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Relationship between dominant and non-dominant hand grip strength and visual response time in kickboxing athletes

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Abstract

This study aimed to explore the relationship between dominant and non-dominant hand grip strength and visual response time in kickboxing athletes. The sample consisted of 28 male athletes aged 16-20 years (mean age: 17.71±1.56 years) with an average sport experience of 2.64±2.68 years. Visual response time was measured using the Fit-light system after a standardized kickboxing warm-up, and grip strength was assessed using a digital hand dynamometer. The findings revealed that grip strength was significantly higher in the dominant hand compared to the non-dominant hand ($Z=-2.03$; $p<0.05$). Additionally, visual response time was faster for the dominant hand ($Z=-2.99$; $p<0.05$). There was a moderate positive correlation between age and grip strength for both hands ($p<0.05$), and a moderate negative correlation between age and visual response time in the dominant hand ($p<0.05$). No significant correlation was found between age and visual response time in the non-dominant hand ($p>0.05$). Height was moderately negatively correlated with visual response time for the non-dominant hand ($p<0.05$), while a high positive correlation was found between the grip strengths of the dominant and non-dominant hands. A moderate negative correlation was observed between grip strength and visual response time for both hands ($p<0.05$). Lastly, a moderate positive correlation was identified between the visual response times of both hands ($p<0.05$). In conclusion, the study suggests that hand grip strength may increase with age and height, and that both grip strength and visual response time are independently influenced by these factors. Improved grip strength in both hands may lead to faster visual response times, which could be advantageous in combat sports such as kickboxing.

Introduction

Kickboxing, a modern combat sport that is formed by a combination of punches and kicks (Turkish Kickboxing Federation, 2004), is a combat sport in which two opponents strike each other with full force with their hands, elbows, knees, shins and feet (Kordi et al., 2009), and compete to score the most points with the technique and speed in accordance with the rules (Turkish Kickboxing Federation, 2004). In order to win in kickboxing, the athlete must make quick attacks and react quickly to counterattacks. In combat sports, scoring points in offensive or defensive practices largely depends on movement speed, joint mobility and response time (Donovan et al., 2006). For this reason, visual response time is seen as an important element in combat sports (Mori et al., 2002). Studies (Asia & Warkar 2013; Bilgin et al., 2014; Çatıkkaş et al., 2011; Donovan et al., 2007; Polat et al., 2018) show that response time is a determining factor of performance in kickboxing. The effectiveness of technical applications depends largely on the shortness of visual response time in terms of completing the move by reacting quickly when the opponent is defenseless and activating defense mechanisms against incoming blows. In this context, systematically determining the factors affecting response time and incorporating them into training programs is of critical importance in terms of

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improving performance. With this factors such as age, gender and body weight are important physiological variables that affect hand grip strength, and it is stated in the literature that there is a positive relationship between anthropometric characteristics and hand grip strength (Singh et al., 2009). In addition, kickboxing requires equal use of dominant and non-dominant limbs (Turkish Kickboxing Federation, 2004). In this context, the importance of response time as well as dominant and non-dominant hand strength in this sport comes to the fore.

When the studies on combat sports are examined, it is seen that they generally focus on branches such as taekwondo, karate, boxing and judo. Given the limited research on kickboxing and the scarce comparisons within combat sports, response time has been identified as a crucial parameter in these disciplines. Therefore, this study aims to examine the relationship between dominant and non-dominant hand grip strength and visual response time in kickboxers.

Methods

Design and Participants

28 male kickboxers (age: 17.71±1.56 years, height: 178.50±21.14 cm, body weight: 69.71±9.34 kg, sports experience: 2.64±2.68 years) who were actively involved in sports were included voluntarily in the study. Participants were informed about the purpose and risks of the study, and written informed consent was obtained from all participants. The study was approved by the Selcuk University of Non-Interventional Ethical Committee (2023/103) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a Declaration of Helsinki. The measurements were taken during the participants' morning workouts. Participants who had been exercising intensively for the last 24 hours, were sleep deprived, or were taking any medication that would slow down the neural mechanism were excluded from the study. Before the study, anthropometric measurements (height-cm, body weight-kg), age, and sports experience information were taken from all participants. After a standard warm-up (5 minutes of kickboxing-specific warm-up movements), the participants were told how to apply the visual-motor reaction and hand grip test and were shown on the devices. Reaction measurements were randomly performed 3 times with the participants' dominant and then non-dominant hands, and the best value was recorded for each participant. The hand grip strength test was performed twice with the participants' dominant and then non-dominant hands, and the average of the two measurements was recorded. The measurements were performed at Selçuk University, Faculty of Sports Sciences, Performance Laboratory.

Body Weight and Height Measurement

Participants' heights were measured using a Seca 213 brand height meter, and their body weights were measured using a Xiaomi brand digital body analysis scale. Measurements were made by ensuring that the participants' bodies were in an upright and stable position and that both feet were equal on the height meter.

Measurement of Visual-Motor Response Time

Visual-motor response time was measured using the Fit Light™ (Fitlight Sports Corp., Canada) device. Visual-motor response time consisted of a simple reaction lasting 10 seconds to visual stimuli appearing on 6 wireless light disks. The disks were placed on the table in the shape of a half-moon. The participant's hand was in the center of the half-moon. The center point of each disk was 40 cm from the center of the half-moon, and the center points of each disk were aligned 25 cm apart. Before the test started, the participant brought his hand to the starting point, the center, and then the test started. The participant reached for the light that was on for 10 seconds and turned off the light, and in the same way, brought his hand back to the center point and then was asked to quickly turn off the other light. The test was completed automatically after 10 seconds. The data on the average reaction speed that the participants could perform for 10 seconds were obtained from the Fit-light device (Tatlıcı & Özer, 2022).

Hand Grip Strength Measurement

Grip strength was measured with a digital dynamometer (TKK 5401 Grip-D; Takei, Niigata, Japan). During the assessment, participants were asked to stand upright with their feet shoulder-width apart and look forward with their elbows fully extended. The dynamometer was held with the measuring hand with the grip meter indicator facing outward and away from any part of the body. Participants were allowed to perform 1 trial for each hand. Participants then measured twice, first with the dominant hand and then with the non-dominant hand. Participants were instructed to squeeze the grip with full force and continuously for at least 2 seconds. They were asked not to shake the grip dynamometer or hold their breath

during the test. The time between each trial was approximately 30 seconds, and the time interval between trials of the same hand was approximately 1 minute. The researcher provided verbal encouragement during the measurement to ensure maximum performance from the participants. The average of the two values shown on the screen of the TKK dynamometer was recorded (Yu et al., 2017).

Data Analysis

The Shapiro Wilk test was applied to determine whether the data were normally distributed in the study. The Wilcoxon test was used to compare two dependent variables. Spearman Correlation analysis was applied to examine the relationship between variables. Statistical evaluation of the data was done using the SPSS for Windows 25.0 package program. The results were evaluated at a 95% confidence interval and a significance level of 0.05.

Results

Relationship between descriptive features and hand strength and visual-motor response time. Table 2 shows the comparison of the dominant and non-dominant hand strengths and visuomotor response times of the participants. The grip strength of the dominant hand was found to be higher than the non-dominant hand ($Z=-2.03$; $p<0.05$). The visuomotor response time of the dominant hand was found to be lower than the non-dominant hand ($Z=-2.99$; $p<0.05$).

Table 3 shows the relationship between the descriptive characteristics of the participants and the handgrip strength and visuomotor response time. There was a moderate positive relationship between age of both dominant and non-dominant hands and handgrip strength and visuomotor response time of the dominant hand ($p<0.05$), however, no significant relationship was found between visual response time of the non-dominant hand and age ($p>0.05$). There was a moderate positive correlation between height and grip strength of both hands. There was also a moderate negative correlation between response time of the non-dominant hand and height ($p<0.05$). There was a moderate negative correlation between sports experience and visual response time of both dominant and non-dominant hands ($p<0.05$). There was no significant correlation between sports experience and grip strength of both dominant and non-dominant hands ($p>0.05$).

A high level of positive correlation was determined between the grip strength of the dominant and non-dominant hands, while a moderate level of negative correlation was determined between the grip strength of the dominant hand and the visuomotor response times of the dominant and non-dominant hands ($p<0.05$). A moderate level of negative correlation was observed between the grip strength of the non-dominant hand and the visuomotor response times of the dominant and non-dominant hands ($p<0.05$). A moderate level of positive correlation was found between the visuomotor response times of the dominant and non-dominant hands ($p<0.05$).

Table 1

Descriptive information of participants (n=28).

Variables	Min	Max	Mean	SD
Age (year)	16.00	20.00	17.71	1.56
Height (cm)	167.00	183.00	178.50	21.14
Body weight (kg)	53.00	91.00	69.71	9.34
Experience in Sport (year)	1.00	11.00	2.64	2.68

Table 2

Comparison of participants' dominant and non-dominant hand strength and visual-motor response time.

Variables		Mean	SD	Z	p
Hand Strength (kg)	Dominant hand	39.41	7.93	-2.03	0.040*
	Non-dominant hand	38.28	7.28		
Visual Response Time (sec)	Dominant hand	0.49	0.03	-2.99	0.000*
	Non-dominant hand	0.51	0.04		

*$p<0.05$

Table 3

Relationship between descriptive characterisitcs and hand strength and visual-motor response time.

Variables		Spearman rho	p
Age	Height	0.263	0.177
	Body weight	-0.258	0.186
	Sports experience	0.345	0.072
	Dominant hand strength	0.435 (M-P)	0.021*
	Non-dominant hand strength	0.405 (M-P)	0.032*
	Dominant hand reaction	-0.514 (M-N)	0.005**
	Non-dominant hand reaction	-0.362	0.058
Height	Body weight	0.318	0.099
	Sports experience	0.268	0.169
	Dominant hand strength	0.670 (M-P)	<0.001***
	Non-dominant hand strength	0.600 (M-P)	<0.001***
	Dominant hand reaction	-0.369	0.053
	Non-dominant hand reaction	-0.514 (M-N)	0.005**
Body weight	Sports experience	0.231	0.237
	Dominant hand strength	0.159	0.420
	Non-dominant hand strength	0.179	0.361
	Dominant hand reaction	-0.098	0.619
	Non-dominant hand reaction	0.077	0.698
Sports experience	Dominant hand strength	0.281	0.148
	Non-dominant hand strength	0.310	0.108
	Dominant hand reaction	-0.443	0.018*
	Non-dominant hand reaction	-0.520	0.005**

**p<0.05; **p<0.01; ***p<0.001.*

Table 4

Relationship between strength and visual-motor response time for dominant and non-dominant hands.

Variables		Spearman rho	p
Dominant hand strength	Non-dominant hand strength	0.924 (H-P)	<0.001***
Dominant hand strength	Dominant hand reaction	-0.510	0.006**
Dominant hand strength	Non-dominant hand reaction	-0.436	0.020*
Non-dominant hand strength	Dominant hand reaction	-0.532	0.004**
Non-dominant hand strength	Non-dominant hand reaction	-0.483	0.009**
Dominant hand reaction	Non-dominant reaction	0.540	0.003**

**p<0.05; **p<0.01; ***p<0.001; H: High; M: Moderate; L: Low; N: Negative; P: Positive.*

Discussion

This study investigated the relationship between dominant and non-dominant hand grip strength and visual-motor response time in kickboxers. Agility, balance, coordination, power, speed and response time can be critical and decisive in kickboxing (Bridge et al., 2014; Sant'Ana et al., 2017). In such sports, sudden and rapid position changes, combining hands and feet with the same skill, and attacks where defense and attack are made very quickly and powerfully at the same time are factors related to response time (Donovan et al., 2006). When the results of the study are examined; the dominant hand grip strength of kickboxers was found to be higher than that measured with the non-dominant hand. Similarly, the visual response time of the dominant hand was lower than the non-dominant hand, meaning that the response time of kickboxers with the dominant hand was faster. The need to

constantly attack and defend against opponents may lead athletes to develop their perceptual abilities; therefore, they learn to perceive stimuli in the external environment earlier than non-athletes (Mori et al., 2002), which leads to faster reactions (Asia & Warkar, 2013).

Kickboxing is a combat sport that involves dynamic, high-intensity intermittent kicks that require complex skills and tactical excellence, and in this sport, athletes are classified according to gender, body mass, and age categories (Kordi et al., 2009). According to the results of the present study; there was a moderate positive relationship between age and handgrip strength of both dominant and non-dominant hands and visual response time of dominant hand; however, no significant relationship was found between visual response time of non-dominant hand and age. There was a moderate significant relationship between height and handgrip strength of both hands. There was a moderate negative relationship between response time of non-dominant hand and height. There was a moderate negative relationship between sports experience and visual response time of both dominant and non-dominant hands, but no significant relationship was found between sports experience and grip strength of both dominant and non-dominant hands. Polat et al. (2018) stated that they could not find a significant difference between the height and right and left hand visual reaction parameters of kickboxing and taekwondo athletes. In a study investigating whether taekwondo athletes competing at an international level react faster than amateur taekwondo athletes, differences were found depending on skill level, age and gender, and taekwondo players competing at an international level showed significantly faster reactions (Vieten et al., 2007). One factor affecting response time is the relationship between the dominant and non-dominant hands in simple response time. The general consensus in the field of motor behavior is that there is a dominant cerebral hemisphere for motor control. Cerebral dominance means that one cerebral hemisphere, usually the left hemisphere, has a relatively greater capacity than the other cerebral hemisphere to provide control over the other side of the body (contralateral). The dominant hemisphere allows movements on the contralateral side of the body to be performed faster, more accurately and more coordinated compared to the non-dominant hemisphere (Teixeira et al., 2003).

In general, in martial arts such as taekwondo, nerve conduction and reaction speed are better, therefore response times are shorter (Asia & Warkar, 2013). Simple response time is considered an important ability for all types of combat sports, especially in relation to visual stimuli (Sant'Ana et al., 2017). Other results of this study support the information in the literature. A high level of positive correlation was determined between the grip strength of the dominant and non-dominant hands, while a moderate level of negative correlation was determined between the grip strength of the dominant hand and the visual response times of both the dominant and non-dominant hands. A moderate level of negative correlation was observed between the grip strength of the non-dominant hand and the visual response times of both the dominant and non-dominant hands. A moderate level of positive correlation was found between the visual response times of the dominant and non-dominant hands. When these findings are evaluated together, it shows that increasing grip strength, regardless of the dominant or non-dominant hand, can improve visual-motor reaction speed and therefore shorten visual response time. Çatıkkaş et al. (2011) also investigated the determination of visual and auditory simple response times of combat athletes and whether response times are affected by hand preference. They reported that there was no difference in the right and left hand response times of athletes, except for judokas, and that the visual and auditory simple response times of combat athletes were not affected by hand preference. Asia & Warkar (2013) showed that taekwondo athletes responded faster to auditory high-frequency and low-frequency sounds, and faster to blue light and red light stimuli. In a study comparing the response times of national kickboxers, it was seen that right and left hand auditory response times were better than right and left hand visual response times (Bilgin et al., 2014). Another study examined the visual and auditory response times of national kickboxing and taekwondo athletes. It was determined that the dominant hand auditory response time of taekwondo athletes was higher than kickboxing athletes, and therefore the auditory response time was faster (Polat et al., 2018).

Conclusion

As a result; it can be said that hand grip strength may increase depending on age and height, however, visual response time may change depending on age and height in this age group. It is thought that hand grip strength and visual response time of both hands may change

independently of body weight and that sports experience may affect visual response time. Notably, an enhancement in grip strength in both the dominant and non-dominant hands, irrespective of hand preference, appears to contribute to improved visual response times.

Authors' Contribution

Study Design: YK; Data Collection: YK; Statistical Analysis: YK; Manuscript Preparation: YK; Funds Collection: YK.

Ethical Approval

The study was approved by the Selcuk University of Non-Interventional Ethical Committee (2023/103) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

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Conflict of interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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