SHORT REPORT

Impact of Ramadan on physical performance in professional soccer players

Yacine Zerguini, Donald Kirkendall, Astrid Junge, Jiri Dvorak

Br J Sports Med 2007;**41**:398–400. doi: 10.1136/bjsm.2006.032037

Objective: Ramadan is a period of daylight abstention from liquid or solid nutrients. As sports continue to be scheduled, an understanding of the effects of Ramadan on Muslim athletes is warranted.
Design: Two Algerian professional soccer teams (55 men) were studied. Field tests of physical and soccer performance were collected before, at the end and 2 weeks after Ramadan in 2004. Players were queried on sleeping habits and personal perception of training and match performance.
Setting: Field setting at club training ground.
Main outcome measures: Performance on fitness and skill tests.
Results: Performance declined significantly ($p<0.05$) for speed, agility, dribbling speed and endurance, and most stayed low after the conclusion of Ramadan. Nearly 70% of the players thought that their training and performance were adversely affected during the fast.
Conclusions: The phase shift of food intake and disruption of sleep patterns affect actual and perceived physical performance. Islamic athletes need to explore strategies that will maximise performance during Ramadan.

Soccer's popularity crosses geographical, political and religious boundaries. One of the major religions of the world is Islam, with over one billion people in multiple nations living under Islamic laws where soccer is one of the major spectator and participant sports.

The major religious period of the Islamic calendar is Ramadan, when healthy post-pubescent Muslims fast, without damaging their health, from sunrise to sunset for the 4-week period. Muslims are invited to abstain from all types of liquid or solid nutrient intake as well as all unhealthy or aggressive behaviour during this period of purification, internal meditation and regeneration.

Physiological and clinical effects of Ramadan on hormonal, metabolic and behavioural responses have been the focus of study. Limited data on physical performance show that submaximal factors (ie, heart rate) are affected little whereas maximal work declines.[1] Because football is contested internationally and matches continue to be scheduled during Ramadan, our aim was to learn how Ramadan affects the performance of competitive soccer players.

MATERIALS AND METHODS

The study was conducted in Algeria in 2004 when Ramadan occurred between 15 October and 13 November. Two professional teams consented to participate in the project. The total number of players who participated in the study was 55. The ethics committee of the state of Algiers approved the protocol. All players gave their signed, informed consent before participation in the project.

Field tests of fitness were conducted 2 days after a match at 14:00 h (typical match time). Explosive leg power was determined by the standing vertical jump. Agility was measured using the four-line test.[2] A dribbling test[2] was used as a test of soccer skill. Speed and acceleration were obtained by photoelectric cells during a 20 m sprint from a standing start. The sprint course had timing lights every 5 m. The fastest of three trials was reported in m/s. Endurance was measured using the 12 min run, with recovery heart rates monitored for 5 min.

Players were tested 2 weeks before the beginning of Ramadan, in the last week of Ramadan and 2 weeks after the end of Ramadan. The players were interviewed daily during the fast by one of two trained technicians regarding physical and emotional factors.

Continuous data were summarised by routine descriptive statistics. Changes over time were determined by repeated-measures analysis of variance (Geisser–Greenhouse correction) with Tukey's follow-up procedure using SAS JMP statistical software (Cary, North Carolina, USA). Nominal data from the interviews were summarised by frequencies. The significance level was set at 0.05.

RESULTS

Of the original 55 players, we had complete data on 48 (injuries or illness). The players averaged 72.6 (SD 5.8) kg in mass, 178.2 (6.1) cm in stature and were aged 17–34 years. Weight did not change over the course of the project.

Table 1 shows the descriptive data and the levels of significance for the performance data. In the fourth week of Ramadan, performance was reduced on a wide range of tests (20 m speed, speed dribbling, agility, endurance and recovery) and was below the initial values when tested 2 weeks after the end of the fasting period.

Table 2 lists descriptive information on subjective ratings regarding the fast. About 70% of players reported that the quality of their training was poorer during the fast, and just over 75% of the players thought that their match performance was reduced during the fast. Sleep volume was reduced by just over 30 min during Ramadan, but nearly three-quarters of the players said that the quality of their sleep was poorer than before Ramadan because the sleep cycle is disrupted to accommodate food intake.

Nearly one-quarter of the players thought that they ate more during Ramadan, whereas more than half perceived that they ate less. The players' estimate of food volume rebounded above pre-Ramadan values during the 2 weeks after the fast. An interesting finding was that the players believed they increased consumption of soft drinks during the fast.

Finally, a series of symptoms changed during the fast, especially an increase in headache and vertigo. In most cases, after the fast, subjective ratings by the players had either returned to pre-Ramadan values or rebounded above pre-fasting levels. Importantly, nearly all the players believed that their training and match performance had improved to close to pre-Ramadan levels once the fast had been concluded.

Table 1 Means (SD) and levels of significance for performance data by test date

	Before Ramadan	End of Ramadan	2 weeks after Ramadan	Overall p value	p Value, before vs end of Ramadan	p Value, before vs 2 weeks after Ramadan	p Value, end vs 2 weeks after Ramadan
Speed (m/s)	7.31 (0.57)	6.92 (0.42)	7.02 (0.43)	0.010	0.005*	0.041*	0.397
Vertical jump (cm)	52.3 (5.27)	52.5 (6.61)	50.44 (6.31)	0.069	0.904	0.062	0.034*
Dribbling (s)	18.79 (1.00)	20.55 (1.78)	19.26 (1.18)	<0.001	<0.001*	0.008*	0.002*
5 m (s)	1.02 (0.25)	0.95 (0.17)	0.90 (0.15)	0.021	0.108	0.008*	0.203
10 m (s)	1.76 (0.26)	1.86 (0.28)	1.70 (0.19)	0.033	0.125	0.158	0.021*
20 m (s)	3.09 (0.33)	3.12 (0.24)	3.05 (0.21)	0.117	0.068	0.308	0.225
4-line (s)	14.69 (0.72)	15.69 (1.18)	15.39 (0.83)	0.001	0.001*	<0.001*	0.189
12 min run (m)	2839.6 (431.6)	2387.5 (474.6)	2631.7 (377.5)	0.001	0.002*	0.045*	0.006*
Heart rate after 12 min run (bpm)	134.75 (9.83)	165.33 (18.39)	167.75 (22.59)	<0.001	<0.001*	<0.001*	0.666
Heart rate 5 min after run (bpm)	92.88 (11.16)	91.04 (14.79)	100.79 (9.13)	0.012	0.6266	0.004*	0.005*

*p<0.05.

DISCUSSION

Although data on the effects of Ramadan on physical performance are limited, this is the first study to focus on competitive professional athletes. Our data show transient changes in performance variables, some of which recover quickly and others that are still reduced 2 weeks after the end of Ramadan.

Endurance capacity was reduced by nearly 20% at the end of Ramadan and about half of the reduction was regained in the 2 weeks after the fast (table 1). Immediate post-run heart rates were increased in near parallel to the reduction in endurance; however, even though the run distance increased in the 2 weeks after the fast, the post-run heart rate was unchanged. One reason for the decline might be the change in sleep patterns. Martin[3] showed about an 11% reduction in aerobic capacity with acute sleep deprivation. Another possibility is that even with adequate carbohydrate intake, football players fail to fully replenish glycogen levels after a match,[4] which would have an impact on an exhaustive effort 2 days after a match. Nonetheless, endurance was reduced, recovered somewhat after the fast, and recovery heart rates were further evidence of a reduction in endurance capacity.

Table 2 Summary of questionnaire data

	Before Ramadan	End of Ramadan	2 weeks after Ramadan
Sleep (h)	8.24 (0.918)	8.38 (1.627)	9.00 (1.343)
Sleep quality (%)			
Usual	69.2	26.9	25.0
Better	7.7	0	54.2
Slightly worse	19.2	61.5	8.3
Substantially worse	3.8	11.5	8.3
Eating habits (% yes)			
Eat early morning	92.3	65.4	95.8
Eat during day	92.3	0	100.0
Eat breakfast (Ftour)	96.2	96.2	95.8
Eat in the evening	42.3	76.9	29.2
Eat late at night	11.5	11.5	0
Symptoms (% mild/moderate)			
Headache	7.6	23.0	0
Tired	30.7	46.1	12.5
Cramps	11.5	0	0
Difficulty in concentration	0	7.6	0
Vertigo	3.8	19.1	0
Vision	0	3.8	0
Digestion	11.5	0	4.2
Other	4.2	0	0
Training performance (%)			
Usual/better	80.7	30.7	95.8
Restricted/DNP	19.3	69.3	4.2
Match performance (%)			
Usual/better	53.7	23.1	91.7
Restricted/DNP	46.3	76.9	8.3

DNP, did not play.

Dribbling speed and agility were both affected, but to say that fasting was the cause might be neglecting other factors such as the environment, motivation and so on. Neither of these tests is of sufficient length of time to have been influenced by availability of fuel and are unlikely to be affected by low calorie intake. Submaximal physical exercise does not seem to be affected appreciably during Ramadan, but there is a shift towards fat metabolism during exercise performed in the afternoon before the evening meal; however, maximal exercise is reduced during Ramadan.[1]

Ramadan is a phase shift in food intake and a disruption in sleep patterns more than a ''fast'' where food is restricted. Food intake is not restricted during Ramadan; the restriction is when food is eaten. Shifting food intake until after sunset upsets the timing of intake, sleep patterns to accommodate the change in mealtime, and the likely effects on behavioural aspects of the normal day's activities. This makes the influence of Ramadan on daily activities more a matter of chronobiology than of calorie restriction.

Training or a match scheduled at 14:00 h could well be ⩾8 h after the player's last meal and many hours until their next meal, which is beyond the window for optimal glycogen replenishment. On the basis of the present data and other practical matters regarding performance and nutrition, the Islamic athlete faces unique challenges not experienced by non-Muslims and needs to explore strategies to optimise physical performance during Ramadan.

All our physical tests required a maximal effort, but these professional football players ran just over 2900 m in 12 min, which, when used to calculate maximum oxygen consumption, gives an average of 52 ml/kg/min. Most reports on the aerobic fitness of male football players give values of 55–65 ml/kg/min. As with most physical tasks that require an exhaustive effort, subject motivation is always an issue. Players who think that their training and match performance have been affected by the fast might not be overly motivated to perform at maximal effort during testing. This could be a result of mood and motivation like that reported by Roky *et al*,[5 6] who showed significant reductions in mood and alertness at the end of Ramadan. The players did believe that their training and performance were

What is already known on this topic

- The effects of food restriction on laboratory performance are well known.
- Ramadan is, however, less a fast and more a phase shift in calorie intake and change in sleeping habits.
- These phase shifts are reported to have effects on the selected activities of daily living, mood, motivation and maximal performance, with little effect on submaximal exercise.

What this study adds

- Ramadan reduced physical and football-specific performance, and many of these decrements had not recovered in the 2 weeks after the end of this period of fasting.
- Players thought that the fast affected both their training and match performance.

both below normal and could be a reflection of their mood during this period.

These data show that physical performance in soccer players is affected during Ramadan, which may be a result of changes in fitness or changes in mood and motivation which has been reported by others. The Islamic competitive athlete needs to explore strategies and options to maintain optimal performance during Ramadan.

Authors' affiliations
Yacine Zerguini, Centre d'Evaluation et d'Expertise en Médecine du Sport, Algiers, Algeria
Donald Kirkendall, Astrid Junge, Jiri Dvorak, FIFA Medical Assessment and Research Centre, Schulthess Clinic, Zurich, Switzerland

Competing interests: None declared.

Correspondence to: J Dvorak, F-MARC, Schulthess Klinik, Lengghalde 2, CH-8008, Zurich, Switzerland; jiri.dvorak@kws.ch

Accepted 4 December 2006
Published Online First 15 January 2007

REFERENCES

1 **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 Fit* 1992;**32**:156–63.
2 **Rosch D**, Godgson R, Peterson TL, *et al*. Assessment and evaluation of football performance. *Am J Sports Med* 2000;**28**(Suppl 5):S29–39.
3 **Martin BJ**. Effect of sleep deprivation on tolerance of prolonged exercise. *Eur J Appl Physiol Occup Physiol* 1981;**47**:345–54.
4 **Bangsbo J**, Mohr M, Krustrup P. Physical and metabolic demands of training and match-play in the elite football player. *J Sports Sci* 2006;**24**:665–74.
5 **Roky R**, Houti I, Moussamih S, *et al*. Physiological and chronobiological changes during Ramadan intermittent fasting. *Ann Nutr Metab* 2004;**48**:296–303.
6 **Roky R**, Iraki L, Hajkhlifa R, *et al*. Daytime alertness, mood, psychomotor performances, and oral temperature during Ramadan intermittent fasting. *Ann Nutr Metab* 2000;**44**:101–7.

EDITORIAL BOARD MEMBER

Andrew Jones

Andrew M Jones received his BSc (Sports Science, First Class, 1991) and PhD (Exercise Physiology, 1994) degrees from the University of Brighton before completing a Postdoctoral Fellowship in Respiratory Physiology at the University of California at Los Angeles.

He worked as a sports physiologist at the Sports Council for Wales before taking up a lecturing position at Manchester Metropolitan University, where he was promoted to Reader (2001) and then Professor of Applied Physiology (2004).

In August 2005, Professor Jones took up a new position as Chair of Applied Physiology at the University of Exeter. He is a Fellow of the American College of Sports Medicine, the British Association of Sport and Exercise Sciences, the European College of Sports Sciences and the Institute of Biology and a member of the Physiological Society and the American Physiological Society.

Professor Jones is a foreign consulting editor for *Medicine and Science in Sports and Exercise* (from July 2005) and a member of the Advisory Board for the *Journal of Sports Sciences*. He is internationally recognised for his research in exercise gas exchange dynamics, exercise testing and endurance training. He has published more than 80 peer-reviewed articles in scientific journals and is co-editor of the text book *Oxygen uptake kinetics in sport, exercise and medicine*. He has a keen interest in the application of his research and is the consultant sports physiologist to UK Athletics.

Figure 1 Andrew Jones.