

# Optimizing training and competition during the month of Ramadan: Recommendations for a holistic and personalized approach for the fasting athletes

## Optimisation de l'entraînement et des compétitions pendant le mois de Ramadan pour les athlètes jeûneurs: Recommandations pratiques

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### RÉSUMÉ

Au cours du mois de Ramadan, les adultes Musulmans en bonne santé se privent de manger et boire de l'aube au coucher du soleil (période variable selon le lieu géographique et la période de l'année). Différemment d'autres formes de jeûne telle que la restriction calorique, le jeûne intermittent du Ramadan (JIR) est une forme unique de jeûne total (abstention totale de nourriture et de liquides), restreint dans le temps, intermittent, et circadien (suivant le rythme circadien et l'horloge biologique humaine). Les athlètes Musulmans continuent à s'entraîner et à participer aux compétitions pendant le Ramadan et les recherches ont montré que selon les efforts physiques, le JIR pourrait avoir des effets divers sur la performance physique (de "pas d'effet" à des "effets marqués"). Les athlètes qui jeûnent pourraient éventuellement souffrir entre autres, d'hypo-hydratation, de rythme et architecture de sommeil modifiés, de troubles du sommeil, d'altérations d'humeur et d'immunité, de performances psychomotrices diminuées et d'une perception générale de fatigue physique et/ou mentale. Cette revue a pour but d'apporter une mise à jour synthétique, basée sur les recherches scientifique et/ou les opinions d'experts sur le sujet, et conséquemment, des recommandations pratiques pour les athlètes, les entraîneurs, les staffs médicaux et scientifiques ainsi que les dirigeants sportifs ; ceci afin de les guider vers l'adoption de stratégies, de mesures et de comportements sociaux et psychologiques afin de faire face aux changements et éventuelles contraintes imposées par l'observance du Ramadan. Ces mesures devraient être ajustées et adaptées, utilisant une approche holistique/globale, plutôt que se concentrer sur des modifications/perturbations isolées. De plus, les stratégies adoptées ne devraient pas être sous forme "solution unique/universelle", mais devraient plutôt prendre en compte la variabilité parmi les athlètes et leurs besoins spécifiques (biologiques, psychologiques, cognitifs et comportementaux), et leur environnement de vie (plus défiant quand un individu pratique le JIR dans un pays à majorité non-Musulmane).

### Mots-clés

Islam; sportifs; optimisation de la performance; rythme circadien, horloge biologique humaine, entraînement, déficit de sommeil, déshydrations, blessure, effet nocebo.

### SUMMARY

During the month of Ramadan, Muslim believers of adult-aged and healthy, restrain themselves from food consumption and liquid intake from dawn to sunset (fasting duration varying according to the geographical location and time of the year). Differently from other fasting regimens such as caloric restriction, Ramadan fasting is a unique kind of fasting, being total (i.e., absolute abstain from food as well as fluid), time-restricted, intermittent, and circadian (following the circadian rhythm and the human biological clock). As such, the fasting athletes could potentially suffer from hypohydration, altered sleep pattern and architecture, sleep disturbances, mood swings, immunological alterations, impaired psychomotor performance and overall perceived physical and perhaps, mental fatigue, among others. Hence, Muslim athletes who continue to train and compete during Ramadan faced many challenges. Research has shown that depending on the level of effort, Ramadan fasting could have diverse effects on physical performance; from no effect to marked effects. The present review aims to provide practical recommendations based on an updated, evidence-based synthesis of the existing scholarly literature and/or experts opinions on the topic and subsequently, some useful tips for athletes, coaches, medical and scientific support, and sports managers, in order to guide them on how to promote appropriate behavioral, social and psychological strategies to cope with the changes and potential constraints induced by the observance of Ramadan fasting. These recommendations should be adjusted and coped with, utilizing a holistic approach, rather than focusing on the single alterations/perturbations. Moreover, the implemented strategies should not be "one size fits it all" approach, but should rather take into account the variability among athletes and their specific needs (biological, psychological, cognitive-behavioral), and their social and living environment; as it is clearly more challenging when the individual is performing the Ramadan fasting in a predominantly non-Muslim majority country.

### Key-words

Islam; sportsmen; performance optimization; circadian rhythm, human biological clock, training, sleep deficit, dehydration, injuries, nocebo effect.

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## INTRODUCTION

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During the month of Ramadan, healthy able-bodied adults of the Muslim faith observe the religious act of Ramadan fasting by voluntarily restraining themselves from food consumption and liquid intake, from dawn till sunset, daily for 29-30 days. As such, they have a reduced meal intake frequency, generally consuming only two main meals (*sahur*, i.e., the last meal before starting the day's fast, and, *iftar*, i.e., the meal taken to break the day's fast). However, during the nocturnal period between dusk to dawn, there is no limit or restrictions to the amount of food or fluid taken (1). Based on a lunar calendar, Ramadan can occur at different times of the year over a 33-year cycle. The exact timing (and hence the daily duration of the daylight fast) of the days of fasting will depend on the latitude of the geographical location, and the season in which Ramadan takes place (2). At low to moderate earth/globe latitudes fasting durations range from between ~10 to ~22 hours, being shorter during winter- and longer during summer-times. Fasting Muslims who live at higher latitudes will be particularly challenging during summer time because of the very long daylight hours. For the Muslim residing near the North and South Poles of the globe, it is simply impossible to adhere to the sunrise/sunset rules. The standard definition of 24-h per day with sunrise/sunset does not apply at these extreme latitudes since the sun can stay in the sky or disappear for days to months. Therefore, in case of such extreme daylight-darkness durations, the fasting duration is ruled based on various Fatwa's-clerical decree (3).

Clearly different from other forms of restricted dietary regimens and protocols, the Ramadan fasting is a unique pattern of fasting, being total (i.e., absolute abstain from food as well as fluid), time-restricted, and intermittent (alternating fast and abstinence with re-feeding and feasting periods), and circadian (following the circadian rhythm and the human biological clock) (3). Thus, Ramadan fasting is a 'dry' fasting as no liquids are consumed during the duration of the day's fast, rendering it particularly challenging with regard to potentially causing hypohydration (which is commonly and wrongly described as dehydration in the literature).

In countries where Muslims represent the majority of the country's population, the daily social activities, including sport activities, are usually re-scheduled to correspond to the Ramadan fasting period, with training sessions and competitions being postponed and/or generally played

during night hours, i.e., after *iftar*. However, this change in sporting schedules is not possible in non-Muslim majority countries, whereby international competitions and events are played regardless of the observance of Ramadan fasting in the competing Muslim athletes (where Muslim athletes may potentially be suffering from hypohydration, altered sleep pattern and architecture, sleep disturbances, including sleep deficit, mood swings and generally impaired physical and psychomotor performance) (4-8). While many studies have shown a negative impact of Ramadan fasting on several aspects of physical performance, there are also several published studies indicating no impact of Ramadan fasting on the exercising Muslim individuals' exercise performances (see reviews 5,9-11). This conflicting outcome is largely due to the methodological difficulty in conducting a randomized, placebo-controlled research in Ramadan fasting such as the inability to blind the subjects involved in the study to the act of Ramadan fasting itself, and also for the fact that many variables such as the drastic changes in the fasted individuals' food and fluid intake, sleep hours and sleep pattern, and behavioral patterns that are all occurring at the same time between, and within, the same individuals during the Ramadan month (4,5,9).

Nevertheless, the majority of the consensus believed that Ramadan fasting is a non-optimal condition for athlete to train or to compete, and places Muslim athletes at a competitive disadvantage. Therefore, the aim of this review is to describe in a practical manner scientifically sound recommendations based on expert panel consensus (the authors of the present manuscript), scholarly literature and/or experts' opinion on the topic for use by both athletes and support staff in order to guide them on how to promote appropriate behavioral, social and psychological strategies to cope with the changes and constraints induced by the Ramadan fasting.

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## PRACTICAL RECOMMENDATIONS

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As was previously mentioned, the observance of Ramadan fasting will have an impact on several variables, such as nutrition, hydration and sleep patterns. It can potentially reduce alertness, motivation, physical, and psychomotor performances (12-15). Therefore, rather than focusing on single alterations/perturbations, these parameters should be adjusted and coped with, utilizing a holistic approach, given the fact that these variables are strictly

inter-related. Moreover, the approach should not be “one size fits it all”, but should take into account the variability among athletes and their specific needs (biological, psychological, cognitive-behavioral), and their social and cultural environment (16). Consequently, fasting athletes will have to face particularly challenging situations when they train and compete in Ramadan month, no matter whether they are residing in a predominantly Muslim or non-Muslim majority country (2,4-6,17-19)

### **Time of day of training sessions**

Specifically concerning the month of Ramadan, the time of day of the training undoubtedly represents a crucial variable, which can be manipulated and adapted to the daylight fasting regimen (20). In this regard, four options are possible:

- 1) Performing training sessions 1-2 h just before *iftar*. Coach should carefully plan and organize training activities so as to end the session just prior to *iftar* time and thus enabling the athlete to replenish their nutrients and fluids immediately post-training. Incidentally, this is also the period, albeit in the non-fasting condition, in which the levels of strength-induced hormonal secretion and arousal are at their peak. For this time of day, it is recommended to perform light technical-tactical sessions with low cardiovascular load or resistance training sessions of relatively short duration.
- 2) Performing training sessions at night, starting ~3 hours after *iftar*. This time of the day seems to be the best option for athletes to maintain an acceptable hydration and nutritional status throughout the training session since intake of food and fluid is allowed. It is recommended to perform high intensity and/or long duration training sessions at this time of the day. It should however be noted that performing training sessions at these evening times may negatively impact on sleep-wake cycle, and thus potentially jeopardizing sleep quality and resulting in sleep deprivation as well as the athlete's outcomes in terms of physical and psychomotor performance. Therefore, in such cases, the overall individual's 24-h sleep management will have to be optimized with particular attention on keeping a healthy and thus sufficient amount of sleep (see further discussion on the section of Sleep below).
- 3) Performing training sessions 2-3 hours after *sahur*. Training at this time is usually not recommended because of the long post-training period before *iftar*, imposing a stress on the athletes' body, with recovery

processes impacted by the absence of food and fluid intake. If the schedule dictates training at this time of the day, it is advised to practice low-intensity type of exercises, strictly focusing and addressing specific skills, tactics and techniques, rather than activities that require high-level and prolonged sustaining of physical efforts;

- 4) In case of multiple training sessions, a day, the athletes could train at the times mentioned in options 1) and 2) described above.

The effects of routine exercise training at a specific time of the day on training-induced physical and/or psychomotor performances and adaptations are poorly understood and are sometimes, equivocal. However, the existing scholarly literature seems to suggest that adaptations to training are greater at the time of day when training sessions are usually carried out (21,22). Therefore, athletes should endeavor to train at the approximate time when they will be competing. Whereas adapting and modifying the schedule time of training sessions seems to be a useful and simple approach, this re-scheduling of time of day of training sessions is almost impossible, especially for team sports operating in non-Muslim majority countries where no changes can be brought to training modalities, such as timing, frequency, duration, etc. It should be noted that modifying the time of day of training sessions does not place the players at a disadvantage if they would be playing out-of-phase in the coming competitions.

### **Training organization**

#### *Principle of frequency, intensity, time and type for optimal training*

Coaches and sports managers should modulate training sessions taking into account physiological and metabolic perturbations induced by response to training in the Ramadan-fasted state, which are usually more intense in the initial first few days of Ramadan observance.

Of importance to note, the literature reports contradicting results with regard to the effects of Ramadan fasting on physical performance. As was previously mentioned, some studies report a clear negative effect of Ramadan fasting, others report no or minimal effect (see reviews 5,9-11). Indeed, when maintaining high training loads during Ramadan, elite judoists were able to maintain several physical performance measures, despite the appearance of fatigue and a slight increase in inflammatory markers (23). On the other hand, a tapering approach (decreasing

training duration while maintain training intensity (15) brought positive results with improvements of muscle power and strength in young soccer players (24). Nevertheless, this decrease in training duration could still impact the total training load and thus potentially the training stimuli, which may result in detraining and negatively impacting performance (15).

A recent study that examined the effects of Ramadan fasting on distance covered over varying running velocities using the global positioning system during a 90-min football (soccer) match showed that the overall physical performance was negatively impacted (25). This study is of particular relevance as it has monitored the players' training load prior, showing a clear and significant decrease in training load during the Ramadan month, and hence a possible decreased in overall physical stimuli. Thus, one cannot exclude the potential detraining effect that could explain the totality or at least part of the decreases in the players' match performance played in the Ramadan-fasted state reported by that study. Indeed, Aloui et al. (12) showed a clear negative effect of Ramadan fasting on repeated sprint ability in young athletes. Therefore, if the athletes wish to perform maximal performance repeated sprint ability training sessions, they should avoid *pre-iftar* time of the day and rather consider performing their high-intensity training session in a fed-state, i.e., after *iftar*.

In terms of training *frequency*, exercising twice a day could be demanding, and particularly for the second session due to accumulated fatigue. However, it could be feasible if the second training session is held after *iftar*. Coaches and sports managers could also exploit the occasion of the first training session performed *pre-iftar* by conducting a more technical- or tactical-emphasis session, and at the same time providing the athletes with detailed feedback, psychological counseling and coaching, in order to educate, relax and prepare them for the second, more physically-demanding training session of the evening (*post-iftar*).

In terms of training *intensity*, a progressive increment loading approach should be adopted, gradually increasing the exercise resistance or stimuli and loading variation throughout the Ramadan month to facilitate athletes' adaptation to the training in the fasted state (24,26). Coaches and athletes should also be aware that the

individual's exercise heart rate, blood lactate and ratings of perceived exertion have been shown to be higher when exercising in the Ramadan-fasted state as compared to the same exercise performed in the non-fasted state (27,28). This has great implications to coaches and athletes when monitoring the individuals' exercise training intensity during Ramadan.

In terms of training *time* (i.e., duration of exercise), the duration of *pre-iftar* training sessions should not be longer than 75 minutes (including warm-up and cool-down phases) in order to avoid hypoglycemia owing to the possibility of the depletion of the fasted individual's muscle glycogen stores, which could increase the risk of musculoskeletal injuries.

In terms of the *type* of exercise performed during the training session, the training protocol, besides resting periods, should incorporate strength or resistance sessions (for instance, once a week) to counteract, or at least, mitigate the potential total protein loss/reduction (as a result of possibly lowered calorie intake and/or decreased training stimuli) and helped preserve the integrity and functioning of the muscle mass (29).

Whilst all these recommendations seem to favor a gradual athlete's adaptation to the fasting month, the need to balance the athlete's training objectives, preserve his/her psychomotor performance and minimize the risk of hypoglycemia and injuries, which on the other hand if overdone, could lead to the fasted athlete undergo detraining (due to the reduced training volumes and loads). In order to avoid this risk, coaches and sports managers should closely monitor athlete (utilizing reliable and validated psychometric tools, such as the Borg's ratings of perceived exertion, or a visual analogue scale, to rate perceived physical, mental conditions and readiness to train) and, eventually, dynamically, adapt and adjust the training protocol accordingly.

### **Training environment**

Unfavorable environmental conditions such as high humidity and heat represent an additional challenge for the Ramadan-fasted athlete, imposing a relevant burden of stress and resulting in increased body temperature and significant sweat loss. Thus, training environment during the day (whilst in the Ramadan-fasted state) should

be cool, if possible, held in a shaded place in order to avoid excessive sweat loss resulting in hypohydration, which could potentially compromise the individual's thermoregulatory response to exercises (leading to excessive hyperthermia). The latter should be avoided because it clearly leads to poorer and inadequate physical and psychomotor performances (30). Also, the domestic living conditions where the athlete resides should be taken into account. If the competition takes place in a Muslim majority country, athletes can share religious practices with their family and/or peers, and conversely this context is completely different in countries in which Muslims represent a minority, and where fasting and adapting to the new feeding and sleeping schedules can really be challenging.

### **Nutrition**

Ensuring an adequate overall nutritional level is fundamental during the month of Ramadan (31). The type, the amount and the time-of-day of ingested food should be closely monitored in order to maximize the athlete's physiological and psychomotor performances. Despite the reduced frequency of meals, the total caloric uptake over the 24-h period can be relatively easily preserved (14). It is also important, however, to consume balanced amounts of carbohydrates, proteins and fats. It is possible that high glycemic index foods be ingested for the *sahur* meal (start of the day's fast) in order to guarantee or even increase the bioavailability of carbohydrates and carbohydrate oxidation rates during the training session performed later during the day (32). And either low or high glycemic index nutrients are suggested when breaking the day's fast (*iftar*), in that they properly modulate the insulin response and provide athletes with adequate muscle glycogen stores (33). It is fundamental to regularly monitor nutritional-related parameters during the fast (including body composition – lean/fat mass, and if possible, blood glucose concentration). The use of sports supplements should be exceptionally and only be considered after a consultation with physicians and experts in the nutritional field.

### **Hydration**

Athletes are recommended to hydrate themselves well between *iftar* and *sahur*, possibly with frequent small amounts of drinks (~200 ml every 30 minutes) and eventually adding osmotically active agents such as

sodium salts, in order to promote greater fluid retention and attenuate excessive urine loss. Fluids such as coffee and tea should be avoided, in that they favor fluid excretion (34). Maximal and/or optimal hydration status should be targeted by *sahur* time. When the fasting duration is especially long (>12 h), *sahur* should be consumed just before dawn and not a few hours earlier. This however, imposes that the athletes be awake at that time, impacting sleep patterns (see below section on Sleep); therefore, the holistic approach should take into consideration the pros and cons of the choices/options.

If feasible, hydration-related variables, such as urine frequency and color and if possible, sweat loss, should be closely monitored. Many studies have reported that levels of hypohydration  $\geq 2\%$  of body mass, negatively impacted physical performance; nevertheless, as abstaining from drinking cannot be blinded to the subjects, there was no evidence of the actual real cause of the physical performance decrement. Recently however, Funnel et al. (35) have investigated the effect of inducing a hypohydration status in blinded individuals (hydration being ensured by nasogastric tubes). To the best of the authors' knowledge, the aforementioned study is the first to show a negative effect of hypohydration (>3% body mass) on physical performance. It reinforces the advice given of ensuring adequate hydration pattern and at the same time avoidance of dehydration in athletes during Ramadan fasting (the primary target would be to keep hypohydration <2% body mass).

### **Body-cooling and mouth-rinsing strategies**

To maintain a thermoregulatory homeostasis, cooling strategies such as ice baths, cold towels, plunge pools, ice vests and appropriate clothing could be used at pre- and during exercise (4,17). Mouth-rinsing (fluids with or without carbohydrates) could lead to some relief, although the evidence for this strategy has been conflicting (36-38). Indeed, if mouth-rinsing has led to performance enhancement in exercise of prolonged duration (36), it did not show any similar positive effects during all-out repeated sprints performed after 3 days of Islamic religious fasting in trained adults (39). Of religious interest is to note that Ramadan-fasted individuals who are engaging in mouth-rinsing during exercise should take into consideration the findings of the latter study, showing that when mouth-rinsing in-between all-out maximal sprint efforts, there is

(i) a slight risk of inadvertently swallowing some of the gurgled liquid and (ii) accurate weighing of the fluid used for mouth-rinsing and therefore expectorated, showed that a small quantity remains in the subject's mouth. Whether this residue is subsequently evaporated by hyperventilation and/or swallowed while the subjects do not feel/realize it, is presently unknown. These considerations could have important religious consequences and should be clearly explained to the fasted Muslim athletes before considering any mouth-rinsing procedures.

### **Sleep**

As sleep is an important pre-requisite for optimal sport performance and also from an injury prevention prospective (40), athletes should avoid sleep deficit and chronic sleep deprivation that typically accompany the life style changes occurring during Ramadan. Scientific evidence has shown that during the month of Ramadan, sleep tends to decrease both from a quantitative standpoint (by approximately 60 min in football players and by 88 min in middle-distance athletes) and from a subjective point of view (in terms of sleep quality) (6,19). Thus, in general, Ramadan-fasting led to around ~60 min of loss of sleep time a day throughout the Ramadan period. On the other hand, however, it has been reported that Muslim athletes tend to indulge in daytime napping much longer during Ramadan than out of Ramadan (17,41). Daytime naps of about ~30-40 minutes could be a useful strategy to help to make-up for the loss of nocturnal sleep, and preserve alertness and adequate neuro-behavioral responses to stimuli (42).

Athletes could also make self-adjustments to the new sleeping schedule during Ramadan, and this should be done gradually taking into account the athlete's chronotype: for instance, going to sleep earlier or later could be another helpful technique for morning- and evening-chronotypes athletes, respectively. Athlete's sleep pattern should be carefully controlled, using non-pharmaceutical approaches such as sleep diaries/registries, psychometric tools (assessing sleepiness or alertness). Pharmaceutical strategies should only be used after exceptional considerations and must be managed by a physician. Finally, coaches and sports managers should instruct and educate athletes regarding the importance of an adequate sleep level and its impact on psychomotor performance (43), and hopefully the acquired knowledge

will increase the chances that the athletes voluntarily adopt an optimal sleep behavior during the month of Ramadan.

### **Psycho-cognitive impact of Ramadan fasting**

Athletes experience varying levels of stress during the month of Ramadan, due to the disruption and/or alteration of their biological clock. This led to not only mood being negatively disturbed, but both physical and mental fatigue has been shown to increase during Ramadan in soccer players (15). Interestingly, a mere 3 days of Islamic fasting similar to Ramadan fasting, has shown that the individual's simple- and multiple-choice reaction time to be negatively impacted (44). Importantly, the latter study investigated cognitive functions under valid ecological conditions, i.e., with the participants performing the cognitive assessment in-between exercise sprints effort. Other study designs with such evaluation performed separately having shown no effect. Thus, the findings of Cherif et al. (44) study suggest that decision-making behaviors during exercise/competitions conditions may be adversely affected in Ramadan. In that regard, it is important to consider the ecological validity of the study designs to inform real world actors (athletes and coaches).

From a psychological prospective, Farooq et al. (45), have shown that elite footballers had strong negative beliefs and attitudes toward Ramadan fasting with regard to their exercise performance capacity. This is of particular importance due to the potential nocebo effect of observing Ramadan fasting during exercise, as was previously suggested by Aziz et al. (25,46). Indeed, the latter researchers showed that compared to the non-fasted condition, exercising in the Ramadan-fasted condition led to a rather surprisingly low physical performance very early during the exercise (where physical fatigue is not likely to occur since endogenous resources are not limited at this time-point), and strongly suggested that this early observation of "fatigue" in the Ramadan-fasted state was potentially due to a nocebo effect (negative belief that Ramadan is obviously having a deleterious effect on physical performance). Interestingly, these authors mentioned that this decrease in performance could also be due to the nocebo effect and/or poor pacing strategy in the Ramadan-fasted athletes (25,46).

The social support network around the athlete as well as the strength of the athlete's spiritual beliefs and the

so-called “religious intelligence”, could be moderating variables in coping with stressors experienced during Ramadan fasting. Mental preparation courses could be attended by Muslim athletes prior the commencing of the Ramadan fasting, in order to learn proactive coping skills (4,17,47). Coaches and managers are encouraged to consider preparing Ramadan with training-rehearsal with athletes who are planning to train and compete in the fasted state before the commencement of Ramadan. This act of rehearsal could help dampen the eventual negative perceptions and/or improve the pacing strategies of fasting Muslim athletes during exercise. In that regard, it seems that experienced athletes, i.e., individuals having fasted for multiple Ramadan-months in their lives, have better coping strategies than beginners (48). Indeed, young boys performing the religious fast for the first time in their lives showed a clear reduced physical performance compared to their performance out of Ramadan periods (49).

Other potential ways of counteracting decrements in physical performance during Ramadan may also be considered, such as listening to music during pre-exercise warm-up which has been shown to help to maintain their exercise performance, by distracting the fasted athletes from the “challenges” of Ramadan fasting (50). There are other promising strategies, such as listening to Holy Qur’an (51), but despite its potential effect on fasting believers, no study has been conducted as yet.

#### **Ramadan, weight categories’ sports, and injury risk**

Fasting during Ramadan for weight categories sports athletes could be more of a challenge (52). Such athletes are encouraged to approach their competition target body weight way ahead before the commencement of Ramadan because tempting to lose weight in addition to training and observing the Ramadan fasting could result in extreme challenges. In addition, Ramadan is accompanied with biological alterations showing an increase in markers of muscle injury (53). This could explain the slight but significant increase in overuse injuries observed in Tunisian football players (54). Nevertheless, the Chamari et al. (54) study’s findings has not been confirmed by a later study conducted in a Middle-East country where Ramadan was not accompanied with any change in injury rates in several teams from the Qatar first league (55). However, it should be highlighted that training and matches in the above-mentioned studies were played during the afternoons and

evenings, respectively, a marked difference of conditions. Despite these contradictory results, and with no direct evidence of the effects of Ramadan fasting on injuries in athletes, emphasis should then be placed on implementing injury prevention strategies during Ramadan. In that regard, the coaches and fasted athletes should therefore optimize their sleep, nutrition, and hydration since these key factors not only reduces their risks to injury during exercise, but also maximizes performance when training and competing in the Ramadan-fasted state.

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### **CONCLUSION**

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Ramadan fasting can negatively impact on some selected athlete’s exercise psychomotor and physical performances. In designing and implementing *ad hoc* training session protocols, coaches and sports managers should take into account the physiological perturbations induced by the observance of the fast, such as hypohydration, nutrients depletion, altered mood, and perceived fatigue; and therefore, should adopt a progressive and appropriate approach, which facilitates athletes to adapt to the religious fasting regimen. Some practical recommendations to counteract or at least mitigate the impact of the Ramadan fasting (when it exists) have been provided in this review. It is important to stress that this approach should be individualized based on the specific needs and physiological and/or psychological characteristics of the fasting athletes. Further research in this field is warranted and a tight collaboration between researchers and sports practitioners is strongly encouraged.

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