

Effect of Ramadan Fasting on Body Composition and Physical Performance in Female Athletes

Amir-Hossein Memari^{*1}, MD; Ramin Kordi^{1,2}, MD, PhD; Nekoo Panahi²; Laya R. Nikookar²; Mohammad Abdollahi²; Ali Akbarnejad³, PhD

Authors' Affiliation:

1. Sports Medicine Research Center, Tehran University of Medical Sciences, Tehran, Iran
2. School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
3. Faculty of Sports Sciences and Physical Education, University of Tehran, Tehran, Iran

* Corresponding Author;

Address: Sports Medicine Research Center, No 7, Al-e-Ahmad Highway, Tehran, P.O Box: 14395-578 Iran

E-mail: sportpsych@tums.ac.ir

Received: May 09, 2011

Accepted: Jul 15, 2011

Key Words: Body Composition; Female Athletes; Performance; Ramadan Fasting

Abstract

Purpose: The aim of this study was to determine the effect of Ramadan fasting on body composition, calorie intake and physical performance in young female athletes undertaking training sessions during Ramadan.

Methods: Twelve voluntary female athletes (15-27 years old) were assigned to the research. A prospective study was conducted to investigate the athletes on four different occasions: one week before Ramadan (T1), the second (T2) and fourth (T3) weeks of Ramadan, and two weeks after the end of Ramadan (T4). Food intake, body composition and physical performance (agility, balance and explosive leg power) were investigated on each occasion. Further, Physical performance was assessed by agility, vertical jump and balance tests.

Results: There was a significant main effect for time for body composition indices. A significant decrease was observed in weight ($P=0.01$) and body mass index (BMI) ($P=0.01$) in T2 compared with T1, further decrease in weight ($P<0.001$) and BMI ($P<0.001$) was observed in T3 compared to T1. Calorie intake decreased significantly in T3 compared with T1 ($P=0.008$), and increased significantly in T4 compared with T3 ($P=0.04$). There was a significant main effect for time for agility performance ($P=0.03$), but no significant main effect for time was observed for vertical jumping ($P=0.1$) and balance performance ($P=0.3$).

Conclusions: This study has found that Ramadan fasting could affect the body composition, but not physical performance in female athletes during Ramadan.

Asian Journal of Sports Medicine, Volume 2 (Number 3), September 2011, Pages: 161-166

INTRODUCTION

Ramadan is a special religious month of Muslim calendar which offers a holistic change in life style including dietary habits, sleep patterns and the way of daily life and social activities. Every volunteer should stay committed for a long time to the rules as well as rituals during Ramadan. Daily fasting time

varies from 10 to 18 hours^[1,2] according to the time of the year that Ramadan occurs as well as the geographical location^[3]. Change in eating habits during Ramadan is in the form of reduction in frequency of food and fluid intake, and increased tendency to consumption of higher calorie foods and drinks^[4,5]. Change in lifestyle may lead to nocturnal sleep reduction^[6,7] followed by an increase in daytime

sleeping [7]. Further findings indicated that there is also an alteration in sleep parameters attributed to the inversion of drinking and meals schedule [8].

Investigations of the energy intake and body composition changes during the month of Ramadan showed different findings which may be due to different nutritional customs and habits and also the length of fasting [9-16].

In recent years, there has also been an increasing interest in investigation of physical performance as a functional index in Ramadan. Several researches conducted in athletes showed that only a few aspects of physical performance compromised during Ramadan [9,17,18]; aerobic exercise at submaximal level had no adverse effect on physical and physiological factors [19]; and sprinting and agility performance were mostly intact during Ramadan [20-22].

However, a general decrease in fitness and sport measurements was observed in some published studies [23,24]. It was concluded that actual and perceived physical performances were affected by the phase shift of food intake and disruption of sleep patterns [23]. Deterioration in VO₂ max, and impaired ability to perform exercise at 75% Vo₂max was observed in similar researches [21,22]. Some authors [25,26] have speculated that this observed alteration could be attributed to sleep loss which has an indirect effect upon physical performance via changes in mental performance. Moreover, subjective feelings like fatigue and other mood indicators are often cited as implying additional stress on the athletes throughout Ramadan. However, it has been noted that these measures may not lead to a drop in performance [27]. It is not completely clear whether intermittent periods of fasting have any effect on competitive sports performance.

Knowing that the 2012 Olympics Games in London will occur over Ramadan; besides the fact that Muslim athletes will continue to train and compete during Ramadan, there is an emergent need for examining how different athletic aspects are affected during Ramadan.

In spite of several investigations on the nutritional, metabolic, body composition and performance alterations in male athletes during the month of Ramadan, to our knowledge, none have investigated the responses in young female athletes who continue

the sports activities throughout this period.

The aim of this study was to determine the effect of Ramadan fasting on body composition, calorie intake, and physical performance in female taekwondo players undertaking training sessions during Ramadan.

METHODS AND SUBJECTS

Participants:

Twelve female taekwondo players (15-27 years old) affiliated to a professional club, volunteered to participate in this study. After receiving a full description of the protocol, each volunteer provided written informed consent. The athletes were in good mental and physical condition and were not taking any medication. None of them were menstruating on test sessions. Participants were involved in 4-5 training sessions (60 minutes) each week before Ramadan; and they followed their normal schedule during Ramadan. The study was conducted in Tehran, Iran, in 2009 when Ramadan occurred between August 22nd and September 20th. The average duration of the fast was about 14 hours. The study was reviewed and approved by the local research ethics committee.

Experimental Design:

All the measurements were made on four different occasions: one week before Ramadan (T1), the second (T2) and fourth (T3) week of Ramadan, and two weeks after the end of Ramadan (T4). Food intake, anthropometric measurements, body composition and physical performance were investigated on each occasion. The tests were performed between 4 PM and 6 PM, in the motor behavior laboratory of Tehran University. The temperature was set at 25°C. All assessments were performed under identical laboratory conditions and by the same examiners in each occasion.

Body Mass and Dietary Intake:

At the beginning of each session weight (by a Seca mechanical dial scale), height (by a Seca 213 stadiometer) and waist-to-hip ratio were measured after

voiding. Body mass index (BMI) was calculated using the standard formula: weight (kg)/height² (m²).

Each player was requested to keep three-day records of food intake and activity patterns; athletes recorded the approximate quantities of all food and beverages consumed, expressed in household measures, for three consecutive days, including a weekend day. The data were analyzed by Food Processor II software (Nutrition System, ESHA Research). Thereafter, daily calorie intake was extracted.

Physical Performance Assessment:

Physical performance was assessed by agility, vertical jump, and balance tests. Before starting the tests, the participants warmed up for 10 minutes. Various tests were performed with 3 to 5 minute intervals of active resting.

Agility was measured using a side-stepping test. The test utilized Dig Side Stepping Counter BS-2 (TAKEL). The participants started from midline on the command of the examiner. They were to step on the sidelines. Each stepping sidelines and passing the midline was counted. If the athlete did not pass the sidelines it was considered an error and was finally reduced from the counts. This procedure was performed twice with a 5 minute interval. The best performance was recorded.

Explosive leg power was determined using a Vertical Jump test (Takei digital vertical jump). Participants began in a standing in lateral position with their hands outstretched on the plate attached to the wall, and moved into a semi-squat position immediately followed by a maximum jump to touch the highest point on the plate which was attached to a digital sensor in order to immediately show the exact jump height. Three trials were completed and the highest jump was recorded.

Stand stork test was used to assess the ability to maintain balance. Participants placed their hands on the hips and positioned the non-supporting foot against the inside knee of the supporting leg, and then they raised the heel to maintain balance on the ball of the supporting foot. The time the player is able to maintain this position is calculated. Any changes of the position, including loss of contact of hands with the hip and non-supporting foot with the knee, or contact of the heel of the supporting foot with the floor is assumed the end of the test.

Statistical Analyses:

Continuous data were summarized by descriptive statistics (mean and standard deviation). Changes over time were analyzed by repeated-measures analysis of variance with week as the repeated factor using statistical package software SPSS 17. P-values less than 0.05 were considered significant. Bonferroni correction was performed where applicable.

RESULTS

A total of 12 female athletes aged 20.7 (±3.9) were assigned to the study. Table 1 shows the descriptive data and the levels of significance for the anthropometric measurements during Ramadan fast. There was a significant main effect for time on body composition indices. Results on weight and BMI showed a significant decrease (1190g) in weight [*P*=0.01, 95% confidence interval (^{95%}CI): 0.5-3.2] and BMI (*P*=0.01, ^{95%}CI: 0.4-1.4) in the 2nd week of Ramadan compared to the baseline, further decrease in weight (*P*<0.001, ^{95%}CI: 0.3-2.5) and BMI (*P*<0.001,

Table 1: The effect of Ramadan fasting on anthropometric measures

Parameters	Pre-Ramadan	2 nd week	4 nd week	Post-Ramadan	P value
Weight (Kg)	56.41 (5.81)	55.22 (5.83) *	54.78 (5.83) ‡	55.43 (5.27)	<0.001
BMI (Kg/m²)	21.82(1.92)	21.35 (1.82) *	21.18 (1.78) ‡	21.46 (1.56)	<0.001
Waist to hip ratio	0.75 (0.05)	0.74 (0.05)	0.75 (0.04)	0.79 (0.07)	0.01

BMI: Body Mass Index; * Pre-Ramadan vs. 2nd week, *P*<0.05, ‡ Pre-Ramadan vs. 4th week, *P*<0.05

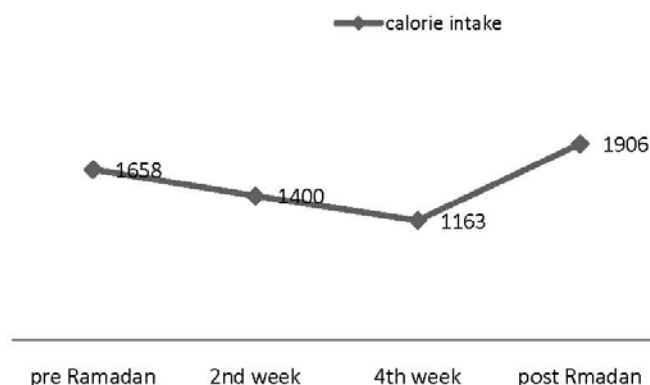


Fig. 1: Mean values for calorie intake (kcal/day) measured during the study

^{95%}CI: 0.6-1.3) was observed in the 4th week of Ramadan compared to pre Ramadan occasion. There was also a significant main effect for time on WHR ($P=0.01$); posthoc analysis revealed that WHR has increased marginally after Ramadan compared to the 2nd week of Ramadan ($P=0.06$).

Fig. 1 shows the data for calorie intake across the occasions. There was a significant main effect for time ($P=0.01$). Calorie intake decreased significantly in the 3rd occasion (4th week of Ramadan) compared with pre-Ramadan ($P=0.008$, ^{95%}CI: 155.3-567.5) and increased significantly in post Ramadan compared to the 3rd occasion ($P=0.04$, ^{95%}CI: -815.3:-50.3).

DISCUSSION

While the London 2012 Olympics Games will occur over Ramadan and many Muslim athletes (males and females) won't give up fasting, very little was found in the literature on the questions about female athlete's alterations during Ramadan. Overall results indicated

that weight and BMI decreased significantly during Ramadan compared with pre Ramadan; WHR showed a decreasing trend in 2nd week of Ramadan compared to the baseline but increased significantly in post Ramadan. The present findings seem to be consistent with other research which found a decrease in body weight in healthy women [1]. It has been suggested that this decline in body weight could be attributed to a decrease in fluid intake and hypohydration with little loss of body fat.

Ramadan fasting is characterized by alterations in meal schedule and frequency. Meals are exclusively nocturnal and less frequent; hence this may affect energy and nutrient intake. Accordingly, current findings showed that total calorie intake was significantly decreased in Ramadan compared with pre-Ramadan period.

However, our results did run contrary to previous findings in male athletes, which showed that the total energy intake remained unchanged in Ramadan [28,29], these studies indicated a varying degree of weight loss in their participants as well. This finding may be explained by the fact that players continued training and activity schedules in addition to experiencing a

Table 2: The effect of Ramadan fasting on test performance results

Parameters	Pre-Ramadan	2 nd week	4 th week	Post-Ramadan	P value
Agility (s)	45.67 (4.50)	49.00 (5.69)	48.00 (6.21)	48.54 (4.24)	0.03
Vertical jumping (cm)	33.00 (6.09)	34.00 (4.47)	34.75 (4.73)	32.58 (3.91)	0.1
Balance (s)	18.15 (14.63)	25.80 (26.70)	20.30 (21.34)	29.27 (35.57)	0.3

decrease in total calorie intake.

However, the findings of this study do not support some previous research which showed no body mass changes might be observable among athletes during Ramadan fasting [11,15]. It could be attributed to a common belief that athletes are likely to overcompensate their food and fluid intake during Ramadan fasting [30]. Hence they might experience an increase in total energy intake without changes in body weight.

Investigating athletes' measures in the post Ramadan period showed that current findings corroborate the ideas of Frost and Pirani [30], who suggested that body indices increased after Ramadan. It is difficult to explain this result, but it might be related to the increase in calorie intake after Ramadan.

On the question of physical performance, results indicated that there were no adverse effects imposed by fasting. Relative improvement in performance variables at the second time may be attributed to a training effect.

Current findings are consistent with those of other studies [17,18,28] and suggest that physical performance would not be adversely affected during Ramadan fasting. However some studies reported a significant decrease in athletic performance capacities [23] which is not necessarily related to changes in calorie intake and sleeping hours during the Ramadan fasting [2]. A possible explanation for this result is that the tests were performed in the same time of the day which they did their training sessions. Furthermore, players might show only slight alterations while they were examined in the afternoon which is considered the target time for peak of performance [18]. This could suggest the important role of habituating to training at a specific time of the day [6]. It seems possible that these results are due in part to the reduction in body mass, as the

performance tests used in our study may favor a lighter body mass.

All physical performance variables showed an improving trend at the second test session which might be attributable to familiarity with the test procedures and a training effect [18].

The study was limited in some ways; the project used a convenience sample without a control group. However, with a small sample size, caution must be applied as the findings might not be transferable to overall female athletes. Considerably more work will need to be done to determine psychophysical mechanisms underlying alterations and or compensations which might happen in athletes during Ramadan.

CONCLUSION

In conclusion, the current findings support the notion that fasting could affect the body composition, but not physical performance in female athletes who maintain their usual training during Ramadan. It seems possible that sportspeople can adapt to the changes at least partially.

ACKNOWLEDGMENTS

The study was approved by the Ethics Committee and human studies Review Board of Sports Medicine Research Center.

Conflict of interests: None

REFERENCES

1. Al-Hourani HM, Atoum MF. Body composition, nutrient intake and physical activity patterns in young women during Ramadan. *Singapore Med J* 2007;48:906-910.
2. Meckel Y, Ismaeel A, Eliakim A. The effect of the Ramadan fast on physical performance and dietary habits in adolescent soccer players. *Eur J Appl Physiol* 2008;102:651-7.

3. Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. *Nutr J* 2010;9:57.
4. Ziaee V, Razaee M, Ahmadinejad Z, et al. The changes of metabolic profile and weight during Ramadan fasting. *Singapore Med J* 2006;47:409-414.
5. Lamine F, Bouguerra R, Jabrane J, et al. Food intake and high density lipoprotein cholesterol levels changes during Ramadan fasting in healthy young subjects. *Tunis Med* 2006;84:647-50.
6. Chennaoui M, Desgorces F, Drogou C, et al. Effects of Ramadan fasting on physical performance and metabolic, hormonal, and inflammatory parameters in middle-distance runners. *Appl Physiol Nutr Metab* 2009;34:587-94.
7. Chaouachi A, Chamari K, Roky R, et al. Lipid profiles of judo athletes during Ramadan. *Int J Sports Med* 2008;29:282-8.
8. Haouari M, Haouari-Oukerro F, Sfaxi A, et al. How Ramadan fasting affects caloric consumption, body weight, and circadian evolution of cortisol serum levels in young, healthy male volunteers. *Horm Metab Res* 2008;40:575-7.
9. Hallak MH, Nomani MZ. Body weight loss and changes in blood lipid levels in normal men on hypocaloric diets during Ramadan fasting. *Am J Clin Nutr* 1988;48:1197-210.
10. Salehi M, Neghab M. Effects of fasting and a medium calorie balanced diet during the holy month Ramadan on weight, BMI and some blood parameters of overweight males. *Pak J Biol Sci* 2007;10:968-71.
11. Faye J, Fall A, Badji L, et al. Effects of Ramadan fast on weight, performance and glycemia during training for resistance. *Dakar Med* 2005;50:146-51.
12. Beltaifa L, Bouguerra R, Ben Slama C, et al. Food intake, and anthropometrical and biological parameters in adult Tunisians during fasting at Ramadan. *East Mediterr Health J* 2002;8:603-611.
13. Ramadan J, Telahoun G, Al-Zaid NS, et al. Responses to exercise, fluid, and energy balances during Ramadan in sedentary and active males. *Nutrition* 1999;15:735-739.
14. Waterhouse J. Effects of Ramadan on physical performance: chronobiological considerations. *Br J Sports Med* 2010;44:509-15.
15. BaHammam A. Assessment of sleep patterns, daytime sleepiness, and chronotype during Ramadan in fasting and nonfasting individuals. *Saudi Med J* 2005;26:616-22.
16. Roky R, Chapotot F, Hakkou F, et al. Sleep during Ramadan intermittent fasting. *J Sleep Res* 2001;10:319-27.
17. Chaouachi A, Coutts AJ, Chamari K, et al. Effect of Ramadan intermittent fasting on aerobic and anaerobic performance and perception of fatigue in male elite judo athletes. *J Strength Cond Res* 2009;23:2702-9.
18. Kirkendall DT, Leiper JB, Bartagi Z, et al. The influence of Ramadan on physical performance measures in young Muslim footballers. *J Sports Sci* 2008;26:S15-27.
19. Ramadan J. Does fasting during Ramadan alter body composition, blood constituents and physical performance? *Med Princ Pract* 2002;11:41-46.
20. Leiper JB, Watson P, Evans G, et al. Intensity of a training session during Ramadan in fasting and non-fasting Tunisian youth football players. *J Sports Sci* 2008;26:S71-9.
21. Wilson D, Drust B, Reilly T. Is diurnal lifestyle altered during Ramadan in professional Muslim athletes? *Biol Rhythm Res* 2009;40:385-97.
22. Sweileh N, Schnitzler A, Hunter GR, et al. Body composition and energy metabolism in resting and exercising Muslims during Ramadan fast. *J Sports Med Phys Fitness* 1992;32:156-63.
23. Zerguini Y, Kirkendall D, Junge A, et al. Impact of Ramadan on physical performance in professional soccer players. *Br J Sports Med* 2007;41:398-400.
24. Aziz AR, Wahid MF, Png W, et al. Effects of Ramadan fasting on 60 min of endurance running performance in moderately trained men. *Br J Sports Med*. 2010;44:516-21.
25. Stannard SR, Thompson MW. The effect of participation in Ramadan on substrate selection during submaximal cycling exercise. *J Sci Med Sport* 2008;11:510-7.
26. Reilly T, Waterhouse J. Sports performance: is there evidence that the body clock plays a role? *Eur J Appl Physiol* 2009;106:321-32.
27. Chaouachi A, Leiper JB, Souissi N, et al. Effects of Ramadan intermittent fasting on sports performance and training: a review. *Int J Sports Physiol Perform* 2009;4:419-34.
28. Zerguini Y, Dvorak J, Maughan RJ, et al. Influence of Ramadan fasting on physiological and performance variables in football players: summary of the F-MARC 2006 Ramadan fasting study. *J Sports Sci* 2008;26:S3-6.
29. Maughan RJ, Bartagi Z, Dvorak J, et al. Dietary intake and body composition of football players during the holy month of Ramadan. *J Sports Sci* 2008;26:S29-38.
30. Frost G, Pirani S. Meal frequency and nutritional intake during Ramadan: a pilot study. *Hum Nutr Appl Nutr* 1987;41:47-50.