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To Learn the Effects of Ramadan-Intermittent Fasting (RIF) and Time of Day on Physical Parameters of Taekwondo Athletes by Coaches

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Abstract
The aim of this study was to investigate the effects of Ramadan-intermittent fasting and different times of the day on the physical parameters of taekwondo athletes. A total of 15 professional Taekwondo athletes, 8 male and 7 female, participated in the study. Performance tests were performed one week before Ramadan (BR), the second week of Ramadan (SWR) and the end of the fourth week of Ramadan (ER) at 07:00 and 17:00. The descriptive statistics of the participants were as follows: mean age 21.131.90 years, height 169.53±8.64, weight 64.80±18.48 in BR and 62.33±16.91 in ER. Speed (30m), agility (hexagon), lower extremity flexibility (hip flexion angle=ROM), and vertical jump strength (counter movement jump=CMJ) performance determination tests were performed. Goniometer was used for lower extremity flexibility measurement and My Jump2 application, which has been proven to be valid and reliable, was used for CMJ performances. The data obtained were evaluated in the statistical package programme (SPSS) at a significance level of 0.05 using parametric (independent t-test) for agility and nonparametric (Mann-Whitney U) test for other tests according to normality test. It was observed that morning and evening hours of different days had no significant effect on speed, agility, flexibility and jumping force values (p>.05), agility test data differed only before and after Ramadan and this difference was in favour of after Ramadan. At the same time, it was observed that the values obtained from the agility test were higher in the morning before Ramadan (11.20 sec) and in the evening before Ramadan (11.28 sec) than in the evening after Ramadan (10.06 sec). As a result, we can say that long-term malnutrition of athletes does not have a positive or negative effect on many performance characteristics. It is thought that learning the findings obtained in this study and future studies by the coaches may provide important contributions to the coaches to prepare and organise more appropriate training programmes for the athletes.

Keywords: Taekwondo, Flexibility, Vertical Jump

Introduction

Ramadan is a special religious month that brings different eating habits without eating or drinking anything for 10-18 hours in a certain month of the year and offers a holistic change in lifestyle, including sleep patterns, daily lifestyle and social activities (Al-Hurani & Atomum, 2007; Meckel et al., 2008). In the literature, due to the increasing number of Muslim athletes in the world, the number of studies adopting the idea that these athletes can continue their training and participate in competitions during Ramadan without losing their athletic performance characteristics is increasing. However, although the view that fasting during Ramadan does not affect performance characteristics in certain time periods is accepted, a clear idea about this situation has still not been accepted. Once a year for 30 days, athletes reduce the frequency of food and fluid intake and desire to

consume richer calories than they consume at other times (Meckel et al., 2008; Ziaee et al., 2006). While it is clear that prolonged periods of food deprivation during the day during Ramadan are detrimental to both health and performance, it is also clear that intermittent fasting, which is an indispensable part of current diet programmes based on the principle of fasting for 12 hours at night, is also detrimental. In this month instead of stopping food intake while sleeping at night, it is preferred to stop eating and drinking during the day. Changes in sleep patterns, physiological and lifestyle changes may cause difficulties in the interpretation of athletic performance of athletes. The level of the effect of fasting in Ramadan on the interpretation of these changes continues to be a subject of debate in the literature. These effects may vary greatly depending on the type of sport, the intensity of training, the month of fasting, the duration of fasting and the nutrition programme applied by the athlete (Maughan et al., 2010).

Review of Literature

In studies conducted in individuals with short-term fasting (11-24 hours), who perform exercise for recreational purposes or who are sedentary, it is thought that this fasting may cause a decrease in sportive performance, while another view in the literature argues that long-term fasting may have a negative effect on sportive performance (Ferguson et al., 2009: Gueye et al., 2003; Ramadan, 2002; Souissi et al., 2007). Mujika argued that training within a few hours after iftar in this month would contribute to more optimal performance, taking into account the fasting status of athletes during Ramadan. However, studies investigating the effects of short- and long-term fasting on the athletic performance of elite athletes state that the decreases in athletic performance of athletes are not very significant (Mujika, et al., 2010; Chaouachi et al., 2009a; Kirkendall et al., 2008; Meckel et al., 2008). The duration of fasting during Ramadan varies each year according to the position of the sun, and the time spent fasting may increase or decrease (Chaouachi et al., 2009b).

Since there is no privilege for Ramadan in the calendar determined for international sports competitions, athletes who want to fast in this month may have to train and compete. With the thought that fasting during Ramadan may cause athletes to have low sportive performance, coaches may reduce the training load by reducing the stress and pressure that may occur in the athlete, which may have a positive effect on the athlete (Leiper et al., 2008). Coaches should organise the frequency, volume and duration of the training they will apply during this period without forgetting the fact that their athletes are physically and physiologically sensitive. At the same time, preventing the pressure, stress and low motivation that may occur in athletes due to Ramadan fasting can prevent athletic performance decreases in athletes.

The aim of this study was that Ramadan-intermittent fasting and different times of the day will not have negative effects on the physical parameters of taekwondo athletes, the reasons for the increase or decrease in the athletic performance of the athletes according to this behaviour model of the coaches may be due to other reasons, and the coaches can make changes in training days and hours according to this situation

Methodology

Subject

Fifteen taekwondo athletes (8 male, 7 female) who were members of a professional club participated in this study voluntarily. The study was conducted in Manisa Celal Bayar University Faculty of Sports Sciences Indoor Sports Hall. After a full explanation of the protocol, each volunteer approved the information sheet. Healthy athletes and those who declared verbally and in writing that they were not taking any medication were included in the study.

Experimental Design

For all measurements, the test protocol was applied to the athletes before Ramadan; 08:00 am, 18:00 pm, during Ramadan; 08:00 am, 18:00 pm and after Ramadan; 08:00 am, 18:00 pm, a total of 6 times. The average duration of fasting in April-May 2022 was determined to be approximately 14 hours.

Descriptive Data

The height of the athletes was measured with a stadiometer (Seca, Germany) with an accuracy of

0.01 m in an anatomical posture, barefoot, with the heels of the feet together, with the subject holding his/her breath, with the head in the frontal plane, with the overhead table touching the vertex point, and the values were recorded in 'em'.

Body weight measurements of the athletes were taken with a stadiometer (Seca, Germany) with a precision of 0.01 m in bare feet and anatomical posture with only shorts on the athletes and recorded in 'kg'.

Speed Test

A standardised progressive warm-up protocol was applied before all tests. In short 10 min intervals, sprint, vertical jump, low level plyometric exercises, foot movements and squat exercises were performed. The 30 m sprint test was performed with an electronic photocell system according to the high exit technique. In order to get the highest values, they were asked to repeat the test 3 times and the best value was evaluated.

Vertical Jump Force (CMJ) Test

A standardised 10-minute warm-up consisting of running, lower extremity dynamic warm-up movements and vertical jumps was applied to the athletes. The athletes were asked to jump upwards with maximal force after performing a rapid downward collapse movement from the knees downwards with the hands at the side in the normal upright posture position. Their vertical jumps were recorded with the high-speed camera in the validated My Jump 2 application using an iPhone 13 (Apple Inc USA) phone (Balsalobre-Fernandez et al., 2015). Each athlete was asked to make 3 vertical jumps as high as possible. A passive rest period of 2 minutes was given at the end of each jump. The take-off and landing of their feet were determined from the video. The jump distances were then calculated using the equation (h= t2 x 1.22625) that determines the jump height. The best results were evaluated (Bosco et al., 1983).

Flexibility Test

In order to determine the hip flexion angles, the hip flexion angles were measured manually on the right lower extremity with a standard goniometer in the flexion position of the hip. In the supine position of the athlete, adduction, abduction and rotation angles of the hip joint were 0° and the knee joint was in the full extension position. The pivot point of the goniometer was placed on the lateral surface of the hip with reference to the apex of the trochanter major. The fixed arm of the goniometer was placed along the lateral midline of the abdomen with reference to the pelvis and the movable arm was aligned on the lateral midline of the femur. ROM values of taekwondo athletes performing voluntary maximal hip flexion were determined and recorded (Norkin & White, 2016).

Agility (Hexagon) Test

The equipment required for this test, which is used to determine the agility (ability) of the participants, is a tape measure, a hexagon drawn on the ground (6 sides 60 cm long) and a stopwatch. The athlete starts the test with both legs in the centre of the hexagon After the start command, the athlete is asked to jump out of the hexagon line with both feet, then come back to the centre and jump clockwise through the 6 sides of the hexagon After completing three full rounds of the hexagon, the stopwatch was stopped and the best score from the two trials was recorded.

Data Analysis

SPSS v23 software was used in the statistical analyses of this study. The data obtained from the participants, descriptive characteristics of the participants (age, height, weight), arithmetic means (X) and standard deviations (SD) of these characteristics were determined. As a result of the Shapiro Wilk normality test, it was found that the 'BR' test was normally distributed (Sahpiro-Wilk-979, $p>.05$), while the others were not normally distributed ($p<.05$). For this reason, parametric (independent sample t-test and ANOVA) analysis method was used for the "BR" test and nonparametric (Mann-Whitney U & Kruskall Wallis) analysis method was used for the other performance test measurement data. The significance level was determined as 5% ($p<.05$).

Results

The results of the data collected from 15 professional taekwondo athletes participating in the study are presented in the form of tables below. Descriptive statistics of the athletes participating in the study are shown in Table 1.

Table 1 Descriptive Characteristics of Professional Taekwondo Athletes

Descriptive Characteristics Professional Taekwondo Athletes (n=15)	
Age (year)	21.13±1.90
Height (cm)	169.53±8.64
BR Weight (kg)	64.80±18.48
ER Weight (kg)	62.33±16.91

(kg: kilogram, cm: centimetre, BR: before ramadan, ER: after ramadan, n: number of individuals)

Descriptive statistics of the participants were as follows: mean age 21.13±1.90 years, height 169.53±8.64, BR weight 64.80±18.48 and ER weight 62.33±16.91.

Table 2 Pre-Ramadan (BR), Ramadan (SWR) and Post-Ramadan (ER) Morning and Evening Performance Test Values of Professional Taekwondo Athletes

Tests	Time	N	Mean	Median	SD
30m (sec)	08.00	45	5.0113	5.1700	.56781
	18:00	45	5.1171	5.3700	.61297
Flexibility (cm)	08:00	45	19.8529	20.0000	4.03778
	18:00	45	20.1967	20.5000	3.96777
Agility (Hexagon) / sec	08:00	45	11.0084	11.0300	1.09071
	18:00	45	10.7227	10.4500	1.22182
Vertical Jump (CMJ)	08:00	45	29.4173	26.3200	6.59129
	18:00	45	29.7153	27.0000	6.23652

(m: metres, cm: centimetre, sec: second, CMJ: counter movement jump, SD: standard deviation, n: number of individuals)

According to the results of independent t-test (parametric), there was no significant difference between morning and evening agility test (t=1.170, p>.05). However, according to Mann-Whitney U test (non-parametric), no significant difference was found in 30 m (U=855, p=.204), flexibility (U=956, p=.651), vertical jump strength (U=950, p=.614) tests (p>.05).

Table 3 Pre-Ramadan (BR), Ramadan (SWR) and Post-Ramadan (ER) Peformans Test Values of Professional Taekwondo Athletes

Tests	Time	N	Mean	Median	SD
30 m (sec)	BR	30	4.9350	5.1250	.52400
	SWR	30	5.0280	5.1850	.54778
	ER	30	5.2297	5.3750	.66808
	Total	90	5.0642	.58989	.58989
Flexibility (cm)	BR	30	19.3200	19.5000	3.98622
	SWR	30	20.5177	21.0000	3.80458
	ER	30	20.2367	20.5000	4.18787
	Total	90	20.0248	20.0000	3.98413
Agility (Hexagon) / sec	BR	30	11.4577	11.3800	1.30170
	SWR	30	10.8413	10.9150	1.05971
	ER	30	10.2977	10.2000	.78679
	Total	90	10.8656	10.9550	1.16053
Vertical Jump (CMJ)	BR	30	29.1490	25.4250	6.56652
	SWR	30	29.3563	26.5150	6.37568
	ER	30	30.1937	27.1500	6.37150
	Total	90	29.5663	26.6000	6.38197

(BR: before ramadan, SWR: second week of ramadan, ER: after ramadan, CMJ: counter movement jump, m: metres, n: number of individuals, SD: standard deviation, cm: centimetre, sec: second)

The ANOVA result was found to be significant (F=8.82, p<.05), and the post hoc test (Tukey) showed that the agility test scores differed only before and after Ramadan, and this difference was in favour of after Ramadan.

As a result of Kruskal Wallis test (non-parametric) test, there is no significant difference between 30 m (Kruskal Wallis H=5.03. p=.081). flexibility, (Kruskal Wallis H=1.03. p=.596) vertical jump strength (Kruskal Wallis H=1.62. p=.443).

The ANOVA result was found to be significant (F=4.21, p<.05), and as a result of the post hoc test (Tukey), it was observed that the agility test scores were higher in the morning before Ramadan (11.20 sec) and in the evening before Ramadan (11.28 sec) than in the evening after Ramadan (10.06 sec).

As a result of Kruskal Wallis test (non-parametric), there was no significant difference in 30 m (Kruskal Wallis H=6.74, p=.24), flexibility (Kruskal Wallis H=1.42, p=.92) and vertical jump strength (Kruskal Wallis H=2.33, p=.80) values.

Table 4 Pre-Ramadan (BR), Ramadan (SWR) and Post-Ramadan (ER) Morning and Evening Peformans Test Values of Professional Taekwondo Athletes

Tests	Time	N	Mean	Median	SD	SE
30 m (sec)	BR (08.00)	15	4.8807	5.1200	.51355	.13260
	BR (18:00)	15	4.9667	5.1800	.52545	.13567
	SWR (08.00)	15	5.1867	5.2800	.64813	.16735
	SWR (18:00)	15	4.9893	5.2300	.54654	.14112
	ER (08.00)	15	5.0893	5.3700	.58087	.14998
	ER (18:00)	15	5.2727	5.5700	.70746	.18267
	Total	90	5.0642	5.2000	.58989	.06218
Flexibility (cm)	BR (08.00)	15	18.9800	19.5000	4.02194	1.03846
	BR (18:00)	15	20.4720	22.0000	4.05555	1.04714
	SWR (08.00)	15	20.1067	20.0000	4.16181	1.07457
	SWR (18:00)	15	19.6600	19.5000	4.06093	1.04853
	ER (08.00)	15	20.5633	21.0000	3.67853	.94979
	ER (18:00)	15	20.3667	20.5000	4.35573	1.12464
	Total	90	20.0248	20.0000	3.98413	.41996
Agility (Hexagon)/sec	BR (08.00)	15	11.4273	11.2000	1.09061	.28159
	BR (18:00)	15	11.1760	11.2800	1.15508	.29824
	SWR (08.00)	15	10.4220	10.5000	.79290	.20473
	SWR (18:00)	15	11.4880	11.6600	1.52265	.39315
	ER (08.00)	15	10.5067	10.3800	.86717	.22390
	ER (18:00)	15	10.1733	10.0600	.78771	.20338
	Total	90	10.8656	10.9550	1.16053	.12233
Vertical Jump (CMJ)	BR (08.00)	15	29.4467	25.0000	7.05622	1.82191
	BR (18:00)	15	28.9367	25.3900	6.49627	1.67733
	SWR (08.00)	15	29.8687	26.4500	6.63953	1.71432
	SWR (18:00)	15	28.8513	25.8500	6.27202	1.61943
	ER (08.00)	15	29.7760	26.7500	6.45161	1.66580
	ER (18:00)	15	30.5187	27.3000	6.30730	1.62854
	Total	90	29.5663	26.6000	6.38197	.67272

(BR: before ramadan, SWR: second week of ramadan, ER: after ramadan, CMJ: counter movement jump, m: metres, n: number of individuals, SD: standard deviation, SE: Standard Error, cm: centimetre, sec: second)

Discussion

It is known that it is extremely important for coaches to know the performance, physical and physiological characteristics of their athletes in terms of athletes' performance status and training design. For this reason, it was thought that Ramadan-intermittent fasting and different times of the day would not have negative effects on the physical parameters of taekwondo athletes, the reasons for the increase or decrease in the athletic performance of the athletes according to this behavioural model of the coaches may be due to other reasons, and the coaches can make changes in training days and hours according to this situation. Fasting in Ramadan is abstaining from food and liquids for 30 days at specified times of the day. Especially in this month, there are studies showing that decreases in sleep and physical performance are observed (Margolis & Reed, 2004). In a study, it was observed that fatigue symptoms were observed at a very high

rate in young football players, especially during the Ramadan fasting, and some physical performance measurement data were low only in the last week of fasting (Chtourou et al., 2011). In the results obtained in this study, there was no significant difference between the mean body weight (kg) of professional taekwondo athletes before Ramadan (BR) (64.80±18.48) and after Ramadan (ER) (62.33±16.91) (p>.05). It is possible to find many studies in the literature that fasting during Ramadan does not affect the body weight of athletes and the weight lost is not significant (Beltaifa et al., 2002; Ramazan & Barac-Nieto, 2000).

According to these data, there is no significant difference between morning and evening agility test (t=1.170, p>.05). It has been shown that the incompatibility of the central nervous system and muscle movements is related to the duration of sleep, but sleep deprivation, even if it is small negatively affects the mental health and coordination performances of athletes (Reily & Waterhouse, 2009). In a previous study showing similar results with our study, a 4x10 m agility test was applied to football players with fasting during Ramadan and no change was observed in the agility performance characteristics of these football players. In another study conducted during Ramadan, no significant difference was found in the speed, agility and endurance performances of football players (Meckel et al., 2008; Kirkendall et al., 2008). In another study conducted with karate athletes, it was stated that fasting during Ramadan did not affect the neuromuscular performance of athletes (Zarrouk et al., 2016).

It is thought that with increased flexibility, athletes will perform better and sports injuries will be minimised. Although flexibility-enhancing exercises are accepted as one of the main components of exercises to be performed before physical activity, the alleged benefits of stretching exercises on performance parameters and prevention of sports injuries have been questioned in many studies (Nelson et al., 2005). In our study (BR, SWR & ER), no significant difference was found in flexibility tests (p>.05). In a study on flexibility performance of athletes during Ramadan, it was shown that fasting decreased the flexibility performance of professional football players. In other studies, similar to our findings, it is seen that flexibility performance is not affected in Ramadan (Zerguini et al., 2007; Torlak & Atici, 2021; Roy & Bandyopadhyay, 2015).

In line with the data obtained, it was observed that the values of 30m sprint tests (U=855, p=.204) of professional taekwondo athletes before (BR), during (SWR) and after (ER) Ramadan were not significant. Zerguini et al. (2007), one of the studies supporting our data in the literature, reported that there was no significant change in the sprint performance of professional football players during Ramadan (Zerguini et al., 2007).

It is known that vertical jump height is the most important parameter in determining lower extremity explosive performance in athletes. This jumping ability in athletes also brings physical success (Buchheit et al., 2010; De Villarreal et al., 2011). It was observed that there was no change in anaerobic performance of the athletes during Ramadan thanks to their daily sleep duration and body composition (Karli et al., 2007). In this study, no significant difference was found in the vertical jump strength (U=950, p=.614) tests of professional taekwondo athletes before (BR), during (SWR) and after (ER) Ramadan (p>.05).

However, studies in the literature on exercises performed during Ramadan have concluded that fasting before exercise causes a decrease in athletic performance (Chtourou et al., 2011; Wilson et al., 2009; Meckel et al., 2008). It is thought that exercising in the evening (18:00) during the month of Ramadan may cause a decrease in performance because of the feeling of fatigue at a higher level in this month and because they have not taken more than 10 hours of food and fluid. In the literature, it has been observed that the exercises performed in the evening during the month of Ramadan tire the athletes physically and mentally more than the same exercise performed at any other time of the day (Chtorou et al., 2012; Waterhouse et al., 2009). It can be thought that the partial deterioration in the physical performance of the athletes may be due to their mood and low motivation. In studies conducted on different sports branches, there are studies showing that fasting in Ramadan has a significant effect on physiological balance such as daily energy needs, sleep duration and fluid balance

(Bouhlel et al., 2006; Hamouda et al., 2012; Chennaoui et al., 2009). However, it is also possible to find studies arguing the opposite (Kordi et al., 2011; Karli et al., 2007; Maughan et al., 2008).

Conclusion

As a result, in the light of the findings obtained from our study, we can say that athletes' not being fed for a long time in Ramadan does not have a positive or negative effect on many performance characteristics. According to this behavioural model of the coaches, the change in the sportive performance of the athletes may be due to other reasons and in order to eliminate these reasons, it is extremely important for the coaches to make changes in the training time and programme according to the current situation of the athletes. In the future studies, more subjects and physiological test parameter data are needed to determine the athlete performance levels in this month for the measurements to be made during Ramadan. We also think that the follow-up of the performance levels of athletes after Ramadan will be effective.

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