

# Sport Participation and Ramadan Observance: Advice for the Athlete

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## ABSTRACT

**Introduction:** A growing number of Muslim athletes now engage in international competition. This raises the question of the advice they should be given if a major event occurs during the month of Ramadan.

**Methods:** A narrative review has been based upon books and extensive reviews completed by the author and other investigators.

**Results:** Practical considerations hamper assessment of the effects of Ramadan upon physical performance, but there seem small decreases in muscular strength and both anaerobic and aerobic capacity. Nevertheless, athletes who wish to observe Ramadan can reduce such effects by prior adjustment of diet and training plans, minimizing sleep loss, and careful management of fluid and food intake during the period of intermittent fasting.

**Conclusion:** Competitors in most events can observe Ramadan with a small loss of athletic performance. However, intermittent fasting can endanger health for individuals with type I diabetes mellitus, and for participants in ultra-endurance events (particularly under hot conditions).

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## Introduction

The observance of Ramadan is a challenge for the sedentary individual, but with the exception of those affected by certain chronic conditions such as diabetes mellitus and hypertension (1-3), the associated daily fast usually has no ill-effects upon health. Indeed, it is quite possible for the average person to meet daily food and fluid requirements during the hours of darkness, and some individuals who have become obese even see Ramadan as an opportunity to moderate their body weight (4). However, the food and fluid needs of the athlete are much greater than those of the average citizen. Thus, during the month of intermittent fasting, substantial water and nutrient deficits can develop over a day of competition, and some adverse effects may accumulate over the course of Ramadan. Moreover, these changes potentially can have negative consequences for training, competitive performance and even health (3,5,6).

The present brief narrative review examines reasons why it has been difficult to obtain consistent empirical data concerning the impact

of Ramadan upon athletes, summarizes the likely effects upon training, performance, and health, and offers some practical suggestions that the sports physician can transmit to the athlete who is facing the challenge of a major international competition during the month of Ramadan.

## Problems in assessing the effects of Ramadan upon athletic performance

It might seem a simple matter to conduct a matched control study and thus to determine empirically the effects of Ramadan upon athletic performance. However, a number of factors militate against obtaining a clear result, including issues of experimental design, the variable characteristics of Ramadan, inter-individual differences in the local environment and the type and timing of competition, the extent of any changes in training schedules and other measures that athletes may have taken unattempted to circumvent the immediate effects of Ramadan.

### *Experimental design*

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It is not easy to find well-matched control groups of athletes to test the effects of Ramadan observance. In some comparisons of team sports, the controls have been drawn from other countries, poorly adapted to local heat and other adverse features of the local environment (7). Often, the controls have been non-Muslims, with consequent differences in various aspects of personal lifestyle. In some studies, living quarters have been shared by experimental and control groups, so that the performance of the controls has also been impaired by the late meal times and short periods of sleep necessitated by Ramadan observance (8). Many investigators have simply compared the performance of the same athlete before and during Ramadan, thus introducing biases due to seasonal differences in physiology and performance (9).

Although the effects of intermittent fasting sometimes accumulate over the month of Ramadan, the main adverse influences upon athletic performance are the progressive drop in fluid and carbohydrate reserves that develop during each day. Thus, to observe the maximal potential impact of Ramadan upon physical performance, it is important to make measurements in the late afternoon. However, some studies have ignored this circadian effect, measuring physical performance in the morning, or even mixing morning and afternoon data.

#### *Characteristics of Ramadan*

Comparisons between studies are complicated by the variable nature of Ramadan itself. The length of the required daily fast varies, depending upon the period of the year when Ramadan occurs, and the latitude in which the competitor is living (or on occasion, the proxy latitude that has been assigned to the individual). However, investigators too rarely report these important parameters.

#### *Environmental factors*

Given the challenge of body fluid depletion, the physiological impact of Ramadan varies greatly with local climatic conditions (dry and wet bulb temperature, radiant heating and wind speed), the extent of any acclimatization of the athlete to hot and dry conditions, and the potential to relax and even to nap in cool and

shaded quarters between events. Domestic living conditions are also an important variable. Some individual athletes will be living at home, and likely will share the religious practices of their family. Others will be living in an athlete's village, with varying adjustments of communal feeding and sleeping schedules during the month of Ramadan.

#### *Type and timing of competition*

The physiological impact of Ramadan observance varies with the type of competition in which the athlete is engaged. The greatest potential impact is upon performance in team sports and prolonged endurance competitions, where there are heavy demands upon fluid and carbohydrate reserves even in the absence of fasting (6). The adverse effects of Ramadan will be relatively small if competition is held in the morning, but much greater when an event is held in the late afternoon. In a country where the Muslim faith predominates, it may be possible to adjust the timing of both competition and training sessions to minimize adverse effects upon observant athletes, but such accommodation is unlikely to be possible in non-Muslim countries.

#### *Training*

If training is relaxed because of increased sensations of fatigue, there can be a substantial loss of physical condition over the course of Ramadan. However, athletes vary greatly in their individual practices, with some maintaining a full training programme. Unfortunately, many investigators have failed to provide details of any changes in training schedule introduced during the period of intermittent fasting.

#### *Measures to circumvent the immediate effects of Ramadan*

In some instances, a competent and well-informed team manager will optimize the training, diet and sleeping patterns of his or her charges before and during Ramadan in an optimal manner, thus minimizing or circumventing the immediate effects of Ramadan, but other competitors will lack this tactical advantage. Many reports fail to discuss this important issue.

### Typical changes in training

Disturbances of sleep, depletion of fluid and carbohydrate reserves, and personal fears of the adverse effects of Ramadan often lead to an increased perception of physical effort during Ramadan (8,10), with a resulting loss of motivation, and a tendency to lighten the duration (11) or the volume (12) of training; this in turn tends to decrease competitive performance. With careful planning, the desire to reduce the volume of training during Ramadan can be incorporated into a planned "tapering" of the conditioning process (13). Training sessions are most effective when there is adequate carbohydrate for expression of the genes involved in muscle hypertrophy (14), and the circulating concentrations of key amino acids are at their peak (15-18). During Ramadan, it is thus advisable to hold conditioning sessions either shortly before or shortly following the evening meal.

### Competitive performance

We will consider briefly indirect negative effects of Ramadan observance upon athletic performance, the impact of a reduced availability of nutrients and fluids, and empirical data on changes in the performance of various types of event.

#### *Indirect negative effects*

Peak performance in all types of competition could be compromised because of an increased perception of effort (19) (although this is not always observed) (8, 20, 21), a greater sense of fatigue (22-24), general fears of an adverse effect of Ramadan upon performance, and a reduction of motivation. A falling blood glucose concentration and dehydration both contribute to an increased sense of fatigue and reduced motivation. In team sports, a player with a low blood sugar might also become more irritable and cooperate less well with other team members. Loss of sleep (25) could further exacerbate such effects, reducing concentration (26) and slowing reflex times (27).

#### *Reduced availability of nutrients*

Maintenance of blood glucose levels over short periods of fasting initially depends upon the process of glycolysis, with a progressive

breakdown of glycogen (about 500 g) stored in the muscles and liver. Even without the challenge of intermittent fasting, glycogen stores are typically exhausted within about 90 minutes of endurance competition, and during Ramadan the initial reserves may be sub-optimal. As glycogen reserves become depleted, there is an increasing reliance upon gluconeogenesis, with the hepatic synthesis of glucose from amino acids, lactate and glycerol (13,28). A growing hypoglycaemia impairs both cerebral function (29) and competitive performance- particularly sustained anaerobic and prolonged aerobic muscular activity (30,31). Empirical data suggests that the blood glucose levels of most athletes are surprisingly well maintained over a day of competition (32-35). However, the metabolic cost of repeated recourse to gluconeogenesis can sometimes be seen in an athlete's progressive loss of lean tissue mass over the course of Ramadan.

There may also be an increased recourse to body fat as a source of energy during Ramadan. Stannard and Thompson (36) noted a dramatic 72% increase in the metabolism of fat during 30 minutes of aerobic cycle ergometer exercise, and other investigators have confirmed that during Ramadan there is an increased usage of fat during vigorous exercise (32, 37, 38). Most athletes have only small initial fat reserves, but to the extent that these are depleted during Ramadan, there may be a decrease of body mass, and thus a decrease in the energy cost of physical activities that involve displacement of the body.

Protein tends to be metabolized to maintain blood glucose during Ramadan, but whether muscle loss is needed to support this metabolic change depends upon the athlete's protein intake. Many athletes normally consume far in excess of their protein requirement of 1.4 g/kg (endurance competitors) to 1.6-1.8 g/kg (strength competitors) (39, 40), and during Ramadan they can simply use a part of this excess protein for gluconeogenesis. However, vegetarians and competitors from poor countries who can afford only a limited protein intake may draw upon their existing lean tissue mass, (23, 41) with a corresponding tendency to a decrease in muscle strength. The decrease of plasma amino acid levels (42) may also impair the synthesis of new protein during training.

### Reduced availability of fluids

A reduction in body fluid reserves can limit cardiac output and thus aerobic performance, as well as reducing muscle strength (43, 44). Fluid needs are greatest during marathon, ultra-marathon and triathlon events, and there do not seem to have been any studies of such competitions during Ramadan. However, losses can amount to 2 L/hour or more during team sports, and Bouhlef and associates (32) demonstrated that the haematocrit of rugby players increased from 39.8 to 43.6% over the course of the day during Ramadan. A 5% decrease of body mass from fluid losses is sufficient to make the difference between a safe and a dangerous elevation of core temperature when undertaking prolonged exercise in a hot environment (45).

### Empirical data on performance during Ramadan

Empirical data on athletic performance during Ramadan are summarized in Table 1. There are some adverse changes, in the 1-5% range, and these would be sufficient to influence performance in contests that are often won by very narrow margins, although they are difficult to detect and to measure accurately in small samples.

Despite the wide variety of sports represented, and the various practical problems hampering experimental evaluation, some broad trends can be discerned.

The observance of Ramadan seems to induce little change in brief anaerobic performance, although greater fatigue is often reported. On the other hand, there is a slowing of track speeds over distances of 100-300m, probably reflecting reduced glycogen stores and thus a poorer anaerobic capacity. Maximal oxygen intake and its field equivalents such as shuttle run tests show little change during Ramadan, but a slowing of performance over longer runs (3000-5000 m)

and a decrease in endurance over periods of 60-90 minutes reflect a decreased aerobic capacity, again likely due to reduced glycogen stores. Most investigators also report some decrease in muscle force and jumping ability, possibly related to dehydration or poorer motivation, although there is little change in agility. A few studies report an early deterioration of muscular performance, but an apparent return to normal values as Ramadan continues.

The lack of data on Ramadan and ultra-endurance sports must be emphasized. Here, the cumulative effects of carbohydrate and fluid depletion are likely to be severe, with a substantial deterioration of performance, and the potential for dangerous and possibly fatal incidents of heat collapse.

### Medical concerns

Specific medical concerns associated with Ramadan observance are poor compliance with prescribed medication, the precipitation of diabetic crises and a worsening of anorexia nervosa or the athletic triad. It remains unclear whether the risk of physical injuries is increased. Finally, those involved in doping control may face difficulties in collecting mandated specimens of urine.

### Compliance with prescribed medication

The altered timing of meals during Ramadan can disrupt the normal use of medications. A survey of average Kuwaitis found that 58% failed to take the prescribed dosage during Ramadan (65). One common problem was a failure to swallow the required medication because water was not available. This particular difficulty is best circumvented by the prescription of slow-release medications that can be taken just once per day, during the hours of darkness (66).

**Table 1.** Empirical data on changes of athletic performance during Ramadan

Anaerobic performance	Aerobic performance	Muscular performance
No change of sprint speed (8,12,46,47)	No change of maximal oxygen intake (30, 37, 46, 52-56) [afternoon decrease found by (57)]	Decrease of muscle force and endurance [found by (12,46,47,52,54) but not by (62)]
Unchanged Wingate test performance (48)	Slowing of 3000-5000 m runs (47,54)	Early decrease of performance with recovery as Ramadan continued (63)
Increased fatigue (19,46,47,49)	Slowing of 60 min and 90 min endurance run (58, 59)	No change of agility (47,64) or loss of agility (62)
Decreased performance over 100-400 m (50, 51)	Early decrease of performance, but recovery as Ramadan continued (60, 61)	

### *Diabetes mellitus*

Hospital admissions for problems associated with diabetes mellitus are increased during Ramadan (67), and for the athlete who suffers from type I diabetes mellitus, the safest approach is to seek a medical exemption from the requirement of fasting (68).

### *Eating disorders*

The observance of Ramadan is commonly accompanied by a small decrease of body mass, due to depletion of fat stores and proteolytic gluconeogenesis. This trend may exacerbate an underlying eating disorder in patients who are suffering from anorexia nervosa or the athletic triad (69), and in such individuals the body mass must be monitored closely throughout Ramadan.

### *Incidence of injuries*

In theory, a low blood sugar might impair concentration and cause irritability, increasing the risk of injuries (2). In the general population, this hypothesis has been tested in terms of seasonal differences in road traffic injuries, but findings have been inconsistent. Factors militating against a clear answer have included altered hours of working and (in some countries) changes in laws regulating the sale of alcohol during Ramadan.

Studies of athletic injuries during Ramadan have also to date yielded unconvincing results, although some professional competitors have a strong belief that their risk of injury is increased when fasting (70). In one comparison of football teams who were competing in the very warm environment of Qatar, most of the teams that were observing Ramadan had the advantage of prior acclimation to the hot conditions, and they actually sustained fewer injuries than the visiting European teams that served as controls (7). Another report suggested an increase of non-contact injuries during Ramadan observance, possibly reflecting altered inflammatory and immune responses (71).

### *Doping control*

Athletes who are observing Ramadan may become sufficiently dehydrated that they cannot produce a urine specimen for doping control. In such situations, authorities are authorized to remain with the contestant until dusk, and the sample is collected after rehydration (72). If a

urine specimen is very concentrated, it may also give an erroneous appearance of doping with drugs that are permitted up to specified urinary concentrations; examples include caffeine (permitted ceiling 12 mg/L) and inhaled salbutamol (permitted ceiling 1000 ng/L).

### **Advice to athletes**

Although performance in short-duration anaerobic and aerobic events and contests of strength may be somewhat reduced during the observance of Ramadan, athletes can continue to participate in such activities without risk to health. The main danger comes from not drinking during prolonged aerobic events under hot conditions; heat collapse and fatalities are then possible.

There can be little objection to intermittent fasting during most types of junior competition; athletes are then competing against others who are also observing Ramadan and face a similar handicap. However, in international events, most participants will not be fasting, and observant Muslims are then at a serious disadvantage. Some may decide to face the added challenge as a part of their faith, but in discussion with their spiritual advisors others may seek to postpone the fast. The judgment on this issue varies from one Imam to another. Some have interpreted a section of the Koran (the second part of Al-Baqarah 2, verse 185) as a justification for athletes who wish to postpone their observance of Ramadan until after they have completed competition. Just prior to the London Olympics, a committee of senior imams met at the Al Azhar University in Cairo, and they issued a fatwā stating that athletes were not required to fast during the Olympic Games. A chaplain to the Athlete's Village commented (73): "*Most of the athletes I've met are delaying fasting for a later date. But some are fasting on all the days while others who attend many communal celebrations.*"

For those who decided to compete while observing the fast, preparations of the coaching team should start well before competition. One aim should be to increase the proportion of energy that is derived from fat. This adaptation is encouraged by following a high fat diet, reducing glycogen stores, and maximizing aerobic training for several weeks prior to competition (74-76). The tapering of training

should also be arranged to coincide with Ramadan. During Ramadan, every effort should be made to avoid a loss of sleep, and if a normal 8 hours of good quality sleep cannot be obtained at night, athletes should seek opportunities for a daytime nap in a cool, quiet and darkened space. It may also be helpful to accustom the body to the new routine by taking a daytime nap for a few days before the beginning of Ramadan. Careful management and maximization of the night-time intake of food and fluid should help to avoid the development of cumulative nutritional deficits. The evening meal should have a high carbohydrate content, to recharge body glycogen stores, whereas the pre-dawn meal should have a substantial fat content and a low glycaemic index, in order to delay gastric emptying, slow the release of carbohydrates into the blood stream and give a feeling of satiety for much of the day (77). If blood glucose has fallen over the day, it may be helpful to undertake a brief spurt of activity immediately prior to competition, thus stimulating hepatic glycolysis and gluconeogenesis. Protein intake should also be boosted, and if possible training sessions should be shifted to close to the time when circulating amino acid levels reach their peak values, to encourage the synthesis of new protein. Water loss can be minimized by external applications of cold water, although this tactic must be used with care, since excessive cutaneous cooling can impair performance, particularly speed and power (78). Finally, if an event must be performed in the afternoon, the competitor should seek to rest and relax in a cool place until the event is called, thereby conserving both fluid and carbohydrate reserves.

## Conclusion

A number of practical considerations hamper accurate assessment of the effects of Ramadan observance upon an athlete's competitive performance. Nevertheless, there is fairly consistent evidence that the intermittent fasting of Ramadan induces small decreases in muscular strength and in anaerobic and aerobic activities that are dependent upon intramuscular glycogen stores. The impact upon the risk of injuries remains unclear, but there may be dangers to health for individuals with type I diabetes mellitus and those competing in ultra-endurance

events under hot conditions. For athletes who wish to observe Ramadan, the effects can be minimized by early adjustments of diet and training plans, minimizing sleep loss, and careful management of diet and fluid and food intake during the hours of darkness.

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