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ORIGINAL RESEARCH

Effect on training and sleep patterns of male combat athletes during Ramadan

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Abstract

During the sacred period known as Ramadan in the Islamic faith, abstaining from food and drink is observed from dawn until dusk. This fasting practice can lead to alterations in the circadian rhythm due to sudden shifts in dietary habits and sleep patterns. Given that changes in circadian rhythm can impact sleep patterns, a relational survey model was implemented in this investigation. Data collection involved the utilization of the Pittsburgh Sleep Quality Index (PSQI) alongside a sociodemographic survey. A total of seventy-three athletes willingly participated in the study. Statistical analysis was conducted using SPSS 25.0, employing the Mann-Whitney U test for variables with two parameters and the Kruskall-Wallis H test was for those with three or more parameters. The significance level was established at $p \leq 0.05$. Upon comparing the PSQI and its sub-dimensions, a statistically significant difference was observed in relation to age, alterations in mealtimes, changes in appetite, duration of sleep, and time required to fall asleep. Consequently, the data gathered in our study indicates that modifications in eating and sleeping schedules during Ramadan can disrupt the sleep quality of athletes.

Keywords

Circadian rhythm; Combat athlete; Sleep pattern; Training; Ramadan

1. Introduction

Globally, 1.8 billion Muslims [1] observe a practice of dietary restriction known as fasting to fulfill a religious duty during the holy month of Ramadan, which occurs in the ninth month of the Islamic lunar calendar [2]. This practice involves refraining from consuming food and drinking from dawn to dusk, also known as iftar [3]. While individuals follow a typical routine for 11 months of the year, the fasting period during Ramadan lasts for one month only. The abrupt alteration in the body's functions during this month-long fasting period leads to modifications in the regulation of the circadian rhythm and sleep patterns [4]. The circadian rhythm pertains to the daily fluctuations in physiological and biological processes within a living being. The rhythm is governed by the suprachiasmatic nucleus, situated in the anterior region of the hypothalamus, which oversees functions such as body temperature, the sleep-wake cycle, glucose balance, nutrient metabolism, cell cycle regulation, and the secretion of various hormones, including Growth Hormone (GH), Adrenocorticotropic Hormone (ACTH), and melatonin [5].

The changes in hormone secretion during Ramadan cause athletes to alter not only their eating and drinking schedules but also their sleeping patterns for a month. While athletes typically maintain a routine of eating, drinking, training, resting, and sleeping throughout the year, these sudden changes also disrupt the sleep pattern due to circadian rhythm changes in the body. The sleep-wake cycle is a fundamental circadian rhythm pattern determinant in humans [6]. Disrupted circadian rhythm in humans, whether caused by voluntary (*e.g.*, shift work or fast travel across time zones) or involuntary (*e.g.*, illness or advanced age) conditions, has been linked to impairments in various mental functions, physical performance, and productivity [7, 8]. Based on this information and driven by curiosity about the impact on athletes of changes in diet and sleep quality during the month of Ramadan, a decision was made to conduct this study.

Upon reviewing the literature, studies on fasting glucose during Ramadan [9, 10], studies on Ramadan and exercise [11–14], Ramadan and dehydration [15, 16], and Ramadan and circadian rhythm in young Malaysian athletes [17], Muslim Tunisian athletes [18], and male athletes [19, 20] were found. Additionally, studies concerning weight loss for combat athletes were identified [21–24]. However, there is a lack of studies investigating the quality of sleep of male combat athletes during Ramadan. Therefore, this study aimed to determine the effect of the altered sleep patterns of male combat athletes during Ramadan on their training.

2. Materials and methods

2.1 Data collection

This research was conducted in Kocaeli province, reaching the entire population of athletes who actively participated in various tournaments across Turkey. However, only 73 athletes agreed to participate voluntarily. Since the questions were required to be filled in Google forms, no missing or incorrect answers were given. The prepared scales were made available through "Google Forms" to be completed remotely, and the study was conducted online using the snowball sampling method during the Ramadan month of 2023. In total, 33 athletes were from boxing, 8 from kickboxing, 17 from taekwondo, and 15 from karate.

2.2 Data collection tools

2.2.1 Socio-demographic survey

The athletes were asked a total of 11 questions about their age, gender, the combat sport they are interested in, employment status, place of residence, income, the effect of changing their eating habits, changes in appetite, their level of interest in the sport, the number of days they train per week, and their daily tea and coffee consumption.

2.2.2 Pittsburgh sleep quality index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI), developed by Buysse *et al*. [25] and validated in Turkish by Ağargün *et al*. [26], was utilized for data acquisition. The PSQI comprises 24 items and encompasses six sub-dimensions: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, sleep medication use, and daytime dysfunction. Respondents answered the pertinent items on a 4-point Likert-type scale, ranging from 0 to 21. The Cronbach's alpha coefficient of the scale was determined to be 0.836.

The Pittsburgh Sleep Quality Index (PSQI) developed by Buysse *et al*. [25] in 1989 is a comprehensive scale designed to assess sleep quality. Comprising a total of 24 questions, this index provides a detailed evaluation of various aspects of sleep, including duration, latency, and frequency of disturbances. The 18 items are categorized into seven components, each scored on a scale of 0–3. By summing up the scores of these components, a total index score ranging from 0 to 21 is obtained. A higher total score on the PSQI indicates poor sleep quality, with a total score of five or above suggesting suboptimal sleep patterns. It is important to note that while the PSQI can identify sleep issues, it does not diagnose specific sleep disorders or their prevalence.

2.3 Data analysis

The data were analyzed using the Statistical Package for the Social Sciences version 25.0 (IBM SPSS Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test assessed whether the data followed a normal distribution. Since the data did not exhibit a normal distribution based on Skewness Kurtosis scores, non-parametric tests were used for analysis. The Mann-Whitney U test was used for independent variables with two parameters, while the Kruskall-Wallis H test was used for those with three or more parameters. A significance level of $p \leq 0.05$. Descriptive statistics were also performed for the sociodemographic data.

3. Results

Table 1 lists participant demographics. Of the participants, the largest age groups were 17–20 (68.5%), those living with family 68 (93.2%), those whose training was negatively affected by the change in eating hours during Ramadan 45 (61.6%), those who perceive a decrease in their appetite 39 (53.4%), the highest participation of those who are interested in combat sports is boxing 33 (45.2%), those who train 5 days and above a week 29 (39.7%), and those who consume the most coffee daily 45 (61.6%).

Upon analysis of Table 2, it was determined that there were no statistically significant variances in any of the sub-dimensions of the Pittsburgh Sleep Quality Index when considering the age factor among women ($p < 0.05$). Likewise, when examining the impact of age on men, no significant differences were observed in the Subjective Sleep Quality, Sleep Duration, Habitual Sleep Activity, Sleep Disorder, Sleep Medication Use, Daytime Dysfunction sub-dimensions and PSQI total scores ($p > 0.05$), and a significant difference was found only in the Sleep Latency sub-dimension between 17–20 years of age and 31 years and over according to the age variable of men ($p < 0.05$).

Table 3 upon analysis of the Pittsburgh Sleep Quality Index in relation to the variable of feeding time change among men, there was no statistically significant difference observed in the sub-dimensions of Sleep Latency, Sleep Duration, Habitual Sleep Activity, Sleep Disorder, Use of Sleep Medication, and total PSQI scores ($p > 0.05$), and a significant difference was found between the sub-dimensions of Subjective Sleep Quality and Daytime Dysfunction according to the feeding time change variable of men ($p < 0.05$).

Upon analyzing Table 4, no significant differences were found in the sub-dimensions of Subjective Sleep Quality, Sleep Latency, Sleep Duration, Habitual Sleep Efficacy, Sleep Disorder, Sleep Medication Use, Daytime Dysfunction ($p > 0.05$) when comparing the Pittsburgh Sleep Quality Index based on changes in appetite among men ($p > 0.05$). However, a significant difference was observed in the total scores of the PSQI among men who reported changes in appetite ($p < 0.05$).

Table 5 illustrates that when comparing the Pittsburgh Sleep Quality Index based on the sleeping hours of male participants, there was no significant difference observed in the sub-categories of sleep latency, sleep duration, habitual sleep activity, sleep disorder, sleep medication use, and Daytime Dysfunction ($p > 0.05$): 00:00–00:00–05:00 hours later in the subjective sleep quality sub-dimension and the total scores of PSQI (Pittsburgh Sleep Quality Index) 21:00–00:00–00:00–01:00–04:00 and 21:00–00:00–05:00 hours later ($p < 0.05$).

Table 6 is examined. When the Pittsburgh Sleep Quality Index was assessed based on the variable of time taken to fall asleep in men, no statistically significant discrepancy was observed among Subjective Sleep Quality, Sleep Duration, Habitual Sleep Activity, Sleep Disorder, Sleep Medication Use, Daytime Dysfunction sub-dimensions and PDQI total scores ($p > 0.05$), A significant difference was found between 0–15 minutes–16–30 minutes, 0–15 minutes–31–60 minutes, and 0–15 minutes–61 minutes or more in the Sleep Latency subscale and between 0–15 minutes–31–60 minutes and 16–

TABLE 1. Statistics on demographic information.

Variable	Parameter	n	%
Age group			
	17–20 ages	50	68.5
	21–25 ages	13	17.8
	26–30 ages	2	2.7
	31 years of age and above	8	11.0
Place of residence			
	Family	68	93.2
	Alone	5	6.8
Did the change in hours of nutrition during Ramadan affect you and your training?			
	Negatively affected	45	61.6
	Positively affected	28	38.4
Have you experienced a change in appetite?			
	Decreased	39	53.4
	Increased	34	46.6
Interested in martial arts			
	Boxing	33	45.2
	Kick boxing	8	11.0
	Taekwondo	17	23.3
	Karate	15	20.5
How many days a week do you train?			
	1–2 days	17	23.3
	3–4 days	27	37.0
	5 days and above	29	39.7
Your daily tea and coffee consumption rate			
	1–4 cups	45	61.6
	5–10 cups	6	8.2
	Not consuming	21	28.8
	11 cups and above	1	1.4
Total		73	100.0

TABLE 2. Comparison of Pittsburgh sleep quality index scores according to age variables.

	n	Male x ± sd	Kruskal-Wallis H	*p*	*Post hoc*
Sleep latency					
17–20 ages	50	0.92 ± 0.87	10.702	0.013*	1–4
21–25 ages	13	1.00 ± 0.57			
26–30 ages	2	1.00 ± 0.00			
31 years of age and above	8	2.12 ± 0.83			

*sd: standard deviation; *: Significant differences.*

TABLE 3. Pittsburgh Sleep Quality Index comparison according to the variable of how the change of eating hours affected you and training.

	n	Male x ± sd	*z*	*p*
Subjective sleep quality				
Negatively affected	45	1.69 ± 0.92	−2.202	0.028*
Positively affected	28	1.25 ± 0.70		
Daytime dysfunction				
Negatively affected	45	1.60 ± 0.88	−3.825	0.001**
Positively affected	28	0.75 ± 0.79		
PSQI				
Negatively affected	45	7.22 ± 2.57	−1.943	0.052
Positively affected	28	5.78 ± 2.60		

*PSQI: Pittsburgh Sleep Quality Index; *: Significant differences; **: More significant differences.*

TABLE 4. Comparison of the Pittsburgh Sleep Quality Index according to the variable "Have you noticed a change in your appetite?".

	n	Male x ± sd	*z*	*p*
Sleep latency				
Decreased	39	1.20 ± 0.92	−1.45442	0.145
Increased	34	0.91 ± 0.83		
PSQI				
Decreased	39	7.28 ± 2.64	−2.17831	0.029*
Increased	34	5.97 ± 2.54		

*PSQI: Pittsburgh Sleep Quality Index; *: Significant differences.*

TABLE 5. Comparison of the Pittsburgh Sleep Quality Index according to the range of sleeping hours.

	n	Male x ± sd	Kruskal-Wallis H	*p*	*Post hoc*
Subjective sleep quality					
21:00–00:00	23	1.13 ± 0.54	10.512	0.005**	1–3
01:00–04:00	34	1.56 ± 0.96			
05:00 and after	16	2.00 ± 0.81			
PSQI					
21:00–00:00	23	5.13 ± 2.47	11.100	0.003**	1–2 1–3
01:00–04:00	34	7.23 ± 2.48			
05:00 and after	16	7.68 ± 2.44			
Total	73	6.62 ± 2.66			

*PSQI: Pittsburgh Sleep Quality Index; **: More significant differences.*

TABLE 6. Comparison of the Pittsburgh Sleep Quality Index according to the time to fall asleep.

	n	Male x ± sd	Kruskal-Wallis H	*p*	*Post hoc*
Sleep latency					
0–15 mins	45	0.58 ± 0.58	12.52	0.002**	1–2 1–3 1–4
16–30 mins	20	1.55 ± 0.51			
31–60 mins	6	2.67 ± 0.52			
61 min and above	2	2.50 ± 0.71			
Sleep disorder					
0–15	45	1.38 ± 0.61	7.41	0.025*	1–3 2–3
16–30	20	1.35 ± 0.59			
31–60	6	2.17 ± 0.75			
61 min and above	2	1.00 ± 0.00			
Total	73	7.50 ± 0.71			

**: Significant differences; **: More significant differences.*

30 minutes–31–60 minutes in the Sleep Disorder subscale ($p < 0.05$).

Table 6 is examined. When the Pittsburgh Sleep Quality Index was assessed based on the variable of time taken to fall asleep in men, no statistically significant discrepancy was observed among Subjective Sleep Quality, Sleep Duration, Habitual Sleep Activity, Sleep Disorder, Sleep Medication Use, Daytime Dysfunction sub-dimensions and PDQI total scores ($p > 0.05$), A significant difference was found between 0–15 minutes–16–30 minutes, 0–15 minutes–31–60 minutes, and 0–15 minutes–61 minutes or more in the Sleep Latency subscale and between 0–15 minutes–31–60 minutes and 16–30 minutes–31–60 minutes in the Sleep Disorder subscale ($p < 0.05$).

4. Discussion

Sleep is a fundamental necessity for a healthy and vibrant life, fostering growth, development, learning, and rejuvenation from infancy onward, preparing individuals for the challenges of the following day [27]. It is widely acknowledged as a cornerstone in promoting physical development and athletic performance [28]. The integration of sleep, nutrition, and hydration in athletes' regimen is recognized to have a significant impact on enhancing their performance and recovery [29]. Given these insights, the study was conceived to explore the impact of abrupt changes in dietary and sleep patterns on the quality of sleep among combat athletes, particularly during the month of Ramadan when fluid intake and nourishment are restricted to specific hours.

Our research reveals a notable disparity in the sleep latency sub-dimension when comparing the Pittsburgh Sleep Quality Scale based on age groups, corroborating existing literature. It has been postulated that diminished sleep quality in men may be attributed to lower plasma melatonin levels [29]. Typically, melatonin secretion aids in reducing sleep onset latency, thereby augmenting both total sleep duration and quality [30]. Studies on athletes experiencing poor sleep quality during Ramadan have indicated alterations in melatonin peaks, influencing circadian rhythms due to variations in melatonin levels in circulation [31, 32]. Moreover, research suggests that melatonin secretion commences later in men, even under subdued lighting conditions [33, 34]. Notably, the time taken by male athletes to fall asleep varies significantly between the 17–20 age group and those aged 31 and above. Interestingly, while poorer sleep quality is prevalent among younger athletes, older athletes seem to experience less disruption in their sleep patterns. This disparity is attributed to the fact that young and active athletes tend to shift their training sessions to nighttime during Ramadan, leading to a decline in their sleep quality [35]. A comprehensive meta-analysis incorporating 18 studies indicates a decline in sleep quality among athletes who continue to train during Ramadan [36].

In our investigation, a notable discrepancy was observed in the subcategories of subjective sleep quality and daytime dysfunction when analyzing the impact of altering mealtimes on training efficacy. Sleep, a fundamental human necessity, constitutes 33% of our lifespan. Widely acknowledged as a pivotal factor for both physical and mental rejuvenation, sleep serves as the cornerstone of a well-rounded existence and is deemed as one of the most crucial physiological requirements [37]. While the quality of sleep has been linked to athletic performance [38, 39], it also holds a direct influence on dietary habits and physical capabilities [40], particularly evidenced by studies highlighting a decline in athletic performance during Ramadan [41]. Existing literature suggests that Ramadan may detrimentally affect athletic performance through its repercussions on both sleep patterns and nutritional intake [42–44]. Subsequently, the decline in training efficacy observed in male athletes as a result of altered mealtimes, along with the significant disparity in the subcategories of subjective sleep quality and daytime dysfunction, finds validation in the existing body of literature.

It was discerned that a substantial difference existed in the overall PSQI score when the scale employed was juxtaposed against the variable "The impact of altering mealtimes on training efficacy". Numerous studies in the literature underscore the potential diminishment in athletes' performance due to compromised sleep quality [45–49]. Consequently, this study revealed that the correlation between the decline in training efficacy among athletes and the overall PSQI score aligned with the prevailing literature.

Upon comparing the PSQI with the variable of appetite change, a marked alteration in the total score was noted. Previous research has indicated alterations in athletes' appetites during Ramadan [32], attributed to the abrupt and drastic shift in meal timings, ultimately resulting in a partial disruption of the usual circadian rhythm [50, 51]. The diminished appetite during Ramadan, stemming from the altered circadian rhythm, is attributed to reduced ghrelin levels in the bloodstream [52]. deduced that the deterioration in sleep quality and decreased appetite in male athletes could be attributed to the substantial impact of circadian rhythm-induced impaired melatonin secretion on food consumption and energy equilibrium [53].

A significant disparity emerged between the Subjective Sleep Quality sub-dimension of the Pittsburgh Sleep Quality Scale and the total PSQI score among athletes based on the variable of sleep duration when compared to the Pittsburgh Sleep Quality Scale. Similar to our research, individuals who work shifts and Saudi adults who fast during Ramadan encounter significant disruptions in their sleep patterns [25], as evident in Saudi Arabia and potentially in other Muslim nations. Sleep patterns linked to fasting are substantially disturbed [54], and the overall sleep duration reported in typically healthy individuals (including athletes) diminishes during Ramadan [55]. It has been indicated that there are significant alterations in both waking and bedtime routines during Ramadan [56]. A study objectively evaluated the sleep-wake schedules of eight Muslim and eight non-Muslim volunteers during a control period (1 week before Ramadan) and the initial two weeks of Ramadan utilizing the SenseWear Pro Armband in Saudi Arabia. It has been noted that Muslims experience a delay in bedtime and a notable decrease in waking times and sleep duration compared to non-Muslims [57], along with a propensity to postpone sleep onset, engage in more evening activities, rise later, and experience increased daytime drowsiness [58, 59]. The findings of our investigation align with existing literature. It has been observed that modifications in diet and lifestyle during Ramadan significantly impact the circadian rhythms of fighters, resulting in altered training and mealtimes, sleep patterns and duration, and an increase in nocturnal activities during Ramadan, leading fighters to retire later.

When analyzing sleep latency and sleep disturbances in our research, we discovered a notable rise in both aspects among male athletes. Specifically, an increase in sleep latency and sleep disturbance scores was observed in athletes experiencing difficulty falling asleep in comparison to those without such issues. Previous research utilizing polysomnography (PSG) to evaluate sleep quality revealed that, despite men reporting higher levels of sleepiness than women, non-REM stages 1 and 2 lasted longer for them. This distinction suggests a variance in sleep patterns rather than sleep efficiency. The crucial stages 3 and 4 of non-REM sleep, associated with physical restoration, are identified as deep sleep, and any disruptions to these phases can lead to sleep disorders [60]. The primary cause of sleep disturbances in men is attributed to interruptions such as sleep apnea (respiratory arrest) and microarousal (micro-arousal) [61, 62]. It is widely documented that respiratory issues tend to worsen with age, with clinical studies indicating that obstructive sleep apnea is more prevalent in men and can escalate to severe levels characterized by witnessed snoring [63]. This condition, referred to as obstructive sleep apnea syndrome (OSAS), manifests through symptoms like breathlessness, snoring and apnoea in men [64], mainly due to pharyngeal collapse that obstructs breathing, a phenomenon more frequently observed in men [65]. The disparity in pharyngeal collapse prevalence between genders is linked to variations in fluid redistribution from the legs to the neck [66] a shift shown to contribute to upper airway constriction [67]. Moreover, testosterone therapy has been associated with an increase in the apnoea-hypopnoea index (AHI) in hypogonadal men [68], As acute testosterone administration increases respiratory responses to hypoxia (oxygen deficiency) and hypocarbia (increased carbon dioxide in the blood), leading to respiratory imbalances and heightened susceptibility to apnea [69, 70]. Weight loss has been shown to elevate testosterone levels, which are typically low in individuals with obesity [71]. Additionally, individuals with OSAS exhibit lower testosterone levels compared to those without the condition [64]. Taking into consideration these findings, our study highlights disruptions such as heightened sleep latency, disturbances, and overall PSQI scores among male athletes, alterations in sleep durations during Ramadan, shifts in patients' sleep timings and meal intervals, anatomical changes, and sleep interruptions due to hormonal imbalances.

5. Conclusions

During the Ramadan period, changes in eating hours not only affect the quality of training in athletes but also impact subjective sleep quality and daytime dysfunction. Additionally, the overall sleep quality of athletes deteriorates with the change in their nutrition patterns. Athletes' sleep quality is also affected by the decrease in appetite observed during this period, and their sleep times change as well. Our study found that athletes who slept after 1:00 AM experienced impaired sleep quality. Overall sleep quality worsened with the change in sleep patterns. Athletes with a sleep onset time of 31 minutes or more experienced sleep disturbances, indicating that circadian rhythm changes, dietary changes and changes in training time are likely to disrupt overall sleep quality in male athletes. Our study also showed that the overall quality of sleep-in athletes deteriorates with age. Hormonal changes affect sleep architecture rather than the process of falling asleep, leading to changes in the body's energy and hormonal balance. This not only reduces athletic performance but also paves the way for various pathological conditions. The data obtained in our study suggests that changing eating and sleeping times during Ramadan disrupts the sleep quality of athletes and may affect the training quality of competitive athletes. Therefore, it is recommended that Muslim performance athletes gradually change their eating and sleeping hours before entering this month to mitigate these effects.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

HA and MSK—were used to design the study. HA—performed the research; analyzed the data. MSK—provided help and advice on research and discussion. HA, MSK, SKT, MEU and BK—wrote the manuscript. All authors contributed to the editorial changes in the manuscript. All authors have read and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics committee approval was obtained from the letter of Kocaeli University Social and Human Sciences Ethics Committee dated 11 April 2023 and is numbered E396527. The participants have voluntary participated this study.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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