PUNCH AND KICK IMPACT OF THE KARATE: A REVIEW

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Abstract

The objective of the review was to determine the punch and kick impact of the karate. The attack impact of the male karateka had the following result: gyaku zuki with 993 to 3501.93±370.83 N, oi zuki with 6884 N, mae geri with 1082.42 to 1208.69 N, and mawashi geri with 1211±219 N. The oi zuki moves forward to strike the opponent, then all the body is used in the punch. But, with the gyaku zuki, the fighter practices the punch with trunk rotation. Then, the oi zuki's mass is greater than the gyaku zuki (3501.93±370.83 N) and this causes greater impact on the oi zuki (6884 N). The torque of the kick phase of the mae geri (223.6 mkp) was greater than that of the mawashi geri (143.7 mkp). The action of the hip internal rotation has less torque than the other hip actions. The hypotheses of the greatest impact of the mawashi geri are explained through of the Newton's second law. In conclusion, the study of the attack impact of the karate is important to improve the performance of the karateka.

Keywords: Karate, punch, kick, biomechanics, martial arts, fight.

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1. Introduction

The karate is a fight that was developed on the Okinawa Island with the objective of self-defense (Lisowska et al., 2021; Nakayama, 2012). In the year 20 the karate was presented to Japan by the master Funakoshi (Marques Junior, 2019). This fight has several attack and defense actions with the objective of the karateka being prepared to fight with one or more opponents (Szczesna et al., 2021).

However, currently, karate has two objectives, the first is for self-defense and the second is a combat sport (Marques Junior, 2022; Nakayama, 2012b). The combat sport of the karate the kumite (is the fight in Japanese) has 84% of actions with less than 2 seconds (Jeknic et al., 2020). During the kumite, the karateka practices punch, kick, and other attacks (Barnamehei et al., 2020). Then, the kumite of karate is a fight with predominance in the anaerobic alactic metabolism (Marques Junior, 2012) and the explosive strength is the predominance strength (Voigt and Klausen, 1990).

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Karate has several styles; in each style the karateka has a way to fight (Lopes Filho and Monteiro, 2015). For example, the Shotokan style karate the karateka during the kumite practices 80% of points with the punch (Markovic et al., 2021). But, when it comes to the olympic karate, the karateka practices more points with the gyaku zuki (is the reverse punch) (Koropanovski and Jovanovic, 2007) and the kick with more points than the male karate was the mawashi geri (is the roundhouse kick) and of the female karate was the ura mawashi geri (is the hook kick) (Bozada et al., 2016; Vidranski et al., 2015, 2019). Another combat sport in which karate is more practiced is the mixed martial arts (MMA) because this fight is very efficient (Jeknic et al., 2017). Then, the karate coach needs to know the impact of the types of punch and kick to guide the fighter during the training and in the moment of the competition (Marques Junior, 2020).

The several styles of karate have different rules and some karate styles are allowed the knockout, and the karateka in the MMA can win by knockout. Therefore, the karate coach needs to know the punch and kick impact. The punch and kick impact was studied by several researchers of different martial arts (Abazari et al., 2016; Adamec et al., 2021; Akbas et al., 2021; Galpin et al., 2015; Iam et al., 2017). However, the impact of punch and kick in case of the karate does not have its own mention in a literature review. Thus, from the following review, the Karate coach shall know the impact of the punch and the kick of several attacks.

The objective of the review was to determine the punch and kick impact of the karate.

2. Results – attack impact (punch and kick) of the karateka

Karate has several styles, but the punches more practiced during the fight are the gyaku zuki (is the reverse punch), the kizami zuki (is the jab punch), and oi zuki (is the lunge punch) (Loturco et al., 2016; Marques Junior, 2019; Szczesna et al, 2021). The kicks more practiced in karate are the mae geri (is the front kick), the mawashi geri (is the roundhouse kick), the yoko geri (is the side kick), the ushiro geri (is the back kick), the ura mawashi geri (is the hook kick), the ushiro ura mawashi geri (is the back spinning hook kick), the mae tobi geri (front kick with jump), and mawashi tobi geri (is the roundhouse with jump) (Alinaghipour et al., 2020; Marques Junior, 2014; Vidranski et al., 2019). Other attacks that a karateka uses in MMA are the hiza geri (is the knee attack), the empi (is the elbow attack), and the uraken (back fist) (Jeknic et al., 2017).

The studies on the punch and kick impact were collected in Google Scholar with the keywords karate punch force and karate kick force during May 2022. The author of the study found 6 articles on punch and 3 articles on kick – a total of 9 articles. The articles on karate were of black belt karate fighters of the male and female gender. The article had a total of 6 studies on the male punch (Cruz et al., 2014; Ishac and Eager, 2021; Souza and Marques, 2017; Penov and Chalakov,

2021; Viero, 2012; Zayed and Aly, 2018), 2 studies on the male kick (Gavagan and Sayers, 2017; Wojciech et al., 2018), and 1 study on the male and female kick (López et al., 2022).

The gyaku zuki impact was the Shotokan karate (Cruz et al., 2014; Souza and Marques, 2017; Penov and Chalakov, 2021; Viero, 2012), and also had gyaku zuki impact without karate style (Zayed and Aly, 2018). The oi zuki impact was on the male taekwondo (TKD) because the author did not find this punch in the karate (Ishac and Eager, 2021). But since the TKD was created based on the Shotokan karate (Moenig, 2011), the author of the study decided to present the oi zuki impact. The results of the punch impact (minimum and maximum) are presented in Figure 1.

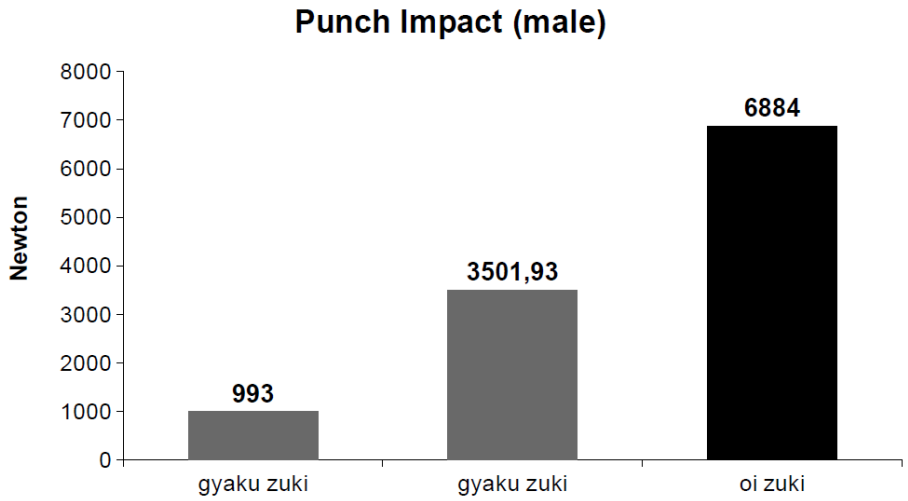

Figure 1. Punch impact of the male karateka (Illustration elaborated by the author).

The mae geri impact of the male karate was of the Idokan style (Wojciech et al., 2018), and in the second article the author did not inform the style (Gavagan et al., 2017). The other article was the mawashi geri of the male and female karate (López et al., 2022). The results of the punch impact (minimum and maximum) are presented in Figure 2.

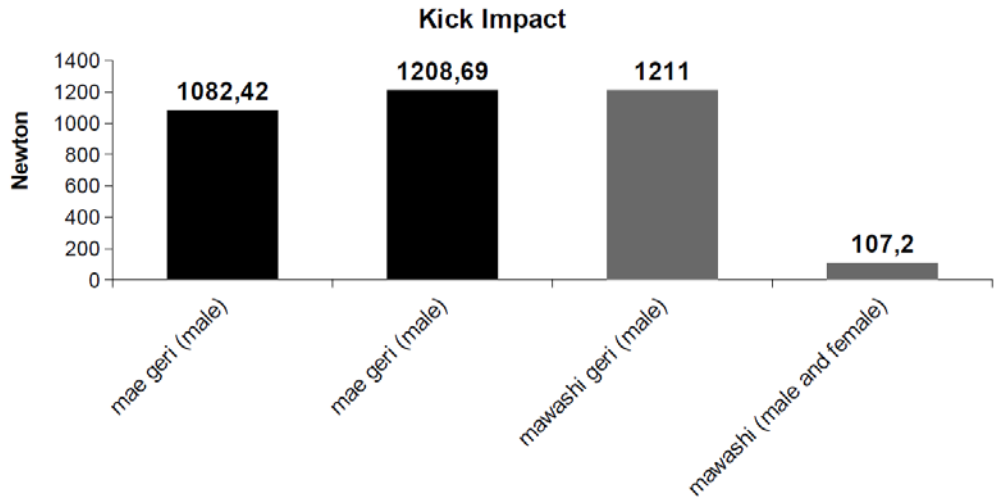

Figure 2. Kick impact of the mae geri and mawashi geri (Illustration elaborated by the author).

3. Discussion

The oi zuki (impact of 6884 N) (Ishac and Eager, 2021) of the male karate had more impact than the gyaku zuki (impact of 3501.93±12.28 N) (Cruz et al., 2014; Souza and Marques, 2017; Penov and Chalakov, 2021; Viero, 2012; Zayed and Aly, 2018) of the same gender. But the study on the velocity of the offensive technique detected that the linear velocity of the oi zuki was 12.64 meters per second (m/s) and the gyaku zuki was 14 m/s (Marques Junior, 2015).

Because the oi zuki with less velocity practiced the punch with more impact?

In biomechanics, an action with more mass and with similar acceleration had more strength (Hall, 1993). This is Newton's second law, the calculation is Strength = mass. acceleration = ? N. For example, the impact strength of the oi zuki of a karateka is different from the gyaku zuki that the same karateka practiced.

The oi zuki moves forward to strike the opponent, then all the body is used in the punch. But the gyaku zuki the fighter practices the punch with trunk rotation but with this attack technique the karateka does not move forward. Then, the mass of the oi zuki is different of the gyaku zuki.

Continuing the example, this karateka practiced the oi zuki with 96 kilograms (kg) and a linear velocity of 12.64 m/s, and the gyaku zuki was with 48 kg and a linear velocity of 14 m/s. Then the author made an adaptation to Newton's second law, the calculation was as follows: Impact Strength = mass in

kg. linear velocity in m/s = ? N. The results are as follows: Impact Strength of the Oi zuki = 96 kg. 12.64 m/s = 1213 N, Impact Strength of the Gyaku zuki = 48 kg. 14 m/s = 672 N.

Therefore, at the moment of the fight, the karateka needs to choose the best punch during the combat because the oi zuki is the punch with more impact, and the gyaku zuki is the punch with more velocity.

Male karateka practiced the mae geri impact of 1208.69 N (Wojciech et al., 2018) and the mawashi geri impact of 1211±2119 N (Gavagan and Sayers, 2017). Male and female karateka practiced the mawashi geri impact of 107.2 N (López et al., 2022). However, the mae geri had a linear velocity of 19.3 m/s and the mawashi geri had a linear velocity of 11 m/s (Marques Junior, 2015). This result was similar to the punch, the mawashi geri with less velocity practiced the kick with more impact.

What is the reason for this event?

Based on kinesiology, it is possible to understand the greatest impact of the mawashi geri with less linear velocity. The motor muscles of the joint movements of the kicks were based on Marques Junior (2001), the joint movements of the mae geri was based on Marques Junior and Silva Filho (2013), the torque in meter kilopound (mkp) of the muscles was based on Weineck (1990), and the joint movements of the new mawashi geri was based on Marques Junior (2011). Table 1 presents the data for the two kicks.

Table 1. Kinesiology of the karate kicks

Kick	Preparatory Phase	Kick Phase
mae geri	**Hip Flexion:** quadriceps femoris (rectus femoris) with 16.4 metro kilopound (mkp), iliopsoas with 10 mkp, tensor fasciae latae with 7.5 mkp, pectineus with 2.7 mkp (auxiliary), and adductor longus was not informed (auxiliary). **Torque (**hip flexion**)** = 16.4 mkp + 10 mkp + 7.5 mkp + 2.7 mkp + 0 = **36.6** mkp	**Hip Extension:** biceps femoris (long head) with 4.4 mkp, biceps femoris (short head) was not informed, semitendinosus with 7 mkp, semimembranosus with 17 mkp, and gluteus maximus with 53.2 mkp. **Torque (**hip extension**)** = 4.4 mkp + 0 + 7 + 17 + 53.2 = **81.6** mkp
	Knee Flexion: biceps femoris with 10.3 mkp, semimembranosus with 16.8 mkp, semitendinosus with 13.2 mkp, gracilis with 3.1 mkp, gastrocnemius was not informed, and popliteus was not informed. **Torque (**knee flexion**)** = 10.3 mkp + 16.8 mkp + 13.2 mkp + 3.1 mkp + 0 + 0 = **43.4** mkp	**Knee Extension:** quadriceps femoris with 142 mkp. **Torque (**knee extension**)** = **142** mkp
	Torque (hip flexion + knee flexion**)** = 3 6.6 mkp + 43.4 mkp = **80** mkp	**Torque (**hip extension + knee extension**)** = 81.6 mkp + 142 mkp = **223.6** mkp
new mawashi geri	Hip flexion and knee flexion is equal to the mae geri. **Torque (**hip flexion + knee flexion**)** = 3 6.6 mkp	Knee extension is equal to the mawashi geri. **Torque (**knee extension**)** = **142** mkp

Kick	Preparatory Phase	Kick Phase
	+ 43.4 mkp = **80** mkp	
		Hip Internal Rotation: gluteus minimum with 0.8 mkp, tensor fascia latae with 0.9 mkp, and other muscles was not informed the mkp (gluteus medium, adductor longus, adductor magnus, adductor brevis, gracilis, semitendinosus, and semimembranosus). **Torque (**hip internal rotation**)** 0.8 + 0.9 + 0 = **1.7** mkp
		Torque (knee extension + hip internal rotation**)** = 142 mkp + 1.7 mkp = 143.7 **mkp**

The torque of each joint movement of the kicks is presented in figure 3.

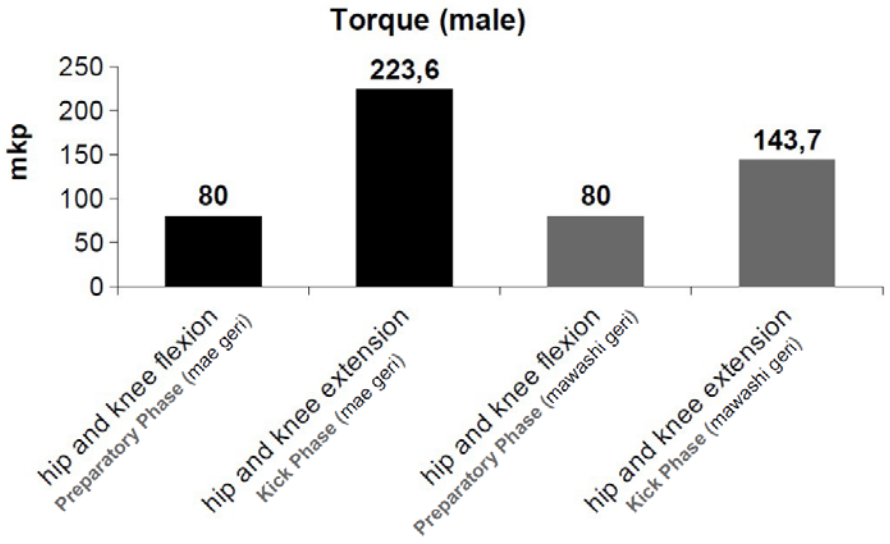

Figure 3. Torque of the kick

Second, Weineck (1990), the action of the hip internal rotation has less torque than the other hip actions.

What is the motive for the greater impact of the mawashi geri?

Two hypotheses respond to the greatest impact of the mawashi geri. The first hypothesis, the acceleration of the mawashi geri and the mae geri may be different. This explanation is based on Newton's second law - Strength = mass in kg. acceleration in m/s^2 = ? N (Rasch, 1991). The second hypothesis on the lever, but the study on the mawashi geri (Gavagan and Sayers, 2017) and the mae geri

(Wojciech et al., 2018) the researcher did not measure the length lower limb (it is the lever), this influences the velocity of the kick. A karateka with a smaller lower limb usually has the fastest kick because the lever is smaller (Rodrigues and Rodrigues, 1985).

The karate punch (gyaku zuki with an impact of 3501.93±12.28 N and oi zuki with an impact of 6884 N) (Cruz et al., 2014; Ishac and Eager, 2021; Souza and Marques, 2017; Penov and Chalakov, 2021; Viero, 2012; Zayed and Aly, 2018) had more impact than the kick (mae geri with an impact of 1208.69 N and mawashi geri with an impact of 1211±219 N) (Gavagan and Sayers, 2017; Wojciech et al., 2018).

What is the reason for the lower impact?

The karate literature does not have this information (Nakayama, 2012c). Perhaps, the reason for the lower impact of the kick was that the Shotokan karate uses more punch during the kumite (fight) and in the kata (imaginary fight) (Marques Junior, 2019). The greater use of the punch perhaps improves this attack more.

The review had a limitation, the author found few studies about the punch (total of 6 articles) and kick (total of 3 articles) impact.

Conclusions

The karate coach needs to know the attack impact (punch and kick) of the fighter with the objective of guiding the karateka during the training and in the championship. However, the review article detected that the punch (gyaku zuki of 3501.93±12.28 N and oi zuki of 6884 N) of the male karateka had more impact than the kick (mae geri of 1208.69 N and mawashi geri of 1211±219 N).

Then, based on attack impact, the karateka needs to use a type of offensive technique according to the moment of the kumite (fight). For example, the oi zuki is a punch indicated to be practiced when the opponent is at a long distance. The gyaku zuki is a punch indicated to be practiced when the opponent is in short distance, or this punch is used for anticipation when the opponent is practicing an attack. But when the karateka has the opportunity to practice the gyaku zuki and the oi zuki, and the fighter needs to practice the punch with more impact because the probability of knockout is higher.

The same idea is used in the kick. The karate attack has four types of offensive actions that are anticipation, attack, defense and counterattack, and dodge (Nakayama, 2012; Marques Junior, 2014). The mae geri is a kick indicated to be practiced during the attack. The mawashi geri is a kick indicated to be practiced during the attack, the anticipation, the defense and counterattack, during the dodge, and after the karateka practices the attack. But when the karateka has the opportunity to practice the mae geri and mawashi geri, the fighter needs to practice the punch with more impact because the probability of knockout is higher.

The studies about the punch and kick impact of the karate had a limitation, most studies of the impact were performed under laboratory conditions and this can interfere with the result of the research. Then, researchers for future studies need to conduct the research in fight situations and with kiai (is the shout practiced during the attack).

In conclusion, the study of the punch and kick impact of the karate is important to improve the performance of the karateka.

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