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EFFECT OF DYNAMIC LOWER EXTREMITY PERFORMANCE ON KARATE ROUNDHOUSE KICK IN CHILDREN

Emel Cetin Ozdogan (a)*, Mustafa Ada (b), Mahmut Unal Bilge (c), Abdurrahman Aktop (a), Recep Gocmen(d)
*Corresponding author

(a) Akdeniz University, Faculty of Sports Science, Dumlupinar Blv. 07058 Campus, Antalya, Turkey, emelcetin@akdeniz.edu.tr
(b) Akdeniz University, Faculty of Sports Science, Dumlupinar Blv. 07058 Campus, Antalya, Turkey, mustafa_ada_42@hotmail.com
(c) Akdeniz University, Faculty of Sports Science, Dumlupinar Blv. 07058 Campus, Antalya, Turkey, unalbilbe@hotmail.com
(d) Marmara University, Faculty of Sports Science, Anadoluhisarı Yerleşkesi. 34815, İstanbul, Turkey, recep.gocmen@marmara.edu.tr

Abstract

The main objective of this study was to determine the effect of dynamic lower extremity performance on some parameters of karate roundhouse kick (Mawashi Geri) in children. Specifically, the kinematic variables related to the displacement, reached maximal velocity of kicking leg, angle of trunk were analysed. The subject of this study composed 13 children from karate sports club. Each participant performed drop jump (0.4 m) for reactive strength parameters, the athletes were asked to demonstrate roundhouse kick performance towards the boxing mannequin using dominant legs. When the groups were evaluated according to the RSI values, it was determined that Group 2 (RSI> 1.5) recorded a longer distance by moving the kicking leg at a smaller angle, which produced less $t_{contact}$ time after the jump ($p < .05$). In addition, statistically significant differences were found between the V_{kick} values of Group 1 and Group 2 athletes and the values of Group 2 athletes were higher ($p < .05$). In conclusion, even though the RSI parameters have some effect on the kinematic parameters in the karate roundhouse kick performance, the study should be repeated with more study groups.

Keywords: Reactive strength index, jump height, roundhouse kick, velocity.

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1. Introduction

From childhood to adolescence, movements become more efficient, along with development in the neuromuscular coordination. The movements that explain the efficiency of movement, such as jumping or sprinting, are explained by the lengthening-shortening cycle (SSC) (Lafayye et al., 2016). SSC has been described as a rapid and rapid progression of eccentric and concentric muscle contractions in the lower extremities and its role in force production has been extensively studied (Arampatzis et al., 2001; Kipp et al., 2015; Thomas et al., 2017).

Vertical jump testing is commonly used by researchers and coaches alike as a means of monitoring physical capacities of athletes and assessing the effects of training interventions (Cronin and Hansen, 2005). Drop jumps and hopping tests can give coaches more information about the stretch shortening cycle capacity of their athletes (Flanagan and Comyns, 2008). Dynamic movements such as jumping and sprinting require the rapid coupling of eccentric and concentric muscle contractions, i.e. the stretch shortening cycle. This contraction produces a much more powerful contraction than from a concentric contraction alone (Young, 1995). Reactive strength has been described by Young as a measure of an individual's ability to change from an eccentric contraction to a concentric contraction (Young, 1995).

Reactive strength is a parameter that indicates the SSC's quickness. It also shows the ability to generate maximal force at minimal time, as well as the ability of the athlete to pass quickly from eccentric contraction to concentric contraction. Calf-achilles is also regarded as a stress measurement on the muscle-tendon system (Locki et al., 2011). The RSI can be calculated by dividing jump height by ground contact time (Flanagan and Comyns, 2008; Young, 1995) or alternatively, by dividing flight time by contact time (Choukou et al., 2014; Markwick et al., 2014).

Drop jump where an individual drops from a predetermined height and immediately on landing, performs a maximal-effort vertical jump while also minimize contact time (Bobbert, 1990). This can be performed with both legs or with a single leg and has been widely used to assess reactive strength (Flanagan et al., 2008; Markwick et al., 2014).

Reactive force, which explains an athlete's SSC feature, is important in many sporting activities as well as in combat sports. Efficient SSC mechanics is supported by the work on the formation of propulsive forces and the conservation of energy (Bosco et al, 1982). It is important that after every knock against the opponent during the roundhouse kick performance of the roundhouse, the throwing spade is quickly withdrawn and then ready to kick again quickly. In order for the athlete to act strongly on the kicking leg, the SSC mechanism must produce sufficient force. In this study which is planned for this purpose, it is aimed to determine the effect of reactive force on kinematic kicking leg in karate children.

2. Problem Statement

The reactive force, which defines the stretch shortening cycle of an athlete, can be considered as the basis of force generation.

- Does the reactive force affect the propulsive forces during the roundhouse kick?
- How much is the effect of the reactive force index parameters on the duration of the kick and the maximal velocity components generated?

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3. Research Questions

Is there any effect on the maximal velocity value and kick duration achieved during roundhouse kick performance of RSI values in children?

4. Purpose of the Study

The purpose of the present study was to determine the effect of dynamic lower extremity performance on some parameters of karate roundhouse kick (Mawashi Geri).

5. Research Methods

5.1. Participants

A total of thirteen children from Antalya Kamikaze Sports Club, 7 boys (age:11.86±2.41 years; height :152±0.13 cm; weight:46±11.76 kg) and 6 girls(age:11.00±1.10 years; height :142±0.08 cm; weight:40.31±10.31 kg), who attended at least one year of training(3 days/week), participated in the study.

5.2. Methods

Before the test, participants realized the specific-karate warming for 20 minutes. At the first stage of the study, participants performed a drop jump performance from a height of 0.4 cm. Strict instructions were given to each participant to keep hands on hips at all times to constrain any involvement from the upper body, avoid stepping down from the box or hopping off of the box, to avoid tucking motion in the air i.e. legs kept straight and attempt to land in the same position as take-off. Participants were asked for to jump at the highest level as soon as possible in the moment of contact with the ground (put hands on waist).Two trials were done and the best was taken into consideration. Each participant performed DJ whilst simultaneously being recorded with a smartphone (iPhone 7 Plus) using the My Jump 2 app and RS parameters (reactive strength index (RSI), jump height(h_{jump}), flight time(t_{flight}), contact time($t_{contact}$)) recorded (Balsalobre et al., 2014).

In the second phase, each athlete's roundhouse kick (mawashi geri) performance was recorded with a high-speed camera (Basler A620f). In the second test, the athletes were asked to demonstrate roundhouse kick performance towards the boxing mannequin using dominant legs. Two performances were recorded and the best performance was assessed. Subsequently, the maximum velocity (V_{kick}) of the knocking leg, the time it takes for the movement to occur (t_{kick}) and the distance the kick has traveled throughout the movement (d_{kick}) were determined. The movements were evaluated using VideoPoint 2.0 and the Kinovea motion analysis program.

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6. Findings

6.1. Physical characteristics of participants

Table 01. Physical characteristics of boys and girls

Parameters	Boys (n=7)	Girls (n=6)
Age (year)	11.86 ± 2.41	11.00 ± 1.10
Height (cm)	152.00 ± 0.13	142.00 ± 0.08
Weight (kg)	46.00 ± 11.76	40.31 ± 10.31
Leg length (cm)	78.43 ± 6.13	74.67 ± 4.37
BMI($kg/m^{2)}$	19.55±2.65	19.83±3.50

The demographic characteristics of male and female students were not statistically different from each other, although length, weight and leg lengths of boys participating in the study had higher values than girls. (p>.05)(Table 01).

6.2. Participants' reactive strength parameters

Determined RSI indices of children, contact time to ground after jumping, air time and jump heights are given in Table 2.

Table 01. Reactive strength Parameters

Parameters	Boys (n=7)	Girls (n=6)
RSI	1.53±0.57	1.24±0.31
h_{jump}(cm)	22.31±5.47	15.82±2.16*
t_{flight}(ms)	419.86±62.71	356.50±26.65*
$t_{contact}$(ms)	297.71±79.96	304.17±61.35

*p<.05

There was no statistically significant difference between the two groups, although RSI values were found to be moderate strength ability in males and low strength ability in females. Similarly, boys h_{Jump} and t_{flight} values were found to be higher than girls' (p<.05).

6.3. Kinematic variables

Table 02. Participants' kinematic data

Parameters	Boys (n=7)	Girls (n=6)
V_{kick}(m/s)	9.96±3.44	6.82±3.16
t_{kick}(s)	33.14±8.76	36.67±4.55
d_{kick}(cm)	200.65±49.67	214.32±33.52
Θ_{trunk}(°)	36.71±5.25	36.67±3.93

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When the kinematic data of the participants were evaluated, it was determined that men performed roundhouse kick movements in shorter time, less distance and faster. However, there was no statistically significant difference between kinematic data of boys and girls (p>.05).

According to the results of the Chi square independence test conducted to determine whether there was a difference between the RSI values of the participants in terms of gender, the RSI values were determined to be sexually unrelated and the participants were re-grouped as Group 1 (RSI <1.5) and Group 2 (RSI> 1.5). The values of Group 1 and Group 2 are given in Table 04.

Table 03. Group comparison of reactive force and kinematic parameters

Parameters	Group 1 (n=7)	Group 2 (n=5)
Height (cm)	141.00±0.07	157.00±0.12*
Weight (kg)	34.73±15.66	51.76±7.97*
Leg Length (cm)	73.63±3.42	81.60±4.72*
t_{kick}(s)	33.00±7.07	37.60±6.88
h_{jump}(cm)	17.68±4.62	21.93±5.78
t_{flight} (ms)	372.38±54.25	419.80±56.11
$t_{contact}$ (ms)	345.63±42.02	228.40±26.78*
Θ_{trunk}(°)	39.00±3.96	33.00±2.35*
d_{kick}(cm)	185.38±38.25	241.48±16.59*
V_{kick}(m/s)	6.92±3.11	11.05±2.84*

When the groups were evaluated according to the RSI values, it was determined that Group 2 recorded a longer distance by moving the kicking leg at a smaller angle, which produced less $t_{contact}$ time after the jump (p <.05). In addition, statistically significant differences were found between the V_{kick} values of Group 1 and Group 2 athletes and the values of Group 2 athletes were higher (p <.05).

7. Conclusion

The aim of the study is to examine the karate roundhouse kick performance of children with different RSI values in terms of some kinematic parameters.

Typical roundhouse kick performance is described by a horizontal and vertical shift of the COM towards the target, which is coupled with a rapid forward pelvic axial rotation, hip abduction, hip flexion, and knee extension (Cavagan and Sayers, 2017). Effective roundhouse kicking performance was characterized by a combination of rapid pelvic axial rotation, hip abduction, hip flexion and knee extension velocities, combined with rapid movements of the center of mass towards the target. Each of these basic variables constitutes a key performance indicator for combat sports skill (Cavagan and Sayers, 2017).

It is an important parameter in the karate sport, in the application of elasticity techniques in front and back, and in combat strategies in competitions. It is directly related to the flexibility of the spine (body-hips) to be able to apply a hand technique comfortably to the far point or to apply a foot technique

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comfortably to the upper level. Mawashi geri technique is a technique that can be applied more easily as the body motion angle increases (Türkeri, 2007). According to Group 2, Group 1 participating in this study was found to have a smaller angular displacement of the kicking peg, even though they had larger Θ_{trunk} angles. This negatively affects the maximal velocity value obtained. Although there was no significant difference between Group 1 and Group 2 vertical jump values, there was a statistically significant difference in $t_{contact}$ values ($p < .05$). The $t_{contact}$ times of Group 1 athletes were longer and affected the h_{jump} value. This shows that the SSC mechanics do not develop as well as the athletes in this group. It can also be considered that they do not perform leg strength as much in the training programs. There was no significant difference between the groups in terms of the duration of roundhouse kick performance (t_{kick}) determined in the study, while there was a significant difference in favour of Group 2 in terms of the distance covered during this period ($p < .05$). Group 2 athletes performed a longer kicking and a longer kick length arc. However, the dominant leg length of Group 2 athletes may also be effective in this stroke length. In study of Paydar et al. (2014), it is stated that the applied technique is related to the displacement of the foot and the linear velocity (Paydar et al., 2014). In this study, the gross value of group 2 was higher than that of group 1, which was higher than that of group 1. During the performance of Group 1, the maximum value reached 6.92 ± 3.11 m.sec^{-1}, which was 11.05 ± 2.84 m.sec^{-1} for Group 2. In Türkeri's (2007) study, as the force increased, the technique decreased at the time of application and increased at the speed of movement, which was based on strength and speed studies. When considered in this context, it can be explained in this way that Group 2 reaches maximum V_{kick} velocity. However, for more precise results, more detailed studies are needed.

In conclusion, even though the RSI parameters have some effect on the kinematic parameters in the karate roundhouse kick performance, the study should be repeated with more study groups. The change in the RSI values should be monitored within the progressing training schedule and the training schedule should be arranged accordingly. If participants in this study are not considered to be newcomers, the reason for their RSI values being so low may be that they are not as important as plyometric work, or that the scope and intensity of training programs are low.

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