

# Practical recommendations to improve sleep during Ramadan observance in healthy practitioners of physical activity

## Recommandations pratiques pour améliorer le sommeil pendant le jeûne de Ramadan chez des pratiquants sains de l'activité physique

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### RÉSUMÉ

**Contexte:** Au cours du mois de Ramadan, plusieurs Musulmans continuent à pratiquer de l'activité physique (AP) et/ou de participer à des compétitions sportives. Cependant, la combinaison de l'observance du Ramadan (OR) et de l'AP est susceptible d'être associée à une perturbation du rythme veille-sommeil.

**Objectifs:** (i) Évaluer les effets de l'OR sur les habitudes de sommeil des pratiquants de l'AP et (ii) proposer des recommandations pratiques, fondées sur des preuves scientifiques, permettant d'améliorer les habitudes de sommeil d'un sujet actif qui pratique l'OR.

**Méthodes:** Le contenu complet de deux bases de données, PubMed/MEDLINE et Web of Science, a été examiné jusqu'au 25 Mars 2019. Tous les articles acceptés concernaient des pratiquants sains de l'AP et qui avaient évalué la quantité et/ou la qualité du sommeil nocturne et/ou la durée des siestes quotidiennes avant et pendant le Ramadan.

**Résultats:** Treize études ont évalué la durée totale du sommeil (DTS) des sujets physiquement actifs. Par rapport à avant Ramadan, la DTS a diminué dans cinq études, a augmenté dans une étude et est resté inchangé dans sept études. La qualité du sommeil a été auto-estimée dans cinq études. Trois études ont montré une diminution de la qualité du sommeil et deux n'ont signalé aucun changement. La durée des siestes quotidiennes a augmenté dans deux études.

**Conclusions et recommandations pratiques:** La poursuite de l'AP pendant l'OR n'a pas diminué la DTS. Cependant, aucune conclusion définitive ne peut être tirée en ce qui concerne la qualité et/ou les caractéristiques du sommeil et la durée des siestes quotidiennes. La quantité et la qualité du sommeil doivent être évaluées afin de lutter contre les perturbations du sommeil. Les personnes physiquement actives devraient éviter les repas copieux la nuit et, si possible, faire une sieste de 20 à 30 minutes pendant la journée. Une douche de 10 minutes à -40 °C et une vidéo d'induction de pleine conscience, auto-administrée pendant six minutes, peuvent être utiles immédiatement avant le coucher. Une supplémentation en tryptophane (1 g/jour) ou de mélatonine (5 à 8 mg) peuvent également améliorer les caractéristiques du sommeil.

### Mots-clés

Religion; Caractéristiques du sommeil; Guide; Individus actifs

### SUMMARY

**Background:** During the month of Ramadan, many Muslims continue to exercise and/or to compete in sporting events. However, the combination of Ramadan observance (RO) and physical activity (PA) is likely to be associated with disrupted sleep-wake patterns.

**Objectives:** to (i) evaluate the effects of RO on sleep patterns in practitioners of PA and (ii) provide some evidence-based practical recommendations to improve an active individual's sleep patterns during RO.

**Methods:** The entire content of two databases, PubMed/MEDLINE and Web of Science was searched for relevant articles through March, 25 2019. All accepted articles concerned healthy practitioners of PA and have assessed sleep quantity and/or quality and/or daily naps, whether based on objective or subjective methods.

**Results:** Thirteen studies evaluated total sleep time (TST) of active individuals in relation to RO; TST decreased in five studies, increased in one and remained unchanged in seven studies. Sleep quality was self-estimated in five studies, with three noting a decreased quality of sleep and two reporting no change. The duration of daily naps was increased in two studies.

**Conclusions and practical recommendations:** Continuation of PA during RO did not decrease TST. However, no firm conclusions can be drawn regarding sleep quality/characteristic and daily naps durations. Sleep quantity and quality should be evaluated in order to counteract sleep disturbances. Physically active individuals should avoid large late night meal, and if possible take 20- to 30- minute daytime naps. A 10- minute shower at -40°C and a self-administered 6-min mindfulness induction video may be helpful immediately before bedtime. Tryptophan (1g/day) or melatonin (5- 8mg) supplements may also improve sleep characteristics.

### Key-words

Religion; Sleep characteristics; Guidelines; Active individuals.

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## INTRODUCTION

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Adequate sleep is essential for optimal health (1,2), physical performance (3), and exercise recovery (4). However, several studies have reported impairments in the total sleep time and its quality in the face of the multifaceted demands of sport participation, even in the absence of Ramadan observance (RO) (5-11). Issues include early morning training sessions (12-14), late-night competitions (15-20), tightly-packed competitive periods (6,11), travel to away matches (11), high training loads (21), jet-lag (22,23) and high altitude exposure (24). Moreover, Lastella et al. (25) suggested that disturbed sleep may indicate overreaching and/or overtraining.

The resulting disruption in sleep-wake patterns has an adverse impact upon physical (26,27) and cognitive performance (28-30), competition outcomes (31,32), mood state (31,33), and immune function (34,35). These issues may all be exacerbated for individuals who continue to train and/or to compete during the holy month of Ramadan. During each day of Ramadan - between 29 or 30 days - healthy adult Muslims abstain from food and fluids, medications, smoking and sexual activities from dawn (el fajr) until sunset (el moghreb). Consequently, meals are taken at night and the normal day-night rhythm is disturbed by rising for the souhour meal, prayers, nocturnal training sessions and/or competitions, and nocturnal social activities.

Given the importance of adequate sleep to optimal performance and recovery, it is necessary to examine the impact of RO upon sleep patterns, and also to offer practical recommendations to minimize disturbances of sleep-wake behavior. Therefore, a review of the literature on this specific topic was undertaken and some evidence-based practical recommendations are offered to coaches and active individuals.

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## REVIEW METHOD

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The process of article selection is outlined in Figure 1. The entire content of PubMed and Web of Science was searched through to March, 25 2019. The literature search was performed using a Boolean combination of the keywords: [(Ramadan)] AND [(athletes) OR (amateur) OR (professional) OR (player) OR (physically active)] AND [(sleep)] OR (sleep patterns) OR (sleep characteristics) OR (sleep architecture) OR (sleep habits) OR (sleep quality) OR (sleep quantity) OR (sleep duration) OR (total sleep time) OR (daytime nap) OR (daytime napping)]. Original

articles, published in English-language peer-reviewed journals, that assessed sleep quantity and/or quality and/or daily naps, whether based on objective or subjective methods, were accepted for analysis. Review articles, conference proceedings, and articles based on sedentary individuals were excluded. The reference lists of identified articles were also searched for additional sources.

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## RESULTS

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### Study selection and characteristics

The initial search process yielded 64 articles, of which 14 papers were retained for the analysis. Many investigators (n=8) enrolled soccer players (36-43), but the remaining studies included cyclists (44), runners (45,46), martial arts participants (47), and power trainers (48). One study enrolled subjects practicing PA for recreational purposes (49). Observations from these studies are summarized in Table 1. All participants were male, with mean ages ranging from 15 to 27 years. The total population included 288 individuals.

### Sleep quantity, quality and architecture in practitioners of physical activity during Ramadan

#### Total sleep time

Among thirteen studies specifying total sleep time (TST), five studies showed a decrease of TST during compared to before Ramadan (37,40,46,47). The remaining seven studies of athletes, all observed no change in TST during Ramadan (36,42-45,48,49). One study reported that the TST of professional Qatari soccer players increased by 99 min during RO (39).

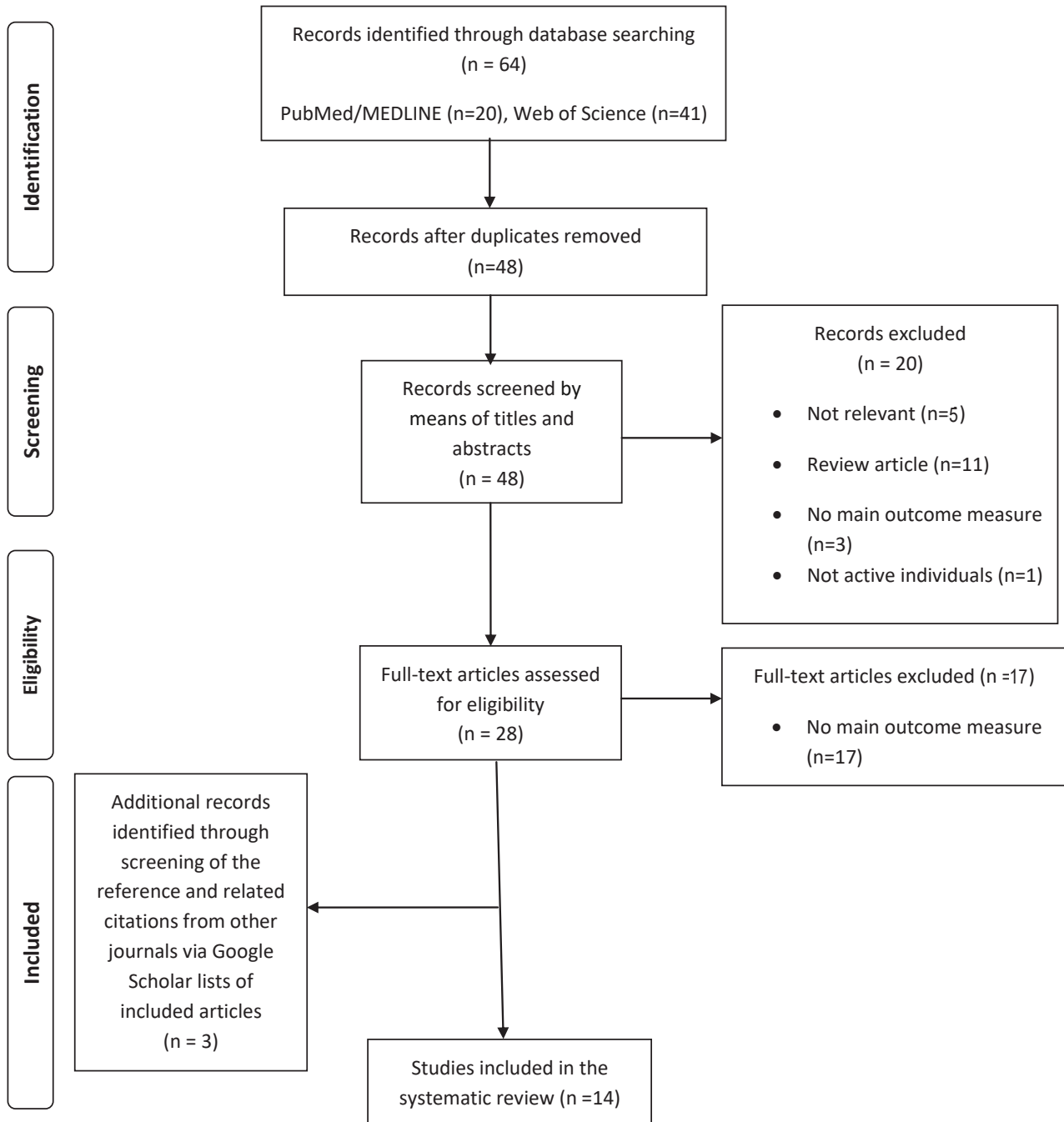
#### Sleep quality/architecture

Using the ambulatory electroencephalography technique, Chamari et al. (44) reported clear disturbances of sleep patterns and architecture during RO with significant increases in the number of awakenings and the duration of light sleep relative to before Ramadan.

Using the Arabic validated version of the Pittsburgh sleep quality index (PSQI) questionnaire (50), Herrera (40) reported that a substantial proportion of soccer players suffered from poor sleep quality during RO. Nevertheless, neither sleep onset latency nor sleep efficiency changed during Ramadan (40).

Boukhris et al. (49) showed that the total PSQI scores for sleep latency and sleep efficiency did not change

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram



**Table 1.** A summary of the studies that assessed sleep characteristics during Ramadan in healthy practitioners of physical activity.

Study	Subjects	Age	Activity	Level of practice	Training program	Sleep Parameters	Method of Sleep measurement	Measurement period	Effects
Karli <i>et al.</i> (47)	10	22 ± 1	Power athletes (2 wrestlers, 7 sprinters and 1 thrower)	Elite	More than 2 hours a day; 6 days a week for at least 4 years.	TST	NM	NM	No change
Zerguini <i>et al.</i> (35)	55	NM	Soccer	Professional	NM	TST	NM	Two weeks before the beginning of Ramadan, in the last week of Ramadan and 2 weeks after the end of Ramadan	No change
						Sleep quality			Three-quarters of the players said that the quality of their sleep was poorer than before Ramadan
Leiper <i>et al.</i> (36)	54 observant, 33 non-observant	18± 1	Soccer	Junior league (amateur)	NM	TST	Questionnaire	Daily records	Loss of 60 minutes sleep/day throughout Ramadan in those fasting; those not fasting lost 105 min/day during the first week of Ramadan
						Sleep quality			No change in the fasters and non-fasters
Meckel <i>et al.</i> (37)	19	15.1±0.9	Soccer	First division team in the Israeli youth league	6.4 * 0.2 h/week (regular month) vs. 4.5 * 0.1 h/week (Ramadan)	TST	NM	Each day during the week before fasting, and during the last week of the Ramadan fast	No change
Chennaoui <i>et al.</i> (44)	8	25± 1	Middle-distance athletes	NM	6 to 10 times per week for at least 3 years	TST	Sleep logs	Day -5 (24h): before Ramadan; Day 0 Day 21 Day 31 (24h): during Ramadan	Decreased 86 min 21 days after the beginning of Ramadan and did not change at the end of Ramadan
Wilson <i>et al.</i> (38)	10	25±3.4	Soccer	professional	19 and 20 training sessions during the 56-day analysis of Ramadan and post-Ramadan/ pre-season training during Ramadan	Timing of sleep	Actigraphy	All the study	Bedtime delayed 199 minutes TST increased 99 minutes
						TST			
Aziz <i>et al.</i> (45)	10	27.3±7.2	Running	Moderately trained	Two and four times per week, between 15 and 25 km a week, during the last 3 months before the start of the study.	TST	NM	24 h	Decreased 180 min/day
						Daytime sleepiness	Karolinska sleepiness scale	24 h	No change
Tian <i>et al.</i>	18	21 ± 3	Martial art	Elite	8.9 (±2.8) hours/week	TST	NM	NM	Decreased 102 min

(46)			(Penack silat)			Daily naps	NM	NM	Increased 162 min
Herrera <i>et al.</i> (39)	9	26 ± 4	Soccer	Professional	NM	TST	PSQI	One week before Ramadan and during the last week of Ramadan	78 min/day less sleep in the fourth week of Ramadan compared with days before Ramadan
						Sleep efficiency	PSQI		No change
						Sleep onset latency	PSQI		No change
						Insomnia symptoms	ISI		No change
						Daytime sleepiness	ESS		No change
Chamari <i>et al.</i> (43)	11	21.6 ± 4.8	Cycling	7 seniors and 4 juniors	The participants had cycling training experience of 9.6 ± 3.6 years	TST	Ambulatory EEG	The last week before Ramadan (BR), at the end of the first week of Ramadan (RA1), at the end of the fourth week of Ramadan (RA4), and at the end of the second week post-Ramadan (PR)	No change
						Sleep macro-architecture			Light sleep duration significantly increased at RA1 and RA4 and then turned back to baseline values at post-Ramadan, while deep and REM sleep stages duration progressively decreased during the study to reach significantly lower values than baseline at 2 weeks PR.
						Periods of sleep interruption			Increased by 2 folds
Aziz <i>et al.</i> (41)	14	21.8 ± 2.4	Soccer	NM	3–5 times a week, between 60 and 90 min per session, and played a competitive match at the end of the week	TST	Actigraphy	24h	No change
Baklouti <i>et al.</i> (40)	24	24 ± 4	Soccer	Semi-professional	The players participated only in the training program specific to the experimental protocol, which was scheduled during the off-season period	Sleep quality	Hooper questionnaire	Before Ramadan and at the end of the fourth week of Ramadan	Decreased
Aziz <i>et al.</i> (42)	13	20.1 ± 0.9	Soccer	Local league (amateur)	Before the first match (i.e., Match 1) of the control session, the team trained four times per week and played one	TST	Actigraphy	In the Ramadan-fasted and non fasted state	No change
						Daytime nap	Actigraphy		Increased during Ramadan

Boukhris et al. (48)	13	21.2 ± 2.9 years	Running	moderately trained	league match at the end of the week. However, during Ramadan, training was reduced to between 2 and 3 times a week and no competitive match was played.	Daytime sleepiness	ESS	Fifteen days before Ramadan, the first ten days of Ramadan, the last ten days of Ramadan, ten days after Ramadan and twenty days after Ramadan	No change
					They regularly practice physical exercise (e.g., jogging) for at least 3 hours per week	TST			Decreased after Ramadan in comparison with during Ramadan
						Sleep latency (min)			Not change
						Sleep efficiency (%)			No change
						Total score of PSQI			Increased ten days after Ramadan in comparison with during Ramadan

Abbreviations:

BR: last week before Ramadan, EEG: electroencephalography, ESS: Epworth Sleepiness Scale, ISI: Insomnia Severity Index, NM: not mentioned, PR: at the end of the second week post-Ramadan, PSQI: Pittsburgh Sleep Quality Index, RA1: at the end of the first week of Ramadan, RA4: at the end of the fourth week of Ramadan, TST: total sleep time.

significantly during Ramadan. Further, the total PSQI score during Ramadan was lower than five, suggesting a good sleep quality. Similarly, the absence of any change in sleep quality was noted when applying a questionnaire to Tunisian soccer players (37). On the other hand, a deterioration in sleep quality during Ramadan was reported in 24 Tunisian amateur soccer players (41) who responded to the Hooper Questionnaire (51) and in 55 professional soccer players who were interviewed (36).

**Daily naps**

Tian et al. (47) reported that the average daily nap duration of martial art practitioners increased from 20 minutes before Ramadan to 180 minutes during Ramadan. Also, Aziz et al. (43) reported that the daily nap duration increased from 10.4 minutes before to 100.4 minutes during Ramadan.

**DISCUSSION**

The main findings are that the TST of athletes is unchanged and the duration of daily naps is increased during Ramadan. However, the number of studies

investigating the effects of RO on sleep quality is limited, thus precluding firm conclusions about the impact upon sleep behavior in active individuals. The single study conducted on physically active subjects is not enough to confirm the absence of change on sleep characteristics during the month of Ramadan. Further, there is yet no published information on sleep quality in relation to exercise or physical performance in female.

**Effect of Ramadan observance on total sleep time in athletes**

Most of the studies of athletes found that TST did not change during Ramadan observance (36,38,42-45,48,49). Chamari et al. (44) have suggested that this can be explained, at least in part, by the close monitoring of athletes by technical and medical staff during training. Other factors may also be involved, possibly including an awareness by athletes of the importance of maintaining sleep patterns, and a practice of staying in bed for a long period in order to reduce consciousness of the fact that they are not eating during daylight hours (52). In physically active but not athletic individuals, the

effects of moderate intensity PA may also contribute to maintenance of a normal TST during Ramadan (49). With the exception of the reports of Chamari et al. (44) and Aziz et al. (42), the TST observed in the remaining studies (36,42,43,45,48,49) exceeded the recommended seven h/day (53), underlining that active individuals continued to get an adequate duration of sleep during Ramadan.

Based simply on sleep behavior, one might anticipate an absence of change in physical performance during RO. This view was supported by Boukhris et al. (49), who reported that short-term maximal performance and muscle fatigue were unchanged during Ramadan. However, other studies have reported decreases in both short- and long duration physical performance during Ramadan, which have been attributed to changes in fitness, mood state and/or motivation (36,42).

Five studies reported that TST was reduced during RO (37,40,43,46,47). With the exception of the study by Leiper et al. (37), the TST decreased to less than the recommended 8h/day during Ramadan, and in such circumstances a decrement in physical and cognitive performance is not surprising. Tian et al. (47) noted a decrease in the performance of some cognitive tasks by martial arts practitioners, and Aziz et al. (46) reported a significant negative impact of RO on alertness, concentration and endurance running. The latter group of investigators (43) further demonstrated that, during Ramadan, soccer players felt "less ready to compete" and were "less able to concentrate" prior to their match. Additionally, the PA profile during a soccer game was adversely affected (i.e., a lower total distance covered, a lesser distance run within the moderate and high- speed zones, and a lower relative speed throughout most of the match) (43).

Discrepancies between studies could reflect differences in culture and lifestyle in the countries concerned (54), or the use of differing tools/methods to assess sleep characteristics (54).

#### **Effect of Ramadan observance on sleep quality/architecture in practitioners of PA**

Five studies evaluated the effect of RO on sleep quality in active individuals. Boukhris et al. (49) found that sleep efficiency, sleep latency, and total PSQI score did not change during Ramadan. Likewise, Herrera et al. (40) reported that PSQI score of professional soccer players remained unchanged during Ramadan. However, more

than 50% of the soccer players concerned had a PSQI score of five or above, and approximately 20–30% had a score of eight or above either before or during Ramadan (40). Such results suggested that a substantial percentage of the athletes suffered from poor sleep quality, irrespective of any changes associated with RO. Recently, Drew et al. (10) attributed the increased PSQI score of Olympic athletes during the preparatory period of the 2016 Summer Olympic Games to gastrointestinal tract symptoms, perhaps related to interruption of sleep and therefore impaired sleep quality by the large size of their evening meal. Leiper et al. (37) reported that despite having about 1 hour less sleep every night throughout Ramadan, the TST of their athletes still averaged more than eight hours, and thus sleep quality was not compromised. Using an electroencephalographic technique, Chamari et al. (44) reported that light sleep stage duration increased significantly during Ramadan, associated with an increase in the number of awakenings, possibly due to souhour and/or increased food-seeking behaviors (44). Zerguini et al. (36) reported that sleep quality of Algerian elite soccer players was impaired during Ramadan (36), again attributing this to the late evening food intake (36).

#### **Effect of Ramadan observance on daytime naps**

The beneficial effects of napping on cognitive and physical performance are well documented (34,55-58). A 30 minutes nap-time was recommended by Davenne (59) and Sampson et al. (60) to avoid sleep inertia, the temporary decrease of mental ability that often follows a longer period of sleep. On the other hand, if naps are substantially shorter than 1 h, they do not provide insufficient time for the slow wave sleep that is important to recuperation (59). Reported nap durations ranged between 1-2 h (43) and 3.0 h (47), thus providing sufficient time to reach slow-wave sleep but posing the risk of post-nap inertia with negative short-term effects on cognitive and physical performance.

#### **Strengths and weaknesses**

The strengths of this review include a comprehensive coverage of the literature and the development of practical recommendations. The major limitations are the lack of information about female, the paucity of objective studies evaluating sleep quality and architecture during Ramadan, and a need for more information concerning active but not athletic individuals. Future studies evaluating sleep quality during Ramadan using polysomnography are

recommended. Moreover, due to the beneficial effects of sleep on health, future studies should investigate the effects of RO on subjects who engage in PA for recreational purposes rather than athletic competition, and investigations should examine dose/response relationships. Available results must be interpreted with caution, since there are methodological inconsistencies between studies and sub-optimal study design features (e.g., lack of a control group, different training loads, and the use of subjective measurement tools).

### Practical recommendations:

Practical recommendations to minimize Ramadan-related disturbances of sleep in active individuals include:

- Sleep quantity and quality should be evaluated in active individuals in order to plan tactics to counter any sleep disturbances.
- Sleep hygiene education can help to improve the sleep characteristics of athletes (61). Sleep hygiene involve practicing behaviors that facilitate sleep while deliberately avoiding factors that interfere with sleep (61). It includes counselling on lifestyle, behavior, and environmental factors such as light, sound and temperature that influence sleep. Recently, O'Donnell and Driller (61) have shown that a single one-hour sleep hygiene education session is effective in improving the amount of sleep taken by elite female athletes, and sleep hygiene education should be advised for subjects engaged in physical activity during the month of Ramadan.
- Coaches should participate to sleep hygiene education sessions during each sports season.
- Sleep specialists should be integrated into sports clubs.
- Napping has a positive effect on physical performance (34,56,58), and a daily 20- to 30-minute nap should be planned to improve alertness (62).
- Large and late meals before bedtime should be avoided (63).
- Claims that supplements such as tryptophan (1g/day) or melatonin (5-8mg) improve sleep characteristics (64) during Ramadan should be verified.
- A self-administered 6-minutes mindfulness induction via a video clip immediately before bedtime may help to decrease pre-sleep arousal and improve sleep quality after evening training sessions (66).

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## CONCLUSIONS

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The continuation of physical training during Ramadan does not affect TST; but increased daily nap duration. No firm conclusions can be drawn regarding the effects of RO on sleep quality and characteristics due to the limited number of available studies and the lack of objective measurements. Moreover, all findings to date on these topics must be interpreted with some caution, due to a variety of important methodological issues and inconsistencies.

Compliance with Ethical Standards

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