

ORIGINAL ARTICLES

Sleep Pattern, Daytime Sleepiness, and Eating Habits During the Month of Ramadan

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We assessed the effect of Islamic fasting and its attendant changes in lifestyle on total sleep time, sleep habits, daytime sleepiness, and eating habits in a group of young healthy subjects during the first 3 weeks of Ramadan. Study participants were healthy Muslim medical students, male and female, who fast for Ramadan. A self-administered questionnaire was designed and given four times: 1) 1 week before Ramadan (baseline, BL), and 2) the first week (R1), 3) second week (R2), and 4) third week of Ramadan (R3) to assess sleep habits, daytime sleepiness and functioning, and eating habits. During weekdays, participants were asked to monitor their sleep habits and other parameters described in the questionnaire, and then to complete the questionnaire on the last weekday of each week, according to the timetable set in the study design. Complete information was available for 56 participants (25 females and 31 males). Bedtime was delayed significantly during Ramadan as compared to BL. There was also a significant delay in wake-up time during Ramadan as compared to BL. Total sleep time at night (TST) dropped slightly during Ramadan as compared to BL, but this drop did not reach statistical significance. The percentage of students who napped during the daytime, 52% before Ramadan, increased significantly to 73% in R1. However, there was no significant difference in TST + naps between BL (7.25±2 hours) and the first 3 weeks of Ramadan. Despite the insignificant change in TST, Epworth Sleepiness Scale (ESS) scores were significantly higher during Ramadan. The time of the main meal changed as well, reflecting the fact that the subjects were fasting during the daytime. The present study revealed several modifications in circadian rhythm, social activity, and eating habits of fasting individuals during the month of Ramadan. These changes affected daytime functioning and resulted in increased sleepiness despite the insignificant change in TST. Further studies are needed to objectively assess daytime sleepiness, sleep-wake schedule, and the circadian pattern of melatonin secretion in those who fast for Ramadan. (**Sleep and Hypnosis 2003;5(4):165-174**)

Key words: Ramadan, fasting, sleep, Islamic, nap, circadian, sleepiness, alertness

INTRODUCTION

Many of the world's religions recommend fasting or abstinence from food and

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drinks for some period of time. Fasting is prescribed for Muslims during the month of Ramadan as one of the five major rules of Islam. Around one and a half billion Muslims fast during this month every year. While fasting, Muslims abstain from food, drink, and smoking during daytime (from dawn to sunset). The pattern of meals changes as well. Usually, two to three main meals are taken: one during breakfast at sunset, dinner after night prayer (Isha), and one before sunrise (Suhur).

The month of Ramadan is a lunar month,

meaning that the occurrence of the month in the year changes with time. The Islamic (Hijra) year contains 354 days; thus, an Islamic year is 11 days shorter than a year using the Gregorian months. As a result, the month of Ramadan occurs 11 days earlier every year, and may occur in any of the seasons. The season of Ramadan affects the duration of fasting time, because fasting hours are longer in summer as compared to winter, and may also affect sleep pattern due to factors such as a shorter nighttime and an earlier dawn.

During fasting, physiological changes are expected to result from both long-term dietary restriction and partial sleep loss. Islamic fasting is distinct from regular voluntary or experimental fasting in several ways: the fasting period is of limited duration (daytime) during the 24 hours of the day; the fasting person must refrain from drinking or smoking as well as eating in the fasting period; the fasting person changes his or her usual circadian pattern of eating by increasing caloric intake at night; and the long duration of this practice (1 month) may allow adaptation to the new regimen and realignment of sleep. Therefore, one may assume that physiological changes occurring during Islamic fasting may be different from those in an experimental fast (1).

During the month of Ramadan, many people alter their sleeping habits and stay awake most of the night, which can affect their daytime alertness and sleepiness. This behavior has been noticed increasingly in Saudi Arabia over the past few years but has not been well documented. The present project was performed to assess the effect of Islamic fasting and its attendant changes in lifestyle on total sleep time, sleep habits, daytime sleepiness, and eating habits in a group of young healthy subjects during the first 3 weeks of Ramadan.

MATERIALS AND METHODS

This descriptive study with repeated measures was conducted during the month of

Shaban (the month preceding Ramadan) and followed the participants during the first 3 weeks of the month of Ramadan in the year 1420 Hijra (between November 27 and December 22, 1999). During that period, fasting commenced around 5 AM and breakfast was eaten around 5 PM.

Study Group

Participants in this study were healthy Muslim medical students, male and female, who fast for Ramadan. Baseline data about pre-existing chronic illness or sleep complaints were collected before commencing the study. Students with chronic diseases or sleep complaints, and those who were smokers at baseline, were excluded. None of the participants drinks alcohol. Participants were not working night shifts during the study period. In Shaban, schools start at 8 AM, and in Ramadan, schools start at 9 AM. There was no midterm or final exam or vacation during the study period.

Questionnaire

One month before Ramadan (Shaban), the participants were interviewed initially by trained medical students to explain the study protocol, inquire about pre-existing chronic illnesses or sleep complaints, and answer participants' questions. A self-administered questionnaire was designed to be given four times: 1) one week before Ramadan (baseline, BL); and 2) the first week (R1), 3) second week (R2), and 4) third week of Ramadan (R3). Each questionnaire contained 21 questions concerning: 1) sleep-wake schedule; 2) naps; 3) quality of sleep; 4) total sleep time at night; 5) possible factors affecting bedtime; 6) daytime sleepiness, using the Epworth Sleepiness Scale (ESS) (2); 7) pattern of meals; and 8) daytime performance. Subjects were also asked to complete a daily sleep diary on weekdays.

Total sleep time (TST), nap duration, wake-up time, and bedtime were calculated on a daily basis for the weekdays, and the means were used in our analysis. The above questionnaires were pre-tested on a sample of 10 students before starting the study and the required modifications were done.

Protocol

The participants were asked to monitor their sleep habits and other parameters described in the questionnaire during weekdays and then, according to the timetable set in the study design, to complete the questionnaire on the last weekday of each week, i.e., Wednesday (The weekend in Saudi Arabia is Thursday and Friday; weekends were not evaluated in this study). The first questionnaire was completed in the last week of Shaban to provide baseline data, and the remaining three questionnaires were completed at the end of each of the first 3 weeks of Ramadan.

Statistical Analysis

Data is expressed as mean±standard deviation (SD). Comparisons between baseline and the first 3 weeks of Ramadan were performed using one-way repeated measures ANOVA for continuous variables. When the difference was significant, post hoc testing was performed using Dunn's multiple comparison test. Chi-square test was used for discrete variables comparing BL vs. R1, BL vs. R2 and BL vs. R3. Results were considered statistically significant at the $p=0.05$ level.

RESULTS

Of the 80 students who participated in the study, 65 subjects returned questionnaires, for a response rate of 81%. Complete information was available on 56 students (70%; 25 females and 31 males). Data on the 56 students who had complete information was included in the final analysis. The mean age of the participants was 22.6 ± 1.3 years (males 22.1 ± 1.36 , females 22.9 ± 1.13 years). Body mass index (BMI) was 23.4 ± 4 kg/m² (males 24.5 ± 4.8 kg/m², females 22.4 ± 3.3 kg/m²).

Sleep Pattern

Sleep habits were assessed during weekdays on four occasions: a baseline point (BL) before Ramadan, and the first (R1), second (R2), and third week (R3) of Ramadan.

Bedtime was delayed significantly during Ramadan as compared to baseline (Table 1). There was no significant difference before vs. during Ramadan in the percentage of subjects who went to bed before 10 PM. However, the percentage of subjects who went to bed between 10 PM and 12 midnight dropped significantly: from 24% at baseline to 7%, 5% and 7% in R1, R2 and R3, respectively ($p<0.01$). The percentage of subjects who went to bed between 12 midnight and 2 AM also dropped significantly: from 49% at baseline to 16%, 16%, and 13% in R1, R2, and R3, respectively ($p<0.001$). On the other hand, the percentage who went to bed between 2 AM and 4 AM increased significantly during the first 2 weeks of Ramadan: from BL 18% to 54% and

Table 1. Sleep pattern before and during Ramadan

	BL	R1	R2	R3	p
Bedtime	23.4 ± 3.5	2.8 ± 2.9*	3.4 ± 3.8*	3.2 ± 2.1*	< 0.05
Wake-up time	6.6 ± 0.9	8.3 ± 0.9*	8.4 ± 1.7*	8.95 ± 0.4*	< 0.001
TST	6 ± 1.5 h	5.8 ± 1.8 h	5.8 ± 1.8 h	5.96 ± 2.2 h	NS
Students who nap %	52%	73%*	68%	54%	0.004
Duration of nap(s)	2.4 ± 1.1 h	1.9 ± 0.9 h	1.7 ± 0.8 h	1.8 ± 0.8 h	0.07
TST + naps	7.28 ± 2 h	7.25 ± 1.5 h	6.85 ± 1.5 h	6.8 ± 1.9 h	NS
ESS	8.3 ± 3.7	10.6 ± 4.2*	9.9 ± 4.5	10.4 ± 4.5*	< 0.05

BL: Baseline, R1: 1st week of Ramadan, R2: 2nd week of Ramadan, R3: 3rd week of Ramadan.

* The difference is statistically significant compared to baseline.

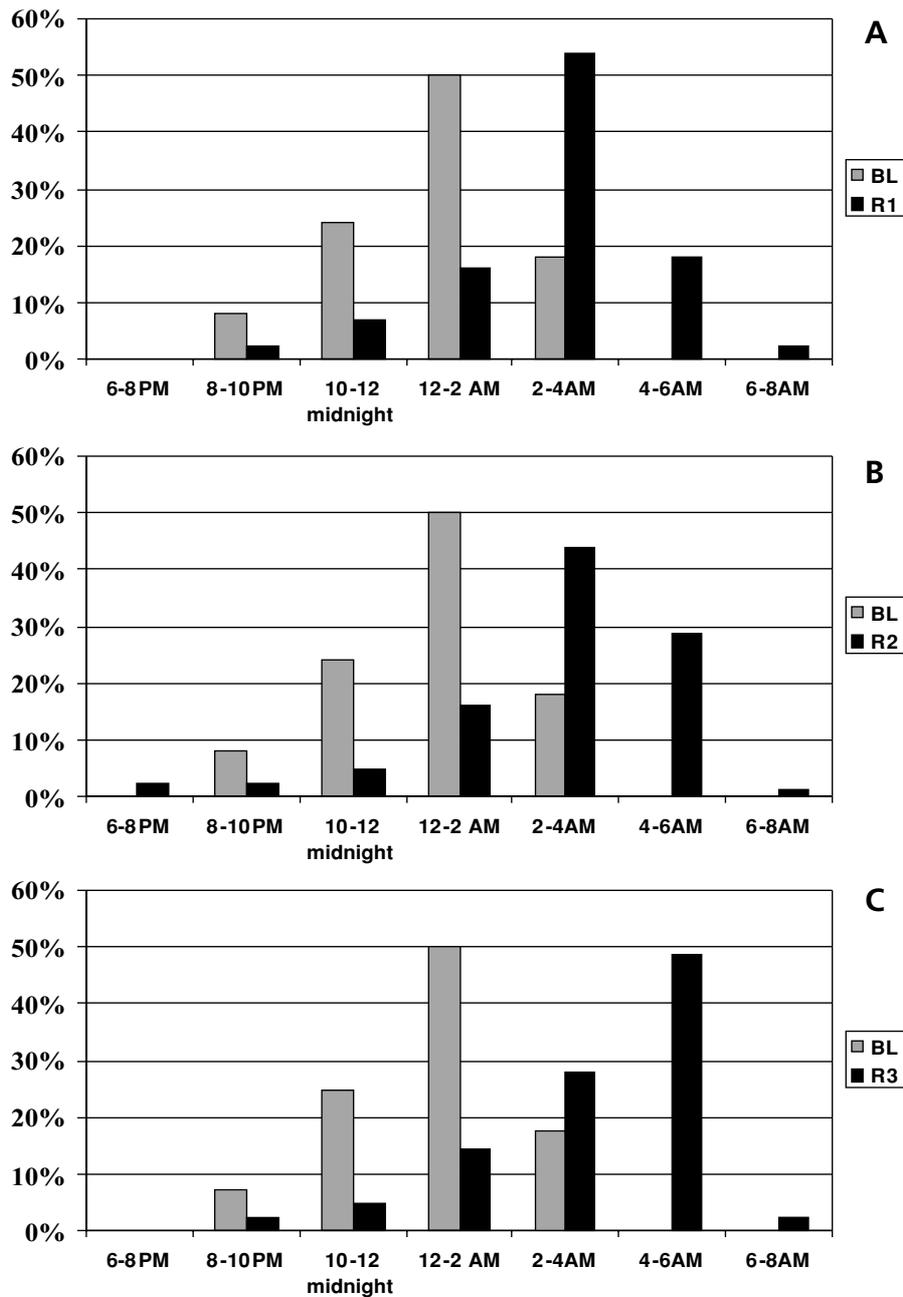


Figure 1. Bedtime before and during Ramadan. A: BL vs. R1, B: BL vs. R2, C: BL vs. R3. BL: Baseline data, R1: 1st week of Ramadan, R2: 2nd week of Ramadan, R3: 3rd week of Ramadan

44% in R1 and R2 ($p < 0.001$). The percentage who went to bed after 4 AM increased over time during the first 3 weeks of Ramadan: R1 20%, R2 32%, and R3 51%, vs. BL 3% ($p < 0.001$). The percentage of subjects who went to bed after 4 AM was also significantly different between the first and third weeks of Ramadan, 20% vs. 51% ($P < 0.001$; Figure 1).

Wake-up time also changed significantly

during Ramadan as compared to baseline (Table 1). There was no difference before vs. during Ramadan in the percentage of subjects who woke up before 6 AM. However, the percentage who woke up before 8 AM dropped significantly during Ramadan: from BL 100% to 7.5%, 5%, and 12.5% in R1, R2, and R3, respectively ($p < 0.001$). On the other hand, the percentage who woke up between 8 AM and 10

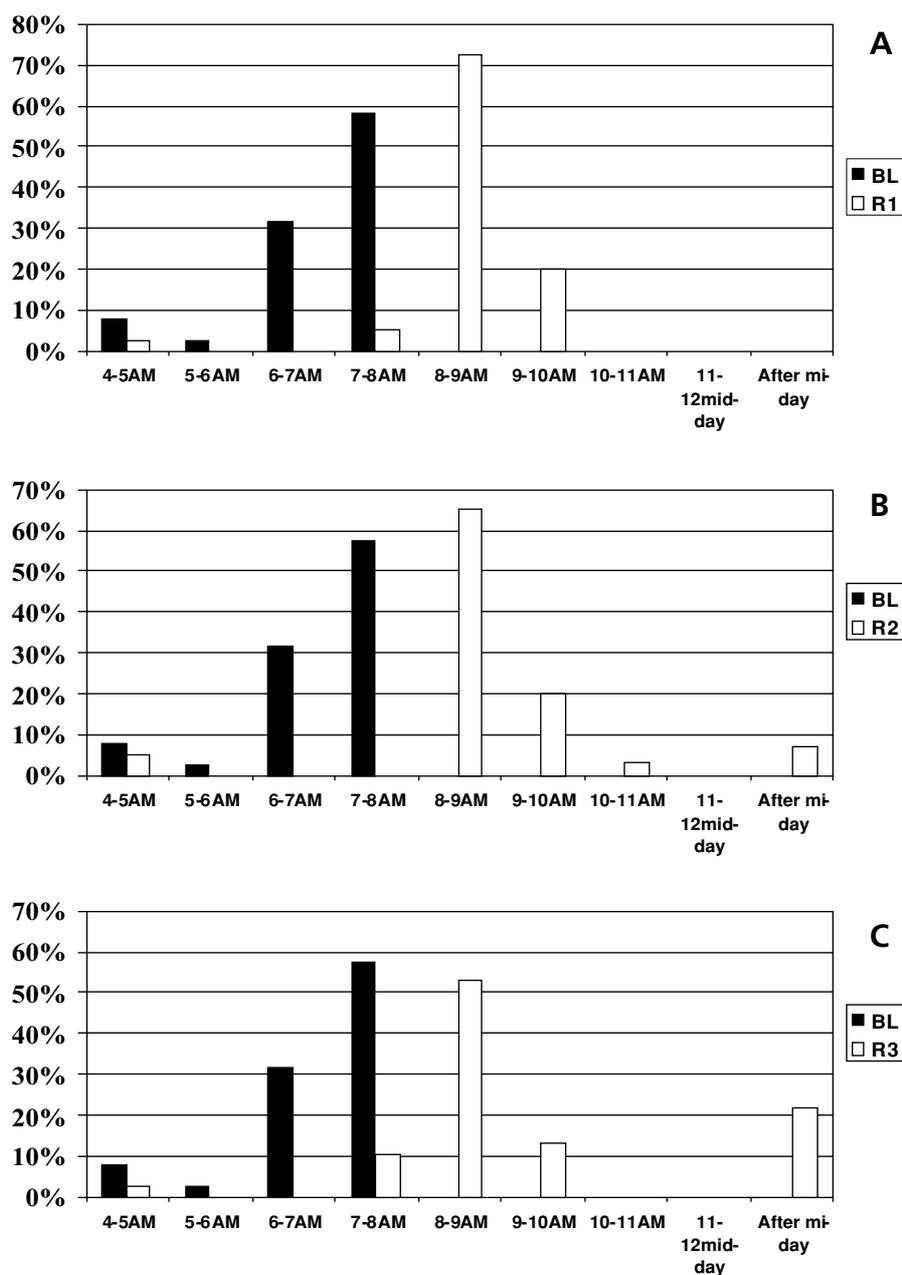


Figure 2. Wake-up time before and during Ramadan. A: BL vs. R1, B: BL vs. R2, C: BL vs. R3. BL: Baseline data, R1: 1st week of Ramadan, R2: 2nd week of Ramadan, R3: 3rd week of Ramadan

AM increased significantly during Ramadan: BL 0% vs. 92%, 85%, and 66% in R1, R2, and R3, respectively ($p < 0.001$). The percentage of subjects who woke up after 12 noon was also significantly higher in the third week of Ramadan, 21%, as compared to the first week of Ramadan, 0% ($p = 0.04$; Figure 2).

Total sleep time at night (TST) dropped slightly during Ramadan as compared to

baseline, but this drop did not reach statistical significance (BL 6 ± 1.5 hours, R1 5.8 ± 1.8 , R2 5.8 ± 1.8 , and R3 5.96 ± 2.2 hours). In response to the question: "Do you feel that you get enough sleep at night? (yes or no)," only 10% of students reported that they got enough sleep at night in R1, as compared to 50% at baseline ($p < 0.001$); satisfaction with sleep subsequently increased to 32% and 31% during R2 and R3.

Participants were also asked to rate their subjective quality of sleep on a scale from 1–5, 1 being poor and 5 being excellent. Reported quality of sleep dropped from 4±1 before Ramadan to 3.4±1, 3.2±1, and 3.1±1.2 in R1, R2, and R3, respectively; the difference between BL and R1 and R2 was significant ($p<0.05$).

All of the subjects who stayed awake after 11 PM before Ramadan attributed that pattern to staying awake to study. That pattern changed during Ramadan, when participants reported spending more time socializing with their families and friends, watching TV, and having spiritual activities (praying) at night (see Figure 3).

Although TST drops in R2 and R3 did not reach statistical significance, they could be clinically significant.

Before Ramadan, there was no difference in TST between those subjects who napped and those who did not nap. However, during the first 3 weeks of Ramadan, TST was significantly less among those who napped as compared to those who did not: R1 5.3±1.6 hours vs. 7.2±1.5 hours; R2 5.1±1.6 hours vs. 7.2±1.6 hours; and R3 4.7±1.6 hours vs. 7.3±1.9 hours ($p=0.001$). There was no difference in ESS scores between those who napped and who did not in BL, R1, R2, or R3.

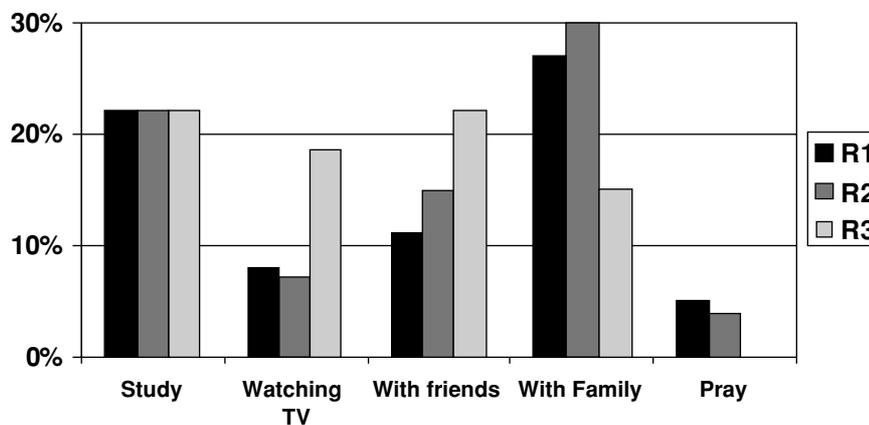


Figure 3. Reasons for staying awake after 11 PM during the first 3 weeks of Ramadan. R1: 1st week of Ramadan, R2: 2nd week of Ramadan, R3: 3rd week of Ramadan

Naps

The percentage of students who napped during daytime increased significantly, from 52% before Ramadan to 73% in R1 ($p=0.004$). The percentage who napped in R2 and R3 increased as well, to 68% and 54%, but those increases did not reach statistical significance. When the duration of naps was added to the TST (TST+naps), there was no significant difference in TST + naps between baseline (7.25±2 hours) and the first 3 weeks of Ramadan: R1 7.22±1.5 hours, R2 6.85±1.5 hours, and R3 6.8±1.9 hours. The reductions in TST + naps were about 2 minutes, 24 minutes, and 27 minutes in R1, R2, and R3, respectively.

Daytime Sleepiness

ESS scores were significantly higher during Ramadan as compared to baseline: BL 8.3±3.7; R1 10.6±4.2; R2 9.9±4.5; and R3 10.4±4.5 ($p<0.05$). The percentage of students who stated that they fell asleep accidentally in class increased significantly from 15% before Ramadan to 36% in R1, 35% in R2, and 30% in R3 ($p<0.05$).

On a 24-hour time scale, subjects were asked to mark the time period of the day or night when they felt most alert and most sleepy; these reported times of greatest alertness and greatest sleepiness did not differ between baseline and during Ramadan (Figure 4). In response to the

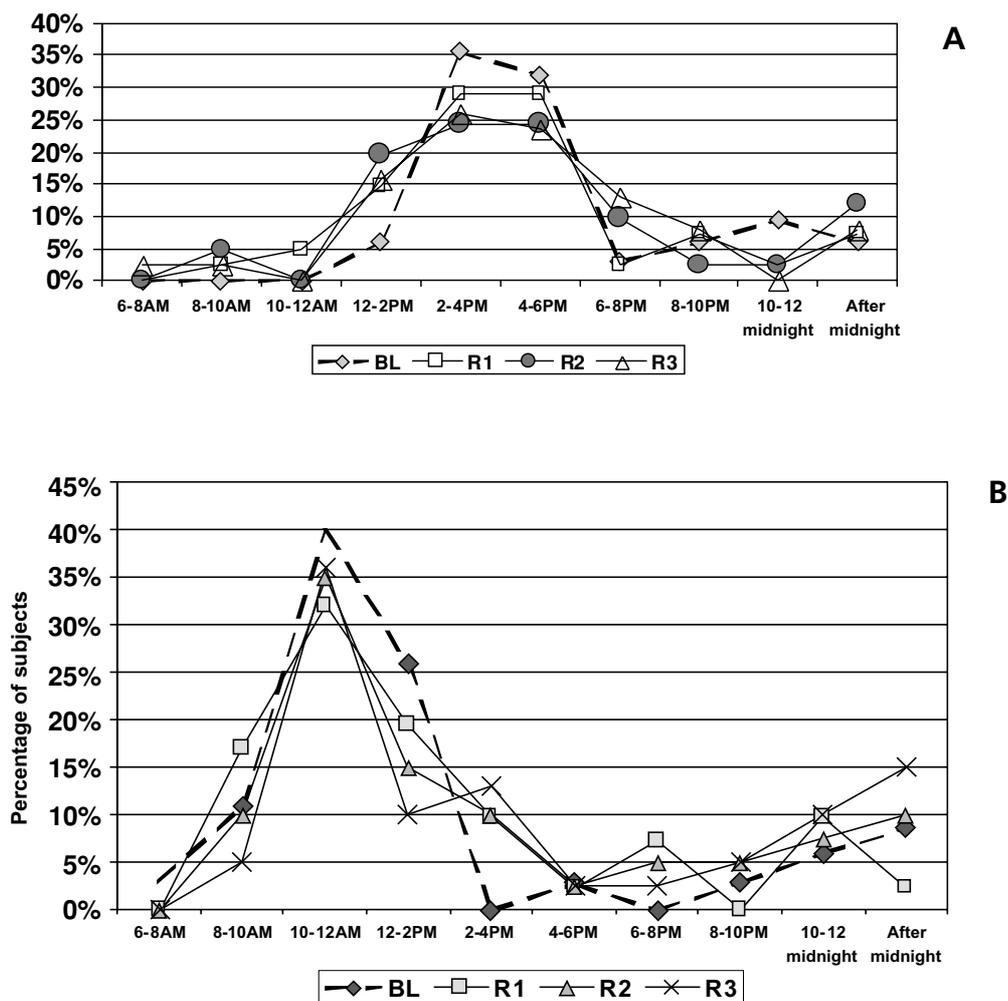


Figure 4 : A: Time of the day when subjects felt most sleepy before and during the first 3 weeks of Ramadan. B: Time of the day when subjects felt most alert before and during the first 3 weeks of Ramadan.

BL: Baseline data, R1: 1st week of Ramadan, R2: 2nd week of Ramadan, R3: 3rd week of Ramadan

question: "Do you think that your sleep pattern (wake-sleep schedule and naps) affects your daytime function? (yes or no)," 16% of subjects at baseline reported that their sleep pattern affected their daytime functioning vs. 68% in R1, 78% in R2, and 70% in R3 ($p < 0.001$).

The percentage of subjects who exercised two times or more per week dropped from 24% before Ramadan to 7%, 9%, and 5% during R1, R2, and R3, respectively ($p < 0.01$).

Eating Habits

The average number of meals per day dropped from 2.7 ± 0.77 before Ramadan to

2.1 ± 0.4 , 2.1 ± 0.4 , and 2 ± 0.4 during R1, R2, and R3, respectively ($p < 0.001$). The time of the main meal changed as well, which reflects the fact that the subjects were fasting during daytime (Figure 5). Most of the participants ate their main meal immediately after breaking fast: R1 60%, R2 61%, and R3 65%.

Although the number of cups taken of different beverages dropped during Ramadan, there was no significant difference before and during Ramadan in the number of cups of tea, coffee, and chocolate or the number of cans of soda that subjects drank. None of the participants reported using stimulants to help in staying awake during Ramadan.

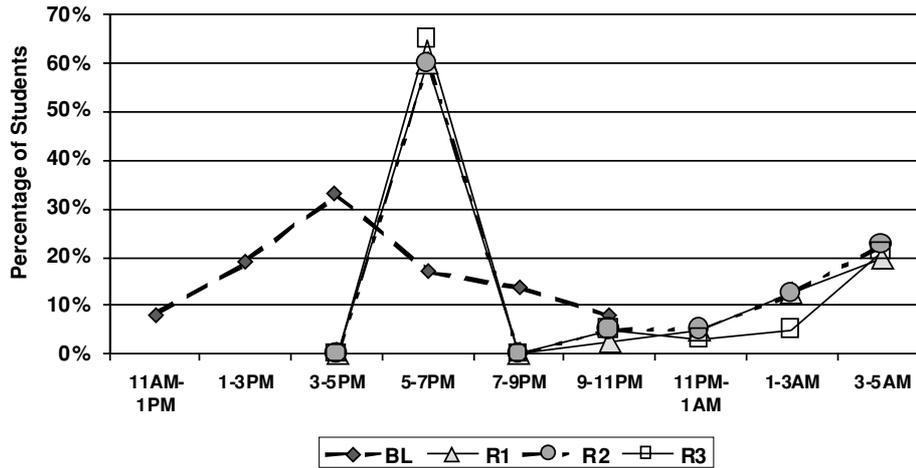


Figure 5. Time of the main meal before and during the first three weeks of Ramadan. BL: Baseline data, R1: 1st week of Ramadan, R2: 2nd week of Ramadan, R3: 3rd week of Ramadan

DISCUSSION

In our study, we followed participants during the first 3 weeks of Ramadan to assess the changes in sleep pattern, eating habits, and daytime sleepiness during Ramadan, taking into consideration the possible adaptation to the new regimen that may occur with time.

Our study demonstrated a sudden and significant delay in bedtime and wake-up time in the participants during Ramadan as compared to baseline. This delay was progressive over time, in that bedtime and wake-up time were significantly delayed in R3 as compared to R1. The delayed wake-up time compensated partially for the late bedtime; hence, there was no statistically significant change in TST. Even after adding nap duration to the sleep time at night, there was no significant difference in total sleep time between BL, R1, R2, and R3. Our findings concur with the results of El Khalifi (3), who found no difference in TST before and during Ramadan, but contrast with those of Taoudi et al. (4), who found a significant drop in TST during Ramadan. Although the drop in TST + naps in R2 and R3 did not reach statistical significance in our results, other studies have demonstrated that even modest sleep restriction (as little as 1 hour of restriction per

night) will accumulate over time and may increase daytime sleepiness progressively (5,6).

Fifty-two percent of our subjects reported napping at baseline before Ramadan. The percentage of subjects who napped during the day increased during Ramadan, but this increase did not reach statistical significance. This finding differs from that of Taoudi et al. (4), who reported decreased naps during Ramadan in a similar population of University students. This difference may reflect some difference in cultural backgrounds. In Saudi Arabia, the habit of taking naps is very popular. Wali et al. (7) have shown previously that up to 88% of Saudis nap in the afternoon. An increase in the percentage of those who nap during Ramadan may indirectly reflect an increased bodily need or wish for more sleep during Ramadan (8).

Despite getting almost the same amount of sleep before and during Ramadan, our study participants felt that the quality of their sleep was significantly worse during Ramadan. They also felt sleepier during Ramadan as assessed by ESS, and more felt during Ramadan that their sleep pattern affected their daytime functioning. These findings raise some important questions: Does acute disruption of the circadian rhythm affect daytime sleepiness

even if TST does not change? Does fasting affect melatonin level or the circadian secretion of melatonin, or is it related to some psychological and mood changes related to fasting? It has been reported previously that delaying bedtime was associated with adverse mood changes and REM changes resembling those of depression (9,10). Bogdan et al. (11) have demonstrated that the nocturnal peak of melatonin is diminished and delayed during Ramadan. Recent polysomnographic studies have shown an increase in sleep latency and a decrease in TST, slow-wave sleep, and REM sleep during Ramadan as compared to before Ramadan (12,13). This may explain subjective feelings of poor sleep quality during Ramadan. Olson et al. have demonstrated that ESS correlates with the psychological status of the individual (14).

Despite the subjective perception of daytime sleepiness, the times of day and night when subjects felt most sleepy and most alert did not differ between baseline and during Ramadan. This result highlights the need for objective assessment of daytime sleepiness and melatonin level under controlled conditions. Recently, Roky et al. (13) demonstrated inconsistency between subjective and objective daytime sleepiness during Ramadan (13). Although a subjective increase in daytime sleepiness occurred at the beginning of Ramadan in that study, objective daytime sleepiness, as measured by the Multiple Sleep Latency Test (MSLT), increased at the end of the month.

More of our participants fell asleep accidentally during Ramadan than at baseline, and, as previously noted, more felt that their sleep pattern during Ramadan affected their daytime functioning than at baseline. This also raises the need for objective assessment of physical and cognitive performance in Ramadan. Bigard et al. (15) has reported impairment of muscular performance during Ramadan.

Because the fasting period is during the daytime, the time of the main meal changes. Most of the participants ate their main meal after breaking their fast and ate light snacks later. The frequency of meals dropped significantly during Ramadan, which has also been shown in previous studies (4,16). Despite this reduction in the frequency of meals, an increase in caloric intake during Ramadan has been suggested (17). Frost et al. (16) reported a significant increase in caloric, fat, carbohydrate, and protein intake in a sample of 15 young Saudis, as well as a significant increase in body weight, although there was a significant reduction in meal frequency and in the number of meals taken outside the family setting.

It has been proposed that meals taken exclusively at night are responsible for circadian rhythm changes in body temperature. Body temperature normally follows a circadian rhythm, rising during the day and falling at night. In general, a falling body temperature induces sleep, whereas a rising body temperature provokes wakefulness. It was reported recently that the circadian rhythm for body temperature changes during Ramadan (13), showing a delay in the occurrence of the acrophase and bathyphase with a reduction in the amplitude. Another study of fasting during Ramadan found that oral temperature significantly decreased at 09:00, 11:00, 13:00, and 16:00, and significantly increased at 23:00 and 00:00 hours (18).

The present study revealed several modifications in the circadian rhythm, social activity, and eating habits of fasting participants during the month of Ramadan. These changes have affected the daytime function and resulted in increased sleepiness despite the insignificant change in TST. Further studies are needed to objectively assess daytime sleepiness, sleep-wake schedule, and the circadian pattern of melatonin secretion in those who fast during Ramadan.

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