



The Effect of Ramadan Fasting on Some of the Physical Fitness and Skill Indices of Female Volleyball Players

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ARTICLE INFO	ABSTRACT
<i>Article type:</i> Research Paper	Introduction: This study aimed to evaluate the effect of Ramadan fasting on some female volleyball players' physical fitness and skill indices.
<i>Article History:</i> Received: 30 Jan 2023 Accepted: 03 Apr 2023 Published: 08 Apr 2023	Methods: This study was conducted on 49 female volleyball players with at least three years of regular participation in sports activities who participated voluntarily and objectively. Participants were divided into fasting and non-fasting groups. The participants performed muscular strength and power, agility, reaction time, skills, and perceived exertion tests during four sessions before fasting, two weeks after fasting, and two weeks following recovery. T-test was used for data analysis.
<i>Keywords:</i> Ramadan Fasting Fitness Skill Understanding effort	Results: The perceived exertion increased following one day [$p=0.001$] and two weeks of fasting [$p=0.000$], and agility decreased following two weeks of fasting [$p=0.028$], while other variables did not significantly change during repetitive measurements. Conclusion: Some physical fitness indices decreased in athletes, and perceived exertion increased during fasting. Thus, athletic competitions are not recommended during Ramadan fasting.

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Introduction

Ramadan fasting is a religious duty and belief obligatory for all healthy and adult Muslims. Changing lifestyle during Ramadan, such as reducing the number and changing the time of meals, changes in the pattern and duration of sleep, and the amount of energy received, may cause changes in daily physical activities [1, 2]. Fasting decreases weight, lean body, and fat content in trained and untrained individuals. The effects of fasting on physical performance indicators are unclear. Some reports have stated a decreased performance, while others found no significant impact [3]. These conditions are more prominent in sports, so many athletes and sports teams stop their training or reduce its intensity [1]. Athletes, trainers, and even doctors often believe athletes face difficulties performing exercises during fasting and can perform physical activity [4]. Ramadan causes changes in eating habits and lifestyle, so sports activity should be reduced this month [1]. However, some studies have suggested that it might enhance physical performance and body composition [3].

In addition, Ramadan fasting is associated with lifestyle changes such as sleep duration and quality and day-night changes in internal body mechanisms, which can affect people's mental health and mood levels differently and reduce the optimal sports performance of an athlete [5]. Seasonal climate changes and length of days lead to many physiological differences in Ramadan and between countries in one year, which can affect sports performance differently [6]. One study indicated that reducing the amount and time of access to energy sources due to fasting and physical exercises during fasting can affect physical fitness functions such as strength, power, speed, agility, endurance, and flexibility. Adaptability, reaction time, and the perception of effort and skills of athletes probably have different effects [7]. However, this study was related to non-Ramadan fasting, which is entirely different.

It is necessary first to have proper physical fitness, meet the energy and fuel needs, and then quickly restore resources and rehydrate appropriately during and after each training session for optimal performance [8]. All these

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factors may change under the influence of fasting and reduce access to energy sources, including the depletion of blood sugar and glycogen reserves. At the same time, it has not been approved yet. With the lack of carbohydrate reserves, fatigue occurs, accompanied by the cessation of activity or a significant reduction in exercise intensity [9]. A decrease in blood sugar causes fatigue, dizziness, hunger, weakness, and a drop in sports performance [8] because the steps that limit the rate of oxidation and slower ATP production potentially prevent the use of fat as a fuel source at higher speeds and affect the intensity and duration of sports activity [10].

Some available studies related to the effects of Ramadan on sports performance have shown conflicting results. Changes in sleeping habits, food, and fluid intake cause at least a series of impacts on sports performance [11]. However, some studies have shown a small or insignificant decrease in performance [1,12].

For example, significant disorders in physical fitness and other factors due to fasting were shown [6,13,14]. The time of maximum running speed, vertical jump [6, 15], muscle strength [13, 14, 16], and performance during endurance exercises [13, 15, 17] reduction has been found during Ramadan.

On the other hand, it has been reported that fasting does not affect the physical performance of athletes [1,12] and does not have a negative impact on people who do aerobic exercise. Fasting does not affect the ability of non-professional athletes to perform sports exercises [18], and Vo_{2max} after seven days of fasting does not change [19]. In the 2007 World Wrestling Championships in Baku, Murad Gustilo, the wrestler of the Russian team, won the gold medal by defeating all competitors while fasting [20]. As far as the physical condition of the athletes is concerned, reducing the amount and time of food and liquid intake during fasting seems to have had no effect.

According to the previous studies, the existence of unequal fasting periods, varied eating habits of iftar due to cultural differences, and the difference in the weather conditions of Ramadan in the different seasons can influence the findings. However, no study was found on women. Since fasting is stopped during monthly menstruation, a shorter fasting period can have different effects. Therefore, studies on the impact of two weeks of fasting, which is usually the

minimum fasting period, seems necessary. In addition, the current research aimed to answer whether two weeks of fasting and recovery after Ramadan and fasting affect female volleyball athletes' physical and skill performance.

Materials and Methods

This semi-experimental and applied study evaluated the effect of fasting on the factors of physical fitness and skill of female volleyball players. Therefore, the study included fasting and non-fasting female volleyball players. Forty-nine female volleyball players participated in this study voluntarily and purposefully. The inclusion criteria were not using any medicine or food supplement, non-smoking, having at least three years of regular weekly exercises, fasting consecutively in the first two weeks of Ramadan, eating Iftar and Sahar meal, and having at least six hours of sleep at night. The exclusion criteria were not regular participation in testing sessions or not continuing fasting for any reason in the fasting group. In the next stage, the subjects who met the inclusion criteria were divided into two fasting [$n=12$] and non-fasting groups [$n=15$] [21]. The fasting group fasted throughout the month of Ramadan except during menstruation. The non-fasting group did not fast during Ramadan due to special conditions that did not affect the research results. In this research, the exercises of the volleyball team continued as usual [two sessions a week for about two hours], and the researcher made no changes. The first, second, third, and fourth tests were conducted before, after one day of fasting, two weeks after, and two weeks after recovering. The tests were performed outside the period of menstrual pain and conducted from three to five in the afternoon, similarly for all test sessions.

The height was measured using a JC5525 tape measure made in America with an accuracy of 4mm. Air temperature and humidity were measured using a Thermometer made in Iran in each session, and the conditions were similar. Since the amount of weight changes can refer to the amount of body water changes [6], the weight before and after each session was measured using a Beurer digital scale made in Germany with an accuracy of 100g.

Strength was measured using a hand-held dynamometer device (made in Korea, model DHD-3). The subject held the dynamometer in one of her hands so that the hand aligned with

the arm and hung next to the thigh. The participant displays her maximum power by pressing the dynamometer without moving her hand [22].

Muscle power was measured using the long jump and Sargent's jump test. Based on the extended jump test, the subject is placed behind the starting line. The participant throws herself forward and up to cover the most significant distance. The closest point of each body part to the starting line is recorded as a record. Based on Sargent's jump test, The subject stands side onto the wall, keeping both feet on the ground, reaches up as high as possible with one hand, and marks the wall with the tips of the fingers (point 1). From a static position, the subject jumps as high as possible and marks the wall with the chalk on his fingers (point 2). This action was repeated thrice, and the best record was recorded [22].

Agility was measured using the zigzag test and a zigzag jump board with a height of 31cm, a width of 4cm, and a length of 4m. The subject jumps in one stage based on eight pairs of back and front jumps from boards with a height of 20cm, a width of 4cm, and a distance of 10cm on the sides of the obstacle and rests for 10s between each stage [23].

The reaction time was measured using the Nelson Hand Reaction Test with a 50cm metal ruler. The subject sits with the hands on the table. The participant takes the ruler that is released between her fingers. The end edge of the ruler (zero degree) is right in front of the examinee's thumb and forefinger. The centimeter value taken from the upper edge of the fingers on the ruler determined the result [22].

Russell and Long service test was used to measure technical skill. The participant was placed at the desired point to serve and sent ten balls to the marking points with a technique. In

this test, the field areas have different issues, and the player's ability to target other regions and score is the criterion [22].

Burke's scale was used to determine the level of players' perception of effort, with a range of one to ten. The subject is classified based on a relative scale of 10 points that measures the amount of action in a range of 0 to 10. The participant announces a number according to her feelings about the test. The closer the number is to 10, means that the test is perceived as more complex, and the subject feels the need for more effort [24].

Statistical Analysis Method

Descriptive statistics (mean and standard deviation) were used to describe variables. Shapiro-Wilk test was used to evaluate the normality of the distribution of findings. Regarding the normal distribution of results, T independent test was used to compare variables between the two groups. Data analysis and processing were performed in SPSS software version 21, and the significance level was set as 0.05.

Results

Table 1 shows the results of a general descriptive statistical analysis. The differences between the fasting and non-fasting groups were examined with T independent test [Table 2], according to the observed t values and significance levels $P < 0.05$. The results showed a significant difference in the perception of effort related to one exercise session. The second and third sessions [$P = 0.001$, $t = 3.738$] and two weeks of fasting [$P = 0.000$, $t = 4.332$] were significantly different. This means that fasting for one day and two weeks increases the perception of athletes and their efforts after a session of sports activities.

Table 1. General descriptive statistical analysis of the fasting and non-fasting groups

Groups	Age (yrs)*	History Sports(yrs)*	BMI (kg/m ²)*
Fasting	29±7.3	6.6±2.8	23±3.7
non-fasting	30±5.1	7.5 ±4.5	23±4.7

*Mean ±Standard deviation

A comparison of the agility record [Table 2], based on observed t values and significance levels, indicated that agility significantly differed between fasting and non-fasting athletes in the third session. In other words, after two weeks of fasting, agility significantly differed between

fasting and non-fasting athletes [$P = 0.028$, $t = 2.330$], and no significant difference was observed in other sessions. This means that fasting for two weeks reduces the agility of athletes.

There was no significant difference between fasting and non-fasting athletes based on hand strength, muscle power [Sargent's jump and long

jump], reaction time, service skill [Table 2 observed t values, and the corresponding significance levels [$P > 0.05$].

Table 2. One-way analysis of variance test results of fasting and non-fasting female volleyball players

Tests	groups	first session	second session	third session	fourth session
Understand the effort	Fasting (mean \pm SD)	2.08 \pm 1.08	6.33 \pm 1.4	6.58 \pm 1.7	3.68 \pm 1.8
	Non-fasting (mean \pm SD)	3.13 \pm 2.6	3.2 \pm 2.6	2.87 \pm 2.5	3.07 \pm 2.4
	t value	1.312	3.737	4.332	0.708
	p value	0.201	0.001	0.000	0.485
Agility record (s)	Fasting (mean \pm SD)	106.5 \pm 14.2	121.5 \pm 13.9	124.92 \pm 12.3	106.5 \pm 12.8
	Non-fasting group (mean \pm SD)	104.67 \pm 28.2	112.27 \pm 11	104.33 \pm 28.4	111.53 \pm 13.1
	t value	0.202	1.922	2.330	1.084
	P value	0.841	0.066	0.028	0.288
hand strength (kg)	Fasting (mean \pm SD)	69.08 \pm 19.2	66.67 \pm 20	70.67 \pm 20.2	70.41 \pm 19.7
	Non-fasting (mean \pm SD)	61.07 \pm 15.2	61.87 \pm 14.6	62.93 \pm 14.7	63.2 \pm 14.9
	t value	1.207	0.719	1.151	1.080
	P value	0.238	0.478	0.26	0.29
muscle power (Sergeant) (cm)	Fasting (mean \pm SD)	25.83 \pm 6.2	26.25 \pm 6.1	25.25 \pm 6.8	26.67 \pm 6.8
	Non-fasting (mean \pm SD)	24.27 \pm 5	24.53 \pm 5.6	24.27 \pm 6	24.93 \pm 5.7
	t value	0.228	0.0756	0.396	0.718
	P value	0.478	0.456	0.695	0.479
muscle power (Long Jump) (cm)	Fasting (mean \pm SD)	154.25 \pm 21.8	155.17 \pm 24	158.08 \pm 26.3	158.08 \pm 25.2
	Non-fasting (mean \pm SD)	160.2 \pm 11.6	160.4 \pm 12.9	161 \pm 11.9	160.53 \pm 11.9
	t value	0.853	0.723	0.378	0.333
	P value	0.372	0.476	0.704	0.741
reaction time (s)	Fasting (mean \pm SD)	9.79 \pm 2.9	9.17 \pm 2.3	7.92 \pm 1.9	7.62 \pm 2.1
	Non-fasting (mean \pm SD)	9.7 \pm 2.7	9.47 \pm 3.1	8.7 \pm 2.9	8.4 \pm 2.8
	t value	0.083	0.277	0.784	0.788
	P value	0.933	0.784	0.44	0.438
Service skill	Fasting (mean \pm SD)	31.08 \pm 9.7	31.92 \pm 10	32.58 \pm 11.5	2.83 \pm 11.8
	Non-fasting (mean \pm SD)	32.8 \pm 6	33.13 \pm 6.2	32.73 \pm 6.1	32.87 \pm 6.9
	t value	0.844	0.387	0.044	0.000
	P value	0.578	0.702	0.966	0.993

Non-fasting subjects showed no significant change in their weight or water loss in any of the

four stages while fasting subjects showed significant weight loss in all four stages [Table 3].

Table 3. Weight changes of subjects by group

Variable	groups	Number	Mean	standard deviation
The first session before the exam	Fasting	12	68.5	11.75
	non-fasting	15	70.99	28.29
The first session after the exam	fasting	12	67.87	11.86
	non-fasting	15	70.84	28.26
The second session before the exam	fasting	12	68.51	11.76
	non-fasting	15	71	28.31
The second session after the exam	fasting	12	67.67	11.86
	non-fasting	15	70.78	28.32
The third session before the exam	Fasting	12	68.3	11.79
	non-fasting	15	71.03	28.23
The third session after the exam	fasting	12	67.52	11.93
	non-fasting	15	70.78	28.22
The fourth session before the exam	fasting	12	68.1	11.67
	non-fasting	15	70.9	28.23
The fourth session after the exam	fasting	12	67.42	11.82
	non-fasting	15	70.75	28.15

Discussion

In this study, the effect of fasting for two weeks of the month was compared in two groups of

female volleyball athletes, including fasting and non-fasting. The tests were conducted one day before Ramadan, after one day of fasting, after

two weeks of fasting, and two weeks after the end of Ramadan. The factors of physical fitness, rate of perceived exertion, and service skills were evaluated. Compared to the non-fasting group, the perceived effort after one day of fasting, agility, and perceived step after two weeks were significant. The skill of fasting female volleyball players decreased after one day and two weeks of fasting compared to before and after Ramadan. In addition, the rate of perceived exertion after one day of fasting and two weeks of fasting compared to before and after Ramadan had increased. The rest of the results were not statistically significant.

This study indicated that during Ramadan fasting, perceived exertion was higher while agility was lower than in non-fasting situations. Perceived exertion is used to determine the intensity of exercise [25], and the present study shows that fasting increased perceived exertion. The ability to perform activities without feeling tired, meet energy and fuel needs, and then quickly restore resources and rehydrate appropriately after each training session is essential for optimal performance [8]. Fasting can change all these factors can change under the influence of fasting.

This finding is consistent with the results of the research of Güvenç [26] and Chennaoui et al. [17], who observed fatigue due to the sleep-wake cycle during Ramadan. Sleep duration is reduced due to the large amount of food eaten at night and the social and religious events that occur during the night. Research has shown that sleep deprivation negatively affects physical performance, especially in tests taken in the afternoon [27, 28]. On the other hand, the results are inconsistent with those of Leiper et al. [29] and Zerguini et al. [30]. Most observers have used the Borg rating of perceived exertion, and with one exception, Ramadan appears to have not affected perceived effort. Twenty minutes post-exercise, Leiper et al. [28] and Zerguini et al. [30] compared formal ratings of perceived exertion and subjective impressions of the difficulty of training between 48 soccer players in Ramadan and 31 that did not they found no inter-group differences. The difference in the physical fitness of the subjects and the players' many years of experience and the gender and the model of the exercises and the type of sports can explain the reasons for the disparity between this and current research results.

This research investigated the effect of fasting on the players' reaction time. The results obtained in this study indicate that with 99% certainty, fasting for two weeks has decreased agility. Agility is an ability that enables a person to quickly change body posture and direction of movement while maintaining balance in space. Many factors influence agility, such as movement speed, reaction time, balance, neuro-muscular coordination, vision, and the necessary awareness [22]. This research shows that fasting has significantly impacted agility. This finding is consistent with the research results of Shephard [7], Chtourou et al. [13], Bouhlel et al. [14], and Memari et al. [31]. Although some studies have revealed no significant changes due to fasting, fasting affects short-term repetitive and maximal exercises [such as the Wingate test] and long-term activities in general [6]. The agility test also had six consecutive stages, which led to a decrease in agility during fasting. On the other hand, the research results are inconsistent with the results of Aziz et al. [32]. The reason for this inconsistency can be in the quality and quantity of food. In both of these studies, the researcher suggested that the proper control of nutrition and the regularity of exercise were the main factors in preventing the negative impact of fasting on the subjects. In the present study, the activities were regular. Though the players' nutrition was controlled to some extent [including the requirement to eat breakfast], it was impossible to monitor the quality and quantity of nutrition. This shows that the influence of food can be significant.

In the present study, the effect of fasting on the hand strength of players was investigated, and it was found that fasting did not significantly impact strength and power. Strength can be defined as the neuromuscular capacity to overcome external and internal resistance [33]. Demonstrating maximum strength depends on three factors: muscle capacity, use of muscle capacity, and technique [34]. Therefore, fasting has not negatively affected these three factors, and the training experience probably led to maintaining strength during fasting. This finding is consistent with the results of Bouhlel et al. [13] and Aziz et al. [32]. The subjects of these studies were all athletes, except for the investigation by Aziz et al., who were also teenagers, and age may be a factor in maintaining strength capacity. On the other hand, the research results are

inconsistent with those of Shepard's [7]. Since fasting did not significantly affect the performance of ordinary people in Shepard's research, this disparity could be the lower intensity and duration of exercises in this research [two sessions per week] compared to Shepard's research. This may indicate the existence of a threshold for performing sports exercises and fasting at the same time. Power is the ability of a person to use maximum power in the shortest possible time, and in a simpler concept, the ability to use power at speed can be called power [22]. Fasting did not negatively affect the ability to use power at speed. This finding is consistent with the results of Bouhlef et al. [14], Memari et al. [31]. Previous professional training experience can play a role in maintaining muscle strength, as well as strength. It is also generally accepted that short [e.g., squat jump, deadlift, maximal voluntary contraction, etc.] or very short-term [e.g., maximal running speed in 5, 10, and 20m, etc.] does not decrease during the month of Ramadan [6]. On the other hand, the results are inconsistent with Shepard's [7] and Chennaoui et al. [17] results. The reason for this can be the difference in the subjects' exercise type. Volleyball is an anaerobic sport, and although aerobic exercises are used simultaneously with non-anaerobic exercises in most volleyball team exercises, the load on the runner's Semi-endurance will be more during Ramadan, causing a higher physical loss and decrease their strength.

The present study investigated the effect of fasting on players' reaction times. Based on the results of this study, no significant impact on reaction time was found in any of the test sessions. Reaction time is the time interval between receiving stimulation by the organ and the action of responding [22]. Factors involved in this case include the intensity of stimulation, the sensory nerves of the stimulated organ, the motor nerves of the responsive organ, exercise, fatigue, motivation, and the individual's health status. The present research showed that implementing activities during fasting does not reduce the reaction time of the investigated players and does not significantly affect its related factors. Lotfi et al. observed no significant effect even though the reaction time test was performed after running for one kilometer [35]. These results were inconsistent with those of

Chennaoui et al. [17]. The reason for this can also be the characteristics of volleyball. The Chennaoui et al. participants were middle-distance athletes and found that significant metabolic, hormonal, and inflammatory changes accompanied Ramadan fasting. Sleep disturbances, energy deficiency, and fatigue during Ramadan fasting could decrease physical performance in Muslim athletes who maintained training [17]. In the present study, fasting did not significantly affect service skills in test sessions. Nobari et al. found that most sporting activities were performed at any time of the day without being affected by Ramadan fasting. Athletes could participate in their physical activities during fasting periods and saw few effects on their performance [36]. Skill is the ability to achieve a particular result confidently and spend minimal energy or time [37]. In this study, fasting did not have a negative effect on the subjects' skills. This finding aligns with the research results of Meckle et al. and Bezuglov et al. [38, 39]. In addition, some studies have shown that the restrictions on diet and liquid intake during the Holy Month of Ramadan had no negative influence on the running performance of elite Muslim professional adult soccer players during daytime matches [39].

Reducing the amount and time of access to energy sources due to fasting, along with physical exercises during fasting, can affect the physical fitness and skills of athletes [7], but the players' many years of experience probably led to maintaining their skills during fasting.

Other results of this study were related to the weight change of participants. Since weight changes can refer to changes in body water [6], examining the weight and amount of water lost by the subjects did not show any significant difference in all four stages in the non-fasting group. However, the weight loss in the fasting group was significant. The psychological effects of fasting and the nutritional habits caused by consecutive fasting during Ramadan decreased water consumption before and after the month. Due to the limitations of the current research, the players' nutrition was controlled to some extent (including the requirement to eat breakfast), and it was impossible to monitor the quality and quantity of food and drinks received. This decrease in body water can be one of the practical reasons for the significant changes in the results of endurance tests, but based on the

fact that this weight loss was significant in all four test sessions, it is clear that more research is needed on the effects of physical fitness on body water and weight loss.

Conclusion

Based on the results, fasting during Ramadan does not affect everyone similarly. Perhaps the adaptation and resistance to physiological and psychological disorders caused by fasting in Ramadan and the type, intensity, and timing of Ramadan throughout the year have different results. However, fasting does not significantly affect static functions such as hand strength, reaction time, and service skills, as well as tasks with deficient mobility, such as the standing jump or long jump (power). However, the effect became significant with increased physical activity and changing the activity towards aerobics (such as agility according to the current research method). The level of perceived exertion was also affected by fasting.

Therefore, dynamic and long-term competitions should not be held during fasting [especially when Ramadan is in the hot season and with extended hours]. Thus, performance changes will not occur by maintaining the energy intake, water consumption, and training load, or the difference will be minimal.

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Conflicts of Interest

There was no conflict of interest to be declared.

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