell in the force production of martial arts athletes during a specific combat gesture has not yet been verified.

The success of a hit may be evaluated by considering its effects, such as the impact force generated when two bodies collide, like the foot and the opponent or punching bag. Another way is to measure the changes in body velocity during a short period of time, through body displacement and its derivations. Therefore, this study aimed to compare the peak of acceleration as an indicator of impact of the Dolio-chagui kick of taekwondo performed with and without the use of kihap.

### METHODS

Sample was composed of 22 male participants, experienced taekwondo practitioners with  $10.9 \pm 7.7$  years of practice, age of  $30 \pm 9$  years, weight of  $75.6 \pm 11.9$  kg and height of  $173.7 \pm 6.6$  cm. Inclusion criteria were as follows: (a) have been training for at least 12 months, (b) have minimum graduation of 6th Geup (green belt), (c) be experienced in the execution of the Dolio-chagui kick and (d) have been free of musculoskeletal injuries for the past six months.

Each participant performed a series of 30 Dolio-chagui kicks (round kick) of taekwondo with and without the use of kihap. The order of the kicks had been previously

randomized for each subject and the time allowed between kicks was free.

Data was collected using an accelerometer DeltaTron® (type 4507 B 006, Brüel & Kjær) piezoelectric, calibrated by 500 mV/g, with a capacity of up to  $\pm 14$  g. The accelerometer was fixed to a 25 kg punching bag that was used as a target. Once data collection began, the participant would position himself to perform the movement and before each kick, one of the investigators indicated if it was to be performed with or without kihap. An investigator with experience in taekwondo was responsible for evaluating whether the kick had been well performed and could be considered valid. In cases where the kick was not valid, the peak was replaced by the performance of one more kick.

The acceleration data was collected as a single set of data for each subject. In the Matlab® software, 7.5 peaks were obtained separately. Peak values were then organized in the SPSS 18.0 software. Shapiro-Wilk and Levene tests were used for verifying normality and homogeneity. A paired samples t-test was used for verifying the difference in acceleration peaks between the kicks performed with and without kihap.

### RESULTS AND DISCUSSION

The mean and standard deviation values of the acceleration peaks of the Dolio-chagui kick performed with and without the use of kihap are presented in Table 01. The mean acceleration peak of the kick performed with kihap was significantly higher than that of the kick performed without kihap, at  $t(21) = 3.172$ ,  $P < 0,01$ , with a large size effect,  $r = 0.57$  [11].

**Table 01:** Mean and standard deviation values of the acceleration peak of the kicks performed with and without kihap, expressed in number of g.

	With kihap	Without kihap
Mean	7.8	7.1
SD	2.8	2.4

The use of yells in elite sports is evident, especially in sports that require explosive force, such as shot put, weight lifting and tennis serves [8]. Yelling is considering a cognitive technique of psychological stimulus that allows for performance enhancement [9].

Martial arts specific literature attributes to the kihap the capacity for enhancing the force, speed and precision of a hit, among other benefits, like breath control [7]. The ability of the kihap to enhance speed and, consequently, the impact force of a hit is shown in the results of the present study.

The effect of the use of cognitive stimulation techniques was evaluated in the performance of force production in the hand grip exercise [8]. Fifty subjects performed the exercise using a hand dynamometer in different situations, including with and without yelling. An enhancement of about 7% in the production of force in the situation with the yell in comparison to the situation without the yell was found. These results point in the same direction as the present study, when the performance of the Dolio-chagui kick with kihap showed acceleration about 10% higher than the acceleration in the kick without the kihap.

In addition, with the aim of evaluating the psychological limits of force production, Ikai and Steinhaus tested the maximum force production during elbow flexion [9]. Several evaluations were performed, among which were the use of the yell during the test. An enhancement of about 12% in the elbow flexion performed with yelling was found in comparison to that without yelling [9]. It should be noted that this study sample comprised subjects not trained in the use of kihap [9]. The authors suggested that the effect of yelling during the elbow flexion was enough to inhibit internal restrictions.

On the other hand, no difference was found in the performance of deadlift exercises by athletes and non-athletes with and without yelling [10]. Although there was no significant difference, authors suggested that in sports like weight lifting, even the smallest changes may decide a finishing position or the winning of a medal, suggesting that the difference found was important [10].

No studies were found that evaluated the effect of yelling on the impact of specific martial arts hits. However, the use of yelling as a voluntary mechanism for enhancing force in fatigue situations has been studied. According to Moreira et al. (2008), central fatigue is a performance-limiting mechanism that exists for preventing organic risks to the body [12]. They suggested that the superior limit of voluntary force is defined psychologically and that yelling has the capacity of enhancing what was previously believed to be a subject's maximum force [12].

Thus, the present study serves as an indicator that the kihap has an effect on the performance of a taekwondo hit. Future studies may further evaluate this effect by using different biomechanical techniques that may help understanding the influence of the kihap in the Dolio-chagui kick of taekwondo. Another aspect that may be explored is the tridimensional characteristic of the acceleration.

## CONCLUSIONS

The peak of acceleration of the Dolio-chagui kick of taekwondo was higher when the kick was performed with the use of kihap than when it was performed without the kihap, suggesting that yelling has the capacity of enhancing the kick's impact.

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