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RESEARCH ARTICLE

The Comparison of Reaction Times in Competing Karate Athletes

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Abstract
The aim of the research is to compare the reaction times of kata and kumite athletes participating in national and international competitions in karate. A total of 108 male competitive athletes, including 40 kata competition athletes between the ages of 18-32 and 68 kumite competition athletes between the ages of 18-29, participated in the research voluntarily. In the research, some physical characteristics of kata and kumite athletes and right-left hand visual and right-left hand auditory reaction time tests were performed. T-Test was applied to determine the difference between groups at the α=0.05 significance level in all independent groups. A statistically significant difference was detected in training age, height and right hand visual reactions ($p<0.05$) among male kata and kumite athletes participating in the competitions. It can be said that these differences are due to the differences in kata and kumite training methods.

Keywords
Kata, Kumite, Karate, Performance

INTRODUCTION

Karate is a traditional physical practice that people used to engage in on the island of Okinawa in the past, as a means of unarmed self-defense. Today, karate is practiced in every country around the world and has been included in the Olympic Games. Through karate training, individuals not only achieve mental discipline built on a specific foundation but also enhance their physical fitness. Moreover, the competition methods within the realm of karate sports have demonstrated significant advancements in terms of athlete performance from the past to the present.

The distinctions between the kata and kumite branches, which are two styles of karate competition, have further fueled athletes' motivation to improve themselves through these branches. While karate is rooted in kihon (basic techniques) exercises, it acquires significance through kata routines, and kumite reaches its final form with mutual attack and defense techniques. The sport of karate can also be described as "the art of controlling punches and kicks, wherein strikes delivered at full speed are retracted without causing harm to the opponent, stopping three or five cm before the opponent's body" (Dilekçi, 2021).

Karate is a popular combat sport that has been officially included in the Tokyo 2020 Olympic Games. Successful participation in karate necessitates athletes to possess a specific physical and physiological profile alongside high technical expertise (Chaabene et al., 2012). In terms of physical performance, athletes must execute techniques with swift and explosive force during competitions to score points (Tabben et al., 2018). Karate tournaments are divided into two main parts: kumite and kata. Athletes in kumite competitions use many karate techniques. Kumite competitions are high-intensity events involving kicks, punches, and quick movements. It can be

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easily understood that the fundamental skills that need to be developed by kumite athletes are perceptual and predictive. On the other hand, kata competition consists of an imaginary series of offensive and defensive moves performed without the presence of an opponent. Kata and Kumite competition styles have different training periods, both before and after the competition. Regarding performance in karate, reaction time, maximum speed, and explosive power are important performance indicators. While karate trainers used to organize their training programs similarly for both kata and kumite competition athletes, separate training programs are now arranged due to changes in the competition rules. With these changes, the training of Kumite athletes has become more dynamic compared to the training of kata athletes (Imamura et al., 2002; Mori et al., 2002; Macan et al., 2006; Franchini and Stanislaw 2009; Chaabene et al., 2015; Nedeljkovic et al., 2017; Filingeri et al., 2012; Guler and Ramazanoglu 2018; Molinaro et al., 2020).

When examining the studies, it was concluded that balance control is an essential component of performance, particularly in martial arts, and that balance-related research should receive special attention, especially in training (Gauchard et al., 2018). Additionally, senior male karate athletes are characterized by low body fat and a mesomorphic-ectomorphic somatotype, and it has been suggested that success depends on burst muscle strength in both the upper and lower limbs (Loturco et al., 2014). Each discipline exhibits distinct physical, physiological, motor, technical, and tactical features. The enhancement of these inherent attributes contributes to an elevation in sports performance, and within this progression, warm-up routines, training regimens, competitive events, and nutrition play pivotal roles. However, one of the most critical factors is the design of a training program tailored to the specific discipline. To effectively structure such a program, it is imperative to identify the salient characteristics unique to that discipline (Harmancı and Karavelioğlu, 2017; Karavelioğlu et al., 2017; Ünveren et al., 2013; Karavelioğlu et al., 2021).

In the existing literature, numerous studies scrutinize the motor and anthropometric traits of karate athletes. After these investigations, factors such as limb proportions, balance, explosive strength, and body types emerge as pivotal elements influencing the success of karate athletes (Nedeljkovic et al., 2017; Filingeri et al., 2012; Güler and Ramazanoğlu, 2018; Loturco et al., 2014). However, the quantity of studies dedicated to the separate analysis of karate athletes specializing in Kumite and kata is relatively limited in the literature. It is speculated that discerning the anthropometric characteristics and reaction times of kumite and kata athletes will provide essential data for athlete selection within this discipline and for the formulation of effective training protocols. Given this context, the current research endeavors to ascertain the reaction times of karate kata and kumite athletes, aiming to uncover potential differences between these two categories.

MATERIALS AND METHODS

Study design and population

A total of 108 male competitive athletes, including 40 kata competition athletes between the ages of 18-32 and 68 kumite competition athletes between the ages of 18-29, participated in the research voluntarily. Attention was paid to the fact that the participant group of the research were kata and kumite competition athletes who train at least three days a week and do not have any health problems.

Before starting the study, Istanbul Rumeli University Ethics Committee approval was obtained (Date: 23/08/2023 Decision No: 2023/08). Participants in the study were evaluated by mobile application and filled out data collection questionnaires. Our study was conducted in accordance with the Principles of the Declaration of Helsinki.

Measuring methods

A personal information form consisting of two parts was prepared by the researcher. In the first part, information about the age, training age, weekly training number and participation in the competitions of the athletes were entered into the personal information form. In the second part of the study, the height (cm), weight (kg), right-left hand auditory (mls), right-left hand visual (mls) reaction time measurement information of kata and kumite athletes were processed. Before the research measurements, the athletes were met and informed about the measurements. The research was conducted in the clubs where athletes trained. The information was entered by the athletes

themselves into the information form prepared by the researcher. Height measurements of kata and kumite athletes were recorded in cm by taking the head upright, knees tense, heels together and body upright. Length measurements were determined with a Gulick anthropometric tape measure with an error of ± 1 mm. The weight measurements of the athletes were recorded by standing on the scale in the head-to-head position, with an error of 0.5 kg. Weight measurements of all athletes were taken when they were wearing karate suits.

Power 2000 New Test Simple Reaction Time Measurement Tool was used to measure the reaction times of kata and kumite athletes. The reaction time device sends sound or visual stimuli at regular intervals. Reaction time measuring device; It can measure both light and sound reaction time and display the obtained result on the digital screen. The athlete touches the button with his index finger to respond as quickly as possible to the stimulus sent by the sensitive button in front of him. In reaction time measurements, the athlete touches the button with his hand in order to respond as quickly as possible to the stimulus sent by the sensitive button in front of him. The time between when the athlete responds to the sent light or sound stimulus and when the stimulus arrives is recorded as milliseconds (mls). Reaction times of the athletes were measured in a quiet environment when the athletes were not tired.

Kata and kumite athletes were taken one by one into a large room at different times. Athletes were allowed to sit comfortably on the chair with their hands on the table. The concentration of the participants was ensured and they were allowed to touch the tool in a comfortable way, first with their right and then with their left fingers. Individuals were asked to respond to first sound and then light stimuli given at unequal intervals. Sound and light stimuli were given five times at different time intervals, and the response time given to this stimulus with the right and left hands was recorded in seconds and the best three measurement results were evaluated. The best three scores among the five reaction time scores achieved by the athletes were analyzed.

Statistical analyses

Statistical analyzes of the study were performed using the SPSS version 22.0. Visual (histogram, probability graphs) and analytical methods (KolomogrovSmirnov/Shapiro-Wilk's test) were used to define whether the variables were normally distributed. After it was determined that the research data had a normal distribution, a T-Test was performed between independent groups at the $\alpha = 0.05$ significance level to determine whether there was a significant difference between the measurements. In the research, it was tested whether there was a statistically significant difference between the age, training age, height, weight, right-left hand auditory and right-left hand visual reaction times of kata and kumite athletes.

RESULTS

Table 1. Age and training age values of kata and kumite athletes

	N		Min-Max		X ± Sd		p
	Kata	Kumite	Kata	Kumite	Kata	Kumite	
Age (year)	40	68	18-32	18-29	23,95±1,59	22,77±2,23	,098
Training Age (year)	40	68	2-20	2-17	12,75±3,51	7,44±2,35	,014*

*p<0.05

The mean age values of kata and kumite athletes; kata athletes 23.95±1.59 years; Kumite athletes' age was determined as 22.77±2.23 years. Independent Sample T-Test was applied between the ages of kata and kumite athletes at the $\alpha=0.05$ significance level. Ages of kata and kumite athletes Independent T-Test values; 0, .098<0.05; It was determined as . Since P>0.05 was found, no statistically significant difference could be detected between the ages of kata and kumite athletes in the study (Table 1).

The mean training age values of kata and kumite athletes; kata athletes 12.75±3.51 years; Kumite athletes' age was determined as 7.44±2.35 years. Independent Sample T-Test was applied between the training ages of kata and kumite athletes at the α=0.05 significance level. Independent T-Test values of kata and kumite athletes, training ages; 0.014<0.05; It was determined as. Since P was found to be <0.05, the training ages of kata and kumite athletes in the study were; A statistically significant difference was detected between.

Table 2. Height and weight measurement values and statistical test results of kata and kumite athletes

Physical measures	N		Min-Max		X ± Sd.		P
	Kata	Kumite	Kata	Kumite	Kata	Kumite	
Height (cm)	40	68	168,0-176,3	167,8-190,1	169,55±4,07	179,55±5,27	,035*
BodyWeight (kg)	40	68	63,0-86,7	54,9-86,2	73,67±3,51	71,88±6,08	,982

*p<0.05

The mean height scores of kata and kumite athletes; kata athletes 169.55±4.07 cm; Kumite athletes were determined to be 179.55±5.27 cm. Independent Sample T-Test was applied between the heights of kata and kumite athletes at the α=0.05 significance level. Independent T-Test values of kata and kumite athletes are 0.035<0.05; It was determined as. Since P was found to be <0.05, a statistically significant difference was detected between the heights of the elite kata and kumite athletes participating in our study. The mean body weight scores of kata and kumite athletes; kata athletes 73.67±3.51kg; Kumite athletes were determined to weigh 71.88±6.08 kg. Independent Sample T-Test was applied between the weights of kata and kumite athletes at the α=0.05 significance level. Independent T-Test values of kata and kumite athletes were determined as weight (kg) 0.982>0.05. Since P>0.05 was found, no statistically significant difference could be detected between the weight (kg) of kata and kumite athletes participating in the study (Table 2).

Table 3. Right hand auditory reaction times of kata and kumite athletes

Reaction Times	N		Min-Max		X ± SS		p
	Kata	Kumite	Kata	Kumite	Kata	Kumite	
Right Hand Auditory (mls) (1)	40	68	162,0-254,00	157,0-252,2	191,16±26,38	186,77±21,7	0,461
Right Hand Auditory (mls) (2)	40	68	165,0-228,00	163,0-248,7	182,37±24,77	179,04±19,07	0,355
Right Hand Auditory (mls) (3)	40	68	169,1-255,09	167,0-238,4	187,62±25,54	188,8±22,74,0	0,222

*p<0.05

The mean values of right hand auditory reaction time of kata and kumite athletes, 1st measurement of kata athletes 191.16±26.38 (mls); 2nd measurement 182.37±24.77 (mls); 3rd measurement 187.62±25.54 (mls), kumite athletes 1st measurement 186.77±21.7 (mls); 2nd measurement 179.04±19.07 (mls); The third measurement was determined as 188.88±22.74 (mls). To investigate whether there was a significant difference between the right hand auditory reaction times of kata and kumite athletes, a t-test was applied at the α = 0.05 significance level. Independent T-Test values of kata and kumite athletes, right hand auditory reaction time; 1. Measurement 0.461>0.05, 2. Measurement 0.355>0.05, 3 measurements 0.222>0.05 were determined. Since P>0.05 was found in all right hand auditory reaction time measurements, no statistically significant difference could be detected between the right hand auditory reaction times of kata and kumite athletes (Table 3).

Table 4. Right hand visual reaction times of kata and kumite athletes

Reaction Times	N		Min-Max		X ± SS		p
	Kata	Kumite	Kata	Kumite	Kata	Kumite	
Right Hand Image (mls) (1)	40	68	165,0-255,12	159,33-234,07	183,11±23,17	177,22±20,7	,027*
Right Hand Image (mls) (2)	40	68	167,0-251,07	163,0-245,2	179,62±25,82	180,06±18,00	,012*
Right Hand Image (mls) (3)	40	68	168,2-254,22	166,74-237,9	187,27±25,54	182,77±21,35	,039*

*p<0.05

The mean values of right hand visual reaction time of kata and kumite athletes, 1st measurement of kata athletes 183.11±23.17 (mls); 2nd measurement 179.62±25.82 (mls); 3rd measurement 187.27±25.54 (mls), kumite athletes 1st measurement 177.22±20.7 (mls); 2nd measurement 180.06±18.00 (mls); The 3rd measurement was determined as 182.77±21.35 (mls). In order to investigate whether there is a significant difference between the right hand visual reaction times of kata and kumite athletes, t-test at α=0.05 significance level was applied. Independent T-Test values of kata and kumite athletes are right hand visual reaction time; 1. Measurement 0.027<0.05, 2. Measurement 0.012<0.05, 3 measurements 0.039<0.05 were detected. Since P<0.05 was found in all right-hand visual reaction time measurements, a statistically significant difference was found between right-hand visual reaction times of kata and kumite athletes (Table 4).

Table 5. Left hand auditory reaction times of kata and kumite athletes

Reaction Times	N		Min-Max		X ± SS		p
	Kata	Kumite	Kata	Kumite	Kata	Kumite	
Left Hand Auditory (mls) (1)	40	68	169,1-255,09	167,0-238,4	181,52±24,44	188,88±22,74	0,222
Left Hand Auditory (mls) (2)	40	68	170,0-238,00	169,0-256,7	187,58±22,88	178,44±22,21	0,255
Left Hand Auditory (mls) (3)	40	68	167,0-233,87	165,0-244,8	184,38±24,92	174,04±21,15	0,368

*p<0.05

Kata and kumite athletes' left hand auditory reaction time mean values for kata athletes' 1st measurement were 181.52±24.44 (mls); 2nd measurement 187.58±22.88 (mls); 3rd measurement 184.38±24.92 (mls), kumite athletes 1st measurement 188.88±22.74 (mls); 2nd measurement 178.44±22.21 (mls); The 3rd measurement was determined as 174.04±21.15 (mls). To investigate whether there is a significant difference between the left hand auditory reaction times of kata and kumite athletes, t-test was applied at the α=0.05 significance level. Independent T-Test values of kata and kumite athletes are left hand auditory reaction time; 1st measurement was determined as 0.222>0.05, 2nd measurement as 0.255>0.05, 3rd measurement as 0.368>0.05. Since P>0.05 was found in all left hand auditory reaction time measurements, no statistically significant difference was found between left hand auditory reaction times of kata and kumite athletes.

Table 6. Left hand visual reaction times of kata and kumite athletes

Reaction Times	N		Min-Max		X ± SS		p
	Kata	Kumite	Kata	Kumite	Kata	Kumite	
Left Hand İmage (mls) (1)	40	68	159,0-246,00	169,0-253,3	186,70±22,77	185,75±19,58	0,253
Left Hand İmage (mls) (2)	40	68	169,0-248,00	165,0-238,7	183,77±20,12	174,99±22,12	0,299
Left Hand İmage (mls) (3)	40	68	167,20-252,12	165,0-228,8"	189,82±24,94	184,77±23,64	0,257

*p<0.05

The mean values of left hand visual reaction time of kata and kumite athletes, 1st measurement of kata athletes 186.70±22.77 (mls); 2nd measurement 183.77±20.12 (mls); 3. measurement 189.82±24.94 (mls), kumite athletes 1st measurement 185.75±19.58 (mls); 2nd measurement 174.99±22.12 (mls); The third measurement was determined as 184.77±23.64 (mls). To investigate whether there was a significant difference between the left hand visual reaction times of kata and kumite athletes, a t-test was applied at the $\alpha = 0.05$ significance level. Independent T-Test values of kata and kumite athletes, left hand visual reaction time; 1st measurement was determined as 0.222>0.05, 2nd measurement as 0.255>0.05, 3rd measurement as 0.368>0.05. Since P>0.05 was found in all left hand visual reaction time measurements, no statistically significant difference could be detected between the left hand visual reaction times of kata and kumite athletes.

DISCUSSION

In the research, the age, training age, height, body weight, right-left hand auditory and right-left hand visual reaction time measurements of kata and kumite athletes, which are the competition branches of karate, were determined. The prominent features of kata and kumite athletes will be determined. The research is designed to guide talented athletes to kata and kumite branches and to develop these branch athletes in their training programs. The anthropometric characteristics of an athlete are extremely important in karate. It is stated that examining the anthropometric features of karate players is important in terms of revealing the most suitable morphological and functional biotype for this sport (Chaabene et al. 2012). It has been revealed that karate players competing at high and medium levels have the same somatotype characteristics (Giampietro et al. 2003). In addition, as a result of studies on Italian and German karate athletes, concluded that being in an ectomorphic structure positively affects performance in karate players (Pieter and Bercades 2009; Fritzsche and Raschka 2007). It supports the athletes to be tall and ectomorphic.

In the vast majority of branches with intermittent high-intensity loads, the energy requirement is met by the anaerobic energy system. For this reason, we can say that the basis of decisive movements that will make karate players successful depends on the anaerobic energy system (Francescato et al. 1995; Beneke et al. 2004). Anaerobic power makes it possible to make defensive or offensive movements in the shortest time in karate. Besides anaerobic power, reaction time is thought to be extremely important. The reaction time or the speed of movement in the face of a stimulus has a critical importance in many sports branches, including karate (Mori et al. 2002). In addition, the number of studies that determine the reaction times of kata and kumite artists and reveal the difference between them is very limited. In the event of a competition, he must choose one of the many actions that can respond to the action of the opponent. The delay time in response to such stimuli increases in proportion to the number of alternative responses. With the increase, the athlete responds to his opponent by choosing the most appropriate response action. In high-performance karate athletes, the selective reaction time will be fast enough to approach the simple reaction time (Deliu, 2001).

Mori et al. (2002) and Williams and Elliot (1999) found that there was a significant difference in reaction times in their studies on karate players at different levels and competing in different categories. In another study, it was determined that the reaction times of the 3rd and 4th dan black belt karate players were better than the reaction times

of the 1st and 2nd dan karate athletes (Fontani et al. 2006). However, Layton's (1993) study on elite karate players competing in different competition categories found that there was no significant difference between reaction times. In our study, a result was found in parallel with the study of Fontana et al. (2006). Considering the studies examining the reaction time, it can be concluded that the reaction time increases as the level increases, so it can be said that it is inevitable to include studies to improve reaction time if it is desired to be an elite-level athlete or to be trained. When we look at the literature, it is seen that the number of studies examining the physical and motoric characteristics of kata and kumite athletes is quite limited. In this study, it was aimed to examine some physical and reaction times of kata and kumite athletes and to determine the differences between them. It was determined that there were significant differences between height, training age, and right-hand visual reaction times.

In the study, it can be said that the kata movement series of the kata athletes between the training ages are repeated with intense work over a long time, and the technical details are overemphasized in each repetition. It can be said that they have reached technical perfection at the end of long training years since the kata branch focuses only on rapid movements and has a lot of technical work. In the study, it can be said that the height of the kata and kumite athletes is due to the weight competition of the Kumite branch according to the kata branch and the weight difference of these weight athletes. In addition, it can be said that the technical details of karate kata exercises (dachi stances) emerged from the fact that they turned to kumite branches since they made too much effort for tall athletes. In the study, it can be said that these features have improved as a result of the right-hand visual reaction times of Kumite athletes, unlike kata athletes, who do different types of movements during training and competition and react quickly to incoming movements in training competitions. It can be said that it is also effective for kumite athletes to use their right hand as the dominant hand and to use this hand excessively to attack during the competition.

It is necessary to increase the number of studies that will enable karate athletes to be more successful in competitions and measure the distinctive athlete characteristics specific to the karate branch. In addition to revealing the differences between kata and kumite athletes, studies that measure the physical and motor characteristics of karate athletes competing in different categories and weights should be increased. It is necessary to carry out analysis and comparison studies according to gender differences by including the gender factor. In addition, studies that examine the relationships between the physical and motor characteristics of karate athletes who are ranked in national and international competitions and their success should be increased. This research aims to determine the differences that may be important for the selection, training methods, and physical tests of karate competition athletes in the future by testing some physical performance profiles of kata and kumite athletes. For this determined purpose, the data of a total of 108 (one hundred and eight) kata and kumite athletes, including 40 (forty) kata athletes and 68 (sixty-eight) Kumite athletes, were analyzed and evaluated. Since kata and kumite athletes were tested in the research, it is thought that it may be important for both the selection and training designs of karate athletes based on these findings. It will be possible to determine the profiles of competition athletes specific to kata and kumite disciplines, with more anthropometric measurements, physical performance, and skill-specific tests, and by expanding the same research on female karate athletes.

Conflict of Interests Statement

There are no conflicts of interest for the contributing author.

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Ethics Statement

Ethical approval of the research was obtained at the meeting of the Rumeli University Rectorate Ethics Committee, dated 23.08.2023 and numbered 2023/08. The research was conducted with volunteer participants.

Author Contributions

Planned by the author: Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search. Author have read and agreed to the published version of the manuscript.

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