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Physical activity, sleeping pattern, and road accidents among Saudi population in Najran Province during the month of Ramadan

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ABSTRACT

This study examined the impact of Ramadan fasting on physical activity and sleep patterns among Saudis in Najran, Saudi Arabia. Seventy-three male and female volunteers completed a self-reported questionnaire over five days at Najran University Hospital. Data collected included demographics, physical activity levels, sedentary behaviors, sleep duration, social activities, and mood changes. Results showed that only 29 participants (39.9%) considered themselves physically active, while 44 (60.3%) were sedentary. The mean age of the active group was 41.60±8.21 years. Among females, only 7 (31.8%) were physically active, while 15 (68.2%) were inactive. Factors such as night work, mood changes, and indoor social activities significantly influenced physical activity levels ($p<0.005$). Regarding sleep, the physically active group had a mean daily sleep duration of 7.43±1.52 hours, while the sedentary group slept an average of 10.20±2.11 hours, showing a statistically significant difference. These findings suggest that Ramadan fasting influences both physical activity and sleep patterns, potentially affecting overall health and well-being.

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1. INTRODUCTION

Muslim people fast during the daylight hours in the month of Ramadan, which falls in the ninth month of the lunar calendar (Islamic calendar). There is no set date of the start of Ramadan as it depends on what lunar sightings are seen in each respective location. The overall duration of fasting hours varies from region to region, depending on the geographical location and season (spring, summer, fall, and winter). Muslims and others, living in Islamic countries, are expected to refrain from eating, drinking, smoking, and sexual activity from dawn to dusk [1]. During a fasting day, two main meals are consumed-one large meal at breaking of the fast known as *Iftar* in Arabic, and a light meal before sunrise, known as *Sahoor*. Food intakes are likely to have effects on body weight, composition, and metabolism, which may influence daily physical activities, sleeping patterns, and the overall quality of life of fasting Muslim people [1], [2].

Social and behavioral changes occur in the lives of Saudis during the month of Ramadan. Saudi Arabian people traditionally spend their time between napping in the afternoon (after work if they are

employed) and then socializing after Maghreb prayer (between 17:00-18:30 PM) this can last until well after midnight. Post-fasting people generally gather in groups known as Shillas or Majmu'as (group of people sitting together) of close friends of similar social status (i.e., age, background, and occupation). Men gather to relax, gossip and joke while smoking waterpipe (*Shisha*) and playing cards or often having a meal around midnight about six hours after breaking of the fast (*Iftar*) or they meet in each other's homes for the occasion, returning home before the early breakfast (*Suhoor*) and then after the beginning of the fasting period.

The social organization of Saudi Arabian people is centered around the home and family. Saudis tend to regularly visit their family members, where there is great respect for family ties, lineage and the elderly. A wide range of socio-religious activities and behavioral changes occur during the month of Ramadan in daytime activities and abstinence from meals, nicotine, tea, and coffee. The disruptions in the normal daily routine with behavioral and nocturnal changes has shown an increase in irritability, decrease in subjective awareness, impaired performance, diminished learning performance and muscular strength brought upon by abstinence of from food and sleep [3] during time of fasting.

Ramadan has a significant social happening. The long nights of social gathering or even the overabundance of popular culture events as in festivities, a dearth of television drama (soap operas) serials and musical events [4] leading to a breadth of time where people eat excessively from the time of the break of the fast (*Iftar*) to the start (*Sahoor*). Ramadan has become a period of laxness, entertainment, leisure, excessive food intake, and festivities rather than spiritual time of deep religious, inner transformation and spiritual awakening and exaltation.

Previous studies have shown increased incidence of traffic accidents occurring during the month of Ramadan more probably related to health changes [1], [5], [6]. While mostly men drive, victims of accidents are all especially women, and children. Psychomotor changes occur during fasting, along with disruptions in sleep and food intake, food deprivation, blood pressure fluctuations, and disturbances in the normal circadian rhythm, can negatively impact physical performance. A study by Trabelsi *et al.* have found that sleep loss can have indirect affect on the physical performance by causing changes in mental performance, coordination, and physical drive [7].

The combination of changes whether dietary intake, time of food, large food intake at short period of time, or sleep pattern changes each or a combination of, may modulate daytime activities, discommodious psychomotor, cognitive specifically mental, and social performance of fasting people. Physical and health related changes can alter the levels of insulin, blood glucose, low energy levels, mood changes, or a combination of all these factors together [8]. Even irregular or reduced sleep, as well as disrupted or intermittent daytime sleep, disrupted nocturnal sleep duration patterns, can lead to varying levels of fatigue throughout the day wake time, all leading to health impediments especially those suffering from disease [9]–[14].

This study compares those individuals who are described as sedentary and active subjects in their daily activities during Ramadan on a number of behaviors as mood and daily sleep. The study provides a comprehensive picture using empirical information of the fasting among Saudi Arabian people during the month of Ramadan in Najran city, Kingdom of Saudi Arabia. The study also uses secondary data to investigate the physical activities, sleeping patterns, and road accidents during the month of Ramadan.

2. METHOD

2.1. Sample

This study is an observational cross-sectional study carried out during the month of Ramadan in March 2023. The weather during the month of Ramadan in March 2023 was around 34 °C at night and earlier in the morning, reaching 48 °C at mid-day hours. The participants in this study were selected from the outpatient's clinic of Najran University Hospital in five consecutive days. A questionnaire was developed and collected from 73 participants. The sample collected was a convenience sample, with inclusion criteria of Saudi Arabian People, being adult, fasting during the month of Ramadan, literate enough to self-complete the questionnaire, not taking regular medications, and being free of chronic diseases. The data excluded non-Saudi citizens because Saudi behavioral organization, and behavior show distinct differences from other Arab cultural groups living in Saudi Arabia. All non-Saudis, non-adult, not fasting and being on regular medications for chronic diseases were excluded from the study.

2.2. Instruments

A questionnaire was used to collect the data. The first section of the questionnaire collected information on socio-demographical variables including gender, age, marital status, occupation, educational status and if participants were involved in night work and regularly fasting during the month of Ramadan. In addition, data collection addressed the total hours spent in the following activities during the month of

Ramadan: i) time spent exercising, ii) time spent daily watching television, iii) time spent daily on the internet, iv) time spent daily on computer games, v) time spent daily on social media sites and smart phones.

The second set of questions addressed the sleeping pattern by probing the following questions: i) If they sleep during the day in Ramadan, ii) What time they used to go to bed during night in Ramadan (earlier, later, or at the same time before Ramadan), iii). In general, if they sleep less or more during the month of Ramadan compared, to pre- Ramadan period, iv); how many hours they sleep daily during the month of Ramadan; v) If they think that fasting during the month of Ramadan can change the sleeping pattern; vi) How sleepy they feel during the day in Ramadan. (Not at all, slightly, moderate, very much). These questions addressed the levels of sleep during the period of Ramadan. The questions would provide a measure of night sleep disruption and a level of disruptions to the circadian cycle.

A third set of questions related to indoor social activities with family and friends, and if they noticed any mood swings during the month of Ramadan (especially depressed mood), irritability, fatigue, and not feeling well. Data was also obtained for road traffic accidents at three major hospitals in Najran area in 2023 from governmental hospitals. This data was used to assess the levels of road accidents before, during and after Ramadan.

2.3. Procedures

The first step of this study was to develop an instrument to collect information on participant sociodemographic activities of daily living and health-related factors (shown in the above section). These questions were in the form of short questions and answers. The questions were written by researchers of this study. The first process was the development of questions made by the researchers and the consensus reached on the substantive questions, format, and form. The second step included a pilot test by asking a group of 20 academics at Najran University to complete the questionnaire. In addition, the same questionnaire was administered to a study group of Najran University students in a class of one of the coauthors. Both sets of responses were analyzed to determine any anomalies, and some items were revised or altered as a result. Once the instrument was improved, the final questionnaire was used to collect information from seventy-three participants.

2.4. Measurements

Two main variables were measured in this study: a) physically active group, those who were performing 30-60 minutes of jogging or brisk walking, 3-5 times per week during the month of Ramadan; b) Sedentary group: those who did not perform any regular exercise during the month of Ramadan. Dependent variables included gender, education level, night work, mood swings, social activities and sleep duration. The unit of measurement of social activities and sleep duration was in units of time. The physical activity variable was measured through a “yes” and “no” response.

2.5. Statistical analysis

All collected data were checked for completeness before they were entered into a spreadsheet and analyzed using Microsoft Excel. Descriptive statistics were generated on all items, and cross-tabulation was used to analyze the associations between different variables that relate those participants who were physically active with those who were sedentary. Ethical approvals for the study were obtained from Najran University College of Medicine ethics committee before the beginning of the study. A written consent was obtained from the participants in the study. The analysis of the data included non-parametric tests showing the differences between expected and observed. Also, a t-test of statistical significance was calculated between physically active and sedentary groups on those items with time being the unit of analysis.

3. RESULTS

Based on the subject’s demographic and baseline data, two groups were formed the physically active and sedentary: Table 1 reports night work, mood, and social activities by those who are physically active and sedentary groups. A total of n = 73 were enrolled in the study; the majority of the participants were male, with n = 51 (69.9%), with a mean age of 41.60±8.21 years. There were n = 29 (39.9%) physically active participants during the month of Ramadan. In contrast, n = 44 (60.3%) of the participants were physically inactive and were placed into the sedentary group, as shown in Table 1. Twenty-one (41.2%), male participants (41.2%) were physically active, and n = 30 (58.9%) males were from the sedentary group. Only n = 7 (31.8%) of the female participants were physically active, and n = 15 (69.2%) were from the sedentary group. The participants doing night work duties were n = 32 (43.8%) of them, n = 9 (28.1%) were physically active, the difference between the frequencies was significant at a $p \leq 0.005$. Mood swings were reported by n=29 (39.7%) participants, and most n=22 (75.9%) were from the sedentary group compared to the physical active, with a significant difference between the two groups with p-value ≤ 0.005.

Table 2 displays the mean time (in hours) spent on daily activities of the active and sedentary groups. For the physically active participants, n = 21 slept 5-6.9 hours, n = 5 slept 5-10 hours, n = 3 slept more than 10 hours per day (the mean is 7.43+1.52 hours). For the sedentary group, n = 27 slept more than n = 10 hours per day, n = 10 slept 7-10 hours per day, n = 7 slept 5-6.9 hours per day (the mean being 10.20+2.11 years). Most of the study participants reported sleeping during the daylight hours of Ramadan. Social indoor activities (e.g., gathering for lengthy night talks) were reported by n = 64 (87.7%), and a large number most of them n=48 (75%) was from the sedentary group.

The comparison between the active and sedentary groups on time spent watching television was statistically significant ($p<0.005$) difference between the two groups sedentary and active. For the physically active group, n = 19 spent 3-5.9 hours, n = 6 spent 6-8 hours, n = 4 spent more than 8 hours (the mean being 4.21+1.30). For the sedentary group, n = 29 spent more than 8 hours watching television, n = 9 spent 6-8 hours, and n = 6 spent 3-5.9 hours (the mean being 7.27+1.20 hours).

In comparison between the physically active and sedentary groups on total hours spent on internet and social media and smartphones (e.g., Facebook, Twitter, WhatsApp), the mean finding results were statistically significant with $p<0.005$ between the two groups. The physically active group of n = 17 spent 3-5.9 hours, n = 7 spent 6-8 hours, n = 5 spent more than 8 hours per day (the mean being 3.9.1+1.74 hours). For the sedentary group, n = 31 spent more than 8 hours per day on the internet and social media, n = 9 spent 6-8 hours, and n = 4 spent 3-5.9 hours per day (the mean being 7.38+2.31 hours).

The results of this study assessed the daily activities of Saudis to explore the activities of sedentary and physically active Saudi Arabian people. With this data, we show the behavioral changes among Saudis involved in road hazards compared to those who are less likely to drive as in the sedentary group. In summary, this study enrolled 73 participants, with a majority being male (69.9%) and 39.9% classified as physically active, while 60.3% were sedentary. Significant differences ($p\leq0.005$) were observed between the two groups regarding night work duties, mood swings, sleep duration, and engagement in sedentary activities like watching television and using social media, with the sedentary group spending significantly more time on these activities. Most participants engaged in social indoor activities, and the sedentary group had notably longer sleep duration (10.20±2.11 hours) compared to the active group (7.43±1.52 hours).

Table 1. Demographic and physical activities data

Psychological/physiological/lifestyle factors	Physically active n (%)	Sedentary group (physically inactive) n (%)	p-value
Night work duty	9 (28.1%)	23 (71.9%)	<0.005*
Mood swings	7 (24.1%)	22 (75.9%)	<0.005*
Social indoor activities	16 (25%)	48 (75%)	<0.005*
Mean daily sleep duration	7.43±1.52	10 .20±2.11	<0.005*

*Normal p-value<0.05, there is significant association

Table 2. Time spent in some activities by our study participants

Activities	Physically active (n = 29) mean±SD	Sedentary group (n = 44) mean±SD	p-value
Sleeping (hours)	Mean = 7.43±1.52	10.20±2.11	<0.005
TV watching (hours)	Mean = 4.21±1.30	Mean = 7.27±1.20	<0.005*
Internet, social media, and smartphones (hours)	Mean = 3.91±1.71	Mean = 7.38±2.31	<0.005*

4. DISCUSSION

The Islamic month of Ramadan brings major changes to the lifestyle of Muslims including dietary habits, sleeping patterns, and social activities. Waterhouse [9] reported that changes in physical activities during the month of Ramadan is due to alterations in timing of food intake. Although the types of physical activities before and during the month of Ramadan are similar, they differ in the timing of performing physical exercise, e.g., walking and jogging before or after the breaking of the fast. Restraining from food and drink for a long period can be associated with a decrease in physical activity. It is well established that dehydration can reduce physical performance especially in warm or hot weather [15]. Kerkeni *et al*. have reported that fasting along with physical activities will lead to energy consumption, excessive sweating, and dehydration [14].

The lifestyle of Muslims during the month of Ramadan is spent indoor and outdoor enjoying social activities with friends and families; such activities are sedentary and further contribute to a significant decrease in physical activities [16]. A study by Bahammam *et al*. suggest that the percentage of those who performed physical exercises more than twice per week fell from 24% to less than 10% during the month of Ramadan month [11]. In a Malaysian study, the number of steps walked per day was used to measure the level of physical activities among adults during the month of Ramadan. The researchers concluded that the number of steps per day declined by 10-13% during the month of Ramadan, compared to the pre-Ramadan period.

Likewise, similar studies on a Saudi Arabian people by a number of researchers (see [11], [16]-[19]) reported a decrease in physical activities among a group of Saudi students during the month of Ramadan.

Additionally, one can argue that there are some reasons for decrease in physical activities during the month of Ramadan. The tendency of people fasting tends to sleep many hours in the daytime and to be awake in the night until dawn. Disruption of the normal daily work routine and robust religious practices such as extensive prayer time after the break of the fast offsetting the nocturnal cycle. Work may start at 8:00 AM which ends about two hours before the break of fast *Iftar,* work hours are offset to nighttime and hence a disruption to the daily regiment of physical activity and exercise. During fasting feelings of thirst and hunger can lower the physical activity and metabolic change during the fasting during the month of Ramadan [18], [19]-[21]. In addition, the negative mood and mental state of fasting decreases the willingness to engage in any form of physical activities, and thus impedes the body from undertaking any sort of extenuating physical exercise [9].

It is noted that night sleep deprivation and physical activities are related. For people who abstain from sleep at night may result in daytime fatigue and impact cognitive functioning. This may explain the increase in accidents and irritability reported in some studies who fast during the month of Ramadan. For example, in a study involving 750 Turkish Muslims fasting during the month of Ramadan, many of the participants reported being fatigued throughout the day (84% of respondents) and reported feeling of sleepiness and irritability at daytime (63% of respondents) [20]. Daytime sleepiness in Ramadan is mainly due to a lack of night sleep as people often stays awake for longer periods at night and some stay awake until dawn engaged in social and spiritual activities. Waking up at dawn to take breakfast before fasting (*Sahoor*) may lead up to further disruption of sleeping pattern [22], [23].

Reduction in night sleep may not be a problem for people who can alter their working hours during the month of Ramadan to sleep during daylight hours, but it can cause difficulties for those who do not have this option. Changes in sleep and wake up time during the month of Ramadan have been reported in previous studies [11], [24]. A study by Bahammam has found delays in starting work during the month of Ramadan [25]. Bahammam *et al.* in another study reported that a delay in bedtime during the month of Ramadan occurred in non-fasting residents of Saudi Arabia whose work commencement time did not change. Bahammam *et al.* explained that lifestyle changes other than fasting may cause a shift in circadian pattern during the month of Ramadan [11].

Sleep latency, which is inversely proportional to sleepiness, increases during daytime, particularly at 10:00 AM, 12:00 PM and 16:00 PM hours. One the first week of Ramadan fasting may have effects on human physical, cognitive and psychomotor performances [9]. A study by Bougrine *et al.* had reported that intermittent fasting may not have that large impact on cognitive performance [26]. Some other studies have also demonstrated an increased irritability [27], [28] and a decrease in mood rating [1]. These changes are important in regular smokers and coffee consumers. However, an epidemiology study did not confirm this detrimental effect of Ramadan on mood.

The findings are mixed with regards to the data on sleep duration during the month of Ramadan among different countries and these differences seem to be related to lifestyle and cultural organization [26]. A study by Maughan *et al.* had found in a group of university students in Morocco that nighttime sleep duration decreased significantly during the month of Ramadan [15]. Researcher study in Saudi Arabian People, had shown no difference in night-time sleep duration or total sleep time (nighttime and naps) [11], [25]. A disruption of the sleep-wake cycle and the major cause to physical or even psychomotor disorders.

International data regarding hospital admissions during the month of Ramadan in Arab Gulf Countries shows an increase due to accidents whereas in other countries there is a decrease. We speculate that an increase is seen in places where people have a very hectic lifestyle and have jobs that require driving to work. It is possible that some people have no choice but to work and drive in Ramadan and these people may be responsible for the high number of accidents seen in Saudi Arabia. In addition, the intermittent fasting has some chronobiological effects on the human body that could result in a decrease of sleep quality, diurnal alertness, psychomotor and physical performances and are responsible for the high incidents of road traffic accidents, performance at work and reduction of working hours during the month of Ramadan [1]. In addition, there are possible causes of increase in road traffic accidents in Ramadan as impaired concentration due to lack of coffee and tea or hypoglycemia. Driving while fasting can increase road traffic accident during the month of Ramadan in Saudi Arabia.

There are many studies found from evidence-based hospital data, that there is a sharp increase in the number of injuries resulting from traffic accidents during the month of Ramadan [1], [29]. Data obtained from the Ministry of Public Health of 2020 in Najran on road accidents (see Table 3 for details) suggests in Najran, during the month of Ramadan there were n = 293 persons of which n =268 males. The number of Saudi Arabian sample was n = 187 persons and the non-Saudis comprised of 106 persons. For the month prior and immediately after Ramadan there were n = 142 and n = 263 respectively. Certainly, road accidents during the month of Ramadan shows a sharp increase compared to prior and after Ramadan could be due to

people rushing home to be with family members often driving at very high speeds before the break of fast. A recent study showed that, during the month of Ramadan people increase their activity on the roads after dawn and a significant traffic jam is observed at the time of business closure, which occurs between 3-5 in the afternoon. Pedestrians are more likely to be on the roads during this time and hence increase the risk of injury. Even at the end of Ramadan and Eid period the increase in heavy traffic both inside cities and on the highways between cities. Also, seasonal street peddlers on the roads often occupy spaces on the main roads and pedestrian pavements. Thus, they not only block the flow of traffic but also hold back pedestrian mobility [30], [31] and one of the causes of accidents.

This study findings showed that the number of the Saudi Arabian people involved in road traffic accidents was similar to the number of foreigners involved in these accidents in Saudi Arabia. The number of victims of road traffic accidents virtually reflects the real ratio of expatriate to Saudi Nationals. Similar patterns may appear in other Gulf countries mainly United Arab Emirates and Kuwait.

Table 3. Demographic data of victims of road traffic accidents at three major hospitals in Najran area in 2020*

Characteristics		Pre-Ramadan	Ramadan	Post-Ramadan
Total No.		142	293	263
Age (years)	0-15	8	4	6
	16-25	33	30	24
	26-45	62	218	199
	46-65	34	41	32
	>65	5	0	2
Sex	Male	129	268	242
	Female	13	26	22
Nationality	Saudi	89	187	160
	Non-Saudi	53	106	103

*Ministry of Public Health, Najran, Saudi Arabia

5. CONCLUSION

In conclusion, most of the study participants were physically inactive and slept more hours per day during the month of Ramadan. They frequently participate in sedentary activities such as watching television, playing computer games, and utilizing social media on their smartphones. The majority of Najran's population sleeps for longer lengths of time during the month of Ramadan. The increase in the number of sleeping hours could be attributed to the fact that many of the participants take their annual vacation during the month of Ramadan or work fewer days. This choice may not be available to individuals who have to work from early morning and deprive themselves from sleep that may explain the increase in accidents and irritability recorded during the month of Ramadan.

Therefore, it is important for public health professionals to prevent traffic or work accidents during the month of Ramadan they must set some measures in action to minimize accidents. These measures can only be achieved by adapting special working conditions for the fasting during the month of Ramadan, particularly for people whose work requires extreme alertness such as long-distance drivers and pilots, labor and other professions that have the religious permission to refrain from fasting. Employers should consider adjusting work hours, allowing flexible break times, and promoting awareness of the effects of fasting on concentration and fatigue. Additionally, hydration and nutrition guidelines should be provided to ensure workers maintain optimal energy levels. Implementing these strategies can help enhance workplace safety, reduce accident rates, and protect both employees and the general public during the month of Ramadan.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

No competing interests exist.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the Institutional Review Board from both De Montfort University (HLSFREC Ref: 1180) and the Najran University Ethics Committee (NUECO Ref: 2013) prior to the commencement of the study.

DATA AVAILABILITY

The data supporting this study's findings are available from the corresponding author upon reasonable request.

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