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The Effect of Ramadan Fasting and Melatonin Supplementation on Sleep Quality, Melatonin and Growth Hormone to Cortisol Ratio in Male Athletes

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ABSTRACT

Introduction: Food habits and wake-sleep cycle influence circadian rhythms. Ramadan fasting (RF) changes food habits and wake-sleep cycle and causes a metabolic imbalance. Melatonin increases sleep quality and daily awareness. The purpose of this study examined the effect of four weeks Ramadan fasting and melatonin supplementation (MS) on sleep quality, melatonin levels and growth hormone (GH) to cortisol ratio in male athletes.

Methods: Thirty active men (20-25 years) were randomly divided into supplement (n=15) and placebo (n=15) groups. Body fat percentage and hormones (melatonin, growth hormone, cortisol and growth hormone-cortisol ratio) were evaluated in three times: before the month, mid fasting and post fasting. Blood samples collected at three times; before sleep, wake up time for Sahur and morning wake up time. To evaluate the intervention effect of supplement and sleep conditions on the dependent variable Repeated Measure (factorial 3*3*2) and Bonferroni post hoc tests were used.

Results: Melatonin (P=0.001), GH (P=0.001), GH-cortisol ratio (P=0.001) significantly increased in supplement group compare to placebo group. Also, Cortisol (P=0.003) and body fat percentage (P=0.001) decreased in the supplement group compare to placebo group. Sleep quality significantly improved in the supplement group (P=0.025).

Conclusion: Supplementing melatonin with improved anabolic conditions and regulated wake-sleep cycle can help the Ramadan fasting condition and prevent the decreased performance during Ramadan fasting.

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Introduction

Ramadan is the holy month of the Islamic calendar. This month is observed by Muslims as a month of fasting [1]. In Ramadan, Muslims wake up in the middle of the night to eat the first meal (Sahur) and then eat nothing until sunset (Iftar). Ramadan fasting impacts behaviors such as eating [2], sleep patterns [3, 4] and hormones, especially circadian rhythm dependent hormones (Melatonin, growth hormone and cortisol) [2]. Month of Ramadan is a unique model of change in sleep patterns [1, 5], food intake [6] and habits[7, 8]. Thus, Ramadan is an excellent opportunity with unique characteristics to study these changes.

Melatonin has a myriad of effects and is used as a reliable marker of circadian rhythms [9, 10]. Studies showed significant reduction in nocturnal sleep time during Ramadan [7, 9]. During Ramadan, the peak in nightly secretion of melatonin is lower than before Ramadan, which may be due to exposure to artificial light for a longer period during Ramadan's first meal in Sahur (approximately one hour before sunrise) [11, 12]. Sleep problems cause loss of secretion of the melatonin, growth hormone, and on the other hand, increase cortisol secretion, which may not be healthy [13].

In a controlled trials study, using 2 mg of melatonin, compared to the placebo group, which was performed on 177 deducted patients, melatonin increased sleep quality and daily alertness [4]. Melatonin reduce the delay in sleep initiation, increased total sleep time and improved sleep quality [14].

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Some studies have shown that, the reduction of melatonin is associated with an increase in cortisol levels in depressed patient. There is evidence that the change in night-time light reduces synthesis of melatonin and increases cortisol secretion is associated with several diseases [2, 15, 16].

Previous studies have suggested a shift delay in the peak of melatonin during Ramadan and reported, Islamic intermittent fasting influences the circadian pattern of circulating melatonin [6, 17]. Sleep quality and duration are important variables in athlete's recovery and adaptation to exercise [18]. Also, sleep quality and duration influences athletic performance and training efficiency [18-19]. Improvement in sleep quality can improves athletic performance and reduce the risk of injury [20].

No available data are found about Ramadan fasting and melatonin supplementation on sleep quality, melatonin and growth hormone to cortisol ratio. Also, because of lunar calendar, the month of Ramadan takes place in different seasons, each year the Ramadan month occurs 11 days earlier, which creates different fasting time and day light schedule. Of the 1.5 Billion Muslims more than 500 thousands fast in Ramadan [1]. So, it is important to study and improve their sleep quality and finally health. In this study, it hypothesized that melatonin supplementation can reduce negative effects of changed circadian rhythm and catabolic effects of changes in GH and cortisol hormones in the month of Ramadan.

Materials and Methods

Study Group

This is a descriptive study with repeated measures in a random sample of active male athlete volunteers. All subjects were martial art athletes with at least three years training experience and five session training per week. The study group consisted of fasting males in Mashhad, Iran. Fifteen were supplemented with melatonin and fifteen placebo subjects were included.

The study was conducted during a week before of Ramadan, which was used as a baseline period (BL), during the second (R2) and last (LR) weeks of Ramadan 1437 Hijri (corresponding to the period from June 7, 2016 to July 7, 2016). To check the participants regular sleep patterns, they were asked to maintain sleep diaries for two weeks prior to the study. Fasting time for the participants was from before sunshine (3:30 am) to sunset (8:10 pm) during Ramadan, mean temperature was 34° and humidity was 41%. During Ramadan, participants received 3 mg melatonin capsule or matching placebo (cellulose) was taken orally 1 hour before bedtime each night for the month of Ramadan. Participants were collegiate athletes who lived in a university dormitory and respected the nutrition requirements and sleeping-awake time. Before starting the study, each participant was asked to IPAQ, PAR-Q, PSQI (Pittsburgh sleep quality index). The fat percentage measured by caliper (four point way) and calculated by Siri's formula.

Before starting the study, each participant was asked to International Physical Activity Questionnaire (IPAQ), Physical Activity Readiness Questionnaire (PAR-Q), Pittsburgh sleep quality index (PSQI). The body fat percentage measured by caliper (four point way) and calculated by Siri's formula.

Before the beginning of the study, a familiarization meeting was held for the subjects. Subjects did not have any illness that fasting would exacerbate, and all had good sleep quality. They were also asked to avoid smoking, caffeine, tryptophan and folate during the study.

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality measured by Pittsburgh Sleep Quality Index (PSQI). It was developed in 1989 by Buysse et al, at the University of Pittsburgh Psychiatric clinic. The questionnaire has nine items in its original form, but since the 5th question contains 10 subfields, the entire questionnaire has 19 items that are scored in a 4-point Likert scale from 0 to 3. Closer point to 0 is better results.

Measuring Blood Biomarkers

One week before the beginning, after the 15 days and the end of Ramadan a blood sample was collected. To minimize sleep disorder, blood samples were collected at 23:00 h (before sleep), 03:00 h (woke up for Sahur), and about 07:00 h (woke up for morning) in sitting position. Blood samples 5cc from a vein in the arm and in the sitting position analyzed to determine the levels of melatonin, growth hormone and cortisol. Blood samples were frozen and transported to laboratory.

All blood samples were stored in the laboratory and after collection all samples were analyzed in

one step by a technician. Subjects were placed in supplemental and placebo groups randomly.

Data Analysis

After collecting and entering the obtained data in SPSS software version 22, raw data was analyzed for calculating central tendency indicators, dispersion and plotting variable graphs, descriptive statistics were used. After confirming the normal distribution of data by Kolmogorov-Smirnov test and homogenization by Leven test, to compare the differences in the normal situation, the repeated measures (factorial 3*3*2) and Bonferroni post hoc test were used.

Table 1. Demographic of the study groups

Variables \ Groups	Supplement	Placebo
	Mean ± SD	Mean ± SD
Age	24.5 ± 4.13	20.72 ± 3.22
Height	1.82 ± 3.1	1.79 ± 3.4
Weight	77 ± 3.9	74 ± 5.2
BMI	24.1 ± 2.6	24.9 ± 2.3

Table 2. Sleep Quality Parameters in Supplement Group (Pittsburgh Sleep Quality Index (PSQI))

Variables	Supplement Group (Mean ± SD)		Placebo Group (Mean ± SD)
Morning Awake (Hour)	**Before**	7.6 ± 0.7	7.5 ± 0.8
	Middle	9.1 ± 2	10.9 ± 2.5
	After	8.4 ± 1.8	9.1 ± 1
Night Sleep (Hour)	**Before**	11.6 ± 0.4	11.6 ± 0.4
	Middle	12.5 ± 1.7	15.6 ± 1.3
	After	11.5 ± 0.5	13.1 ± 0.6
Reality Night Sleep (Hour)	**Before**	5.2 ± 0.3	5.2 ± 0.3
	Middle	5.8 ± 2.2	5.2 ± 3.1
	After	5.4 ± 1.1	5.3 ± 0.9
Sleep Delay (Hour)	**Before**	0.17 ± 0.11	0.14 ± 0.08
	Middle	0.12 ± 0.09	0.12 ± 0.10
	After	0.14 ± 0.10	0.11 ± 0.06
Total Score (Hour)	**Before**	3 ± 1.3	3.5 ± 1.1
	Middle	2.3 ± 1.7	8 ± 4.1
	After	3.5 ± 1	3.6 ± 2.3

Results

Comparison between variables were showed in figures 1-4. The findings of this study indicate that after one month of melatonin supplementation, serum levels of melatonin significantly increased at the beginning of the night in the supplement group compared with placebo. Also, the supplementation group had significantly higher levels of melatonin compared to the placebo group. Also, in the morning, serum levels of melatonin in the supplement and placebo group decreased after month of Ramadan compared with middle of the month of Ramadan.

Results showed higher GH levels in melatonin supplemented group compared to the placebo group. Pre-month serum levels of growth hormone in the supplement and placebo groups increased by 18% and 10.8% at 11 pm respectively. At 3 am, increased by 205% and decreased by 10% in the supplement and placebo groups respectively. At 7 am in the morning, decreased 7% and 5.7% respectively. Also, in the middle of the month, GH increased by 18.4% and 21.2% at 11 pm, 4.7% and 12% at 3 am, and 5.3% and 7.7% at 7 am, in the supplement and placebo groups respectively. Also, at the end of the month, supplementation and placebo groups increased 39.8% and 34.4% at 11 pm, 220% and 0.75% at 3 am, and 13% and 1.5% at 7 am, respectively compared to the baseline.

The findings of the present study indicate that serum cortisol levels was lower at baseline in the supplement group compared to the placebo group. Also, midnight cortisol was at its lowest level, and the supplementation group significantly decreased the proportion of placebo group. However, at the beginning of the day, the

placebo group showed a greater increase in cortisol levels than the supplement group.

The ratio of growth hormone to cortisol before the month of Ramadan in the supplement and placebo groups increased by 87.5% and decreased by 10% at 11 pm. At 3 am, increased 150% in the supplement group, and remained unchanged in placebo group. At 7 am increased by 37% and 11% in the supplement and placebo groups. Also, in the middle of the month, increased by 20% and 33% at 11 pm, in the supplementation and placebo groups respectively, at 3 am 33% and 41% increased, and at 7 am decreased by 9% in the supplement group, and remained unchanged in placebo group. Also, at the end of the month, supplementation and placebo groups increased by 125% and 20% at 11 pm, 23% and 41% at 3 am, and increased by 25% and 11% at 7 am in the morning, in the supplement and placebo groups respectively compared to the baseline.

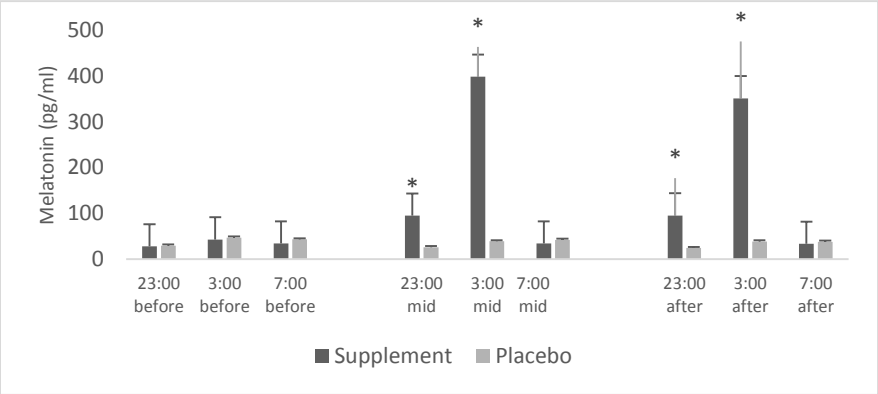

Figure 1. Effect of Ramadan fasting and melatonin supplementation on melatonin levels.

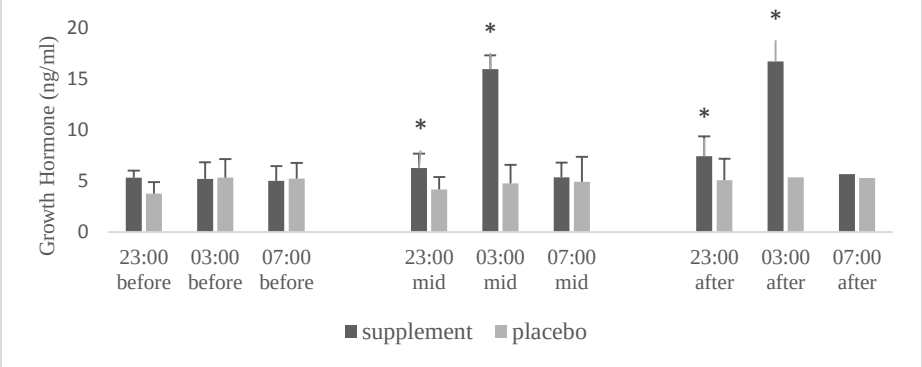

Figure 2. Effect of Ramadan fasting and melatonin supplementation on growth hormone.

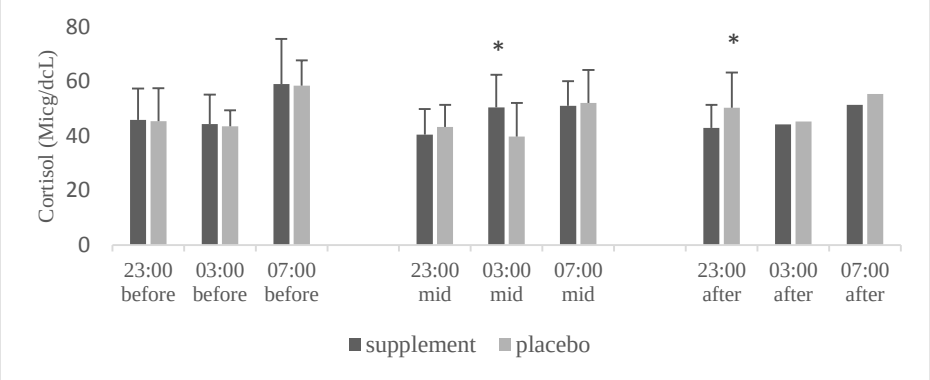

Figure 3. Effect of Ramadan fasting and melatonin supplementation on cortisol levels.

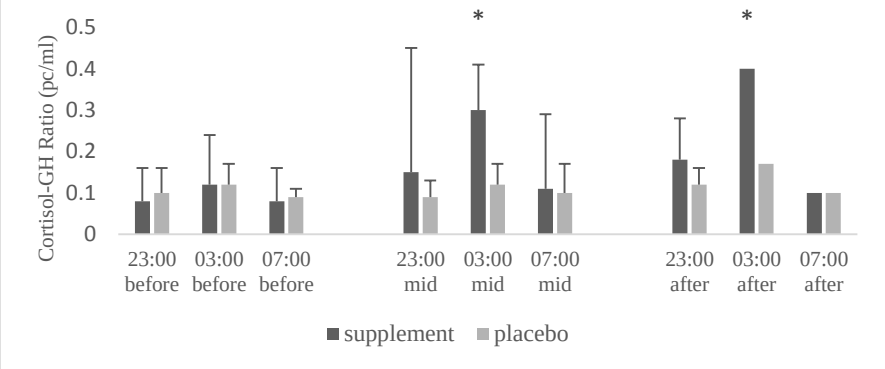

Figure 4. Effect of Ramadan fasting and melatonin supplementation on cortisol-GH ratio levels.

Discussion

During the month of Ramadan, the peak nightly secretion of melatonin was lower than before Ramadan, which may be due to exposure to artificial light for a longer period during Ramadan. The peak in melatonin is associated with lower body temperature, fatigue, decreased consciousness and physical performance.

The findings of this study indicate that after one month of melatonin supplementation, serum levels of melatonin significantly increased at the beginning of the night in the supplement group compared with placebo (245.5% in the middle of the month compared to the previous month and 261% at the end of the month Compared to the previous month). Also, mid-dark, which is near the peak in melatonin secretion, the supplementation group had significantly higher levels of melatonin compared to the placebo group (846% in the middle of the month compared with the previous one and 736.5% at the end of the month compared to the previous month), which increased the depth of sleep. Also, in the morning, serum levels of melatonin in the supplement and placebo group decreased by 1.2% and 11.9% respectively after month of Ramadan compared with middle of the month of Ramadan, suggests a possible daily increase in consciousness. During the month of Ramadan, the peak nightly secretion of melatonin is lower than before Ramadan, which may be due to exposure to artificial light for a longer period during Ramadan. This indicate that, melatonin reduces the delay in starting sleep, increases the overall sleep time and improves overall sleep quality [1].

Results related to GH showed higher GH levels in melatonin supplemented group. An important point of the study's finding is that the growth hormone coincides with the increase in melatonin, and it shows an important role of melatonin in stimulating the growth hormone secretion. Melatonin has been shown to stimulate the secretion of the growth hormone [21], and the peak time of secretion of both agents is also close, that is, they reach the peak at the same time as entering the deep sleep stage [22, 23]. By preventing the release of somatostatin, melatonin increases the secretion of the GH [24]. Melatonin increases the expression of the GH gene, a response completely blocked by somatostatin. The action of melatonin on the pituitary gland is not limited to stimulating or synthesizing the GH, but also regulates the function of other key components regulating the somatotropes [24].

The findings of the present study indicate that serum cortisol levels was lower at baseline in the supplement group compared to the placebo group (7% in the middle of the month compared with the beginning of the month and 17.3% at the end of the month compared to the beginning of the month), which possibly reduces consciousness and improves sleep status. Also, midnight cortisol was at its lowest level, and the supplementation group significantly decreased the proportion of placebo group (22.3% at the end of the month compared to the middle and 4.3% at the end of the month compared to the previous month). However, at the beginning of the day, the placebo group showed a greater increase in cortisol levels (3% in the middle of the month compared with the previous month and 8% at the end of the month) than the supplement group. In healthy individuals, levels of cortisol rise rapidly after awakening and peak at 30-45 minutes. It gradually drops throughout the day, rising again in the late afternoon, falling

by the end of the day and reaching its lowest point in the middle of the night. An 24-hour abnormal cortisol rhythm is associated with chronic fatigue syndrome[25] and insomnia[26]. Results showed positive GH/cortisol levels in melatonin supplemented group. Hormones that influenced by sleep deprivation in sports population are growth hormone and serum cortisol and these changes has been related with overtraining [27]. Many anabolic hormones, such as melatonin and GH, are secreted during sleep, and the rate of secretion of catabolic hormones such as cortisol increases during awakening. An imbalance in quality or quantity of sleep causes a reduction in the secretion of total anabolic and catabolic hormones [4, 28]. Also, GH and cortisol imbalances due to sleep deprivation related with chronic fatigue and repeated injuries coercing sportsmen to quit professional games in their career [29, 30].

Finally, this study demonstrates melatonin supplementation improves sleep quality and prevents catabolic effects of Ramadan with increases in cortisol-GH ratio. It seems that, initial days of receiving Melatonin have greater results on sleep quality, and after period of time this effects decreases. In present study, these changes in sleep quality may be because of reduced sensitivity to taking melatonin supplement or adaptations to month of Ramadan conditions in control group.

Conflict of Interest

There are no conflict of interest.

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