



# The Benefits of Ramadan Fasting on the Cognitive Function of Medical Students

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ARTICLE INFO	ABSTRACT
<i>Article type:</i> Research Paper	Adult Muslims have a religious obligation to fast every day for 29-30 days in Ramadan.
<i>Article History:</i> Received: 24 Feb 2020 Accepted: 15 Jun 2020 Published: 28 Apr 2021	In fasting individuals, the level of cognition may be affected, which in turn influences the performance of individuals. The present study aimed to assess the possible adverse effects of Ramadan fasting on the cognitive functions of medical students in Morocco. The study was conducted on 41 male Muslim medical students, who took a neuropsychological test one week before, during (second and third weeks of Ramadan) and after Ramadan. In addition, the participants were assessed in terms of the sleep patterns, working hours, and meals. According to the findings, Ramadan fasting decreased the body weight and body mass index of the students. The tests were performed using a CogState computerized cognitive tasks battery, which examined the psychomotor function (processing speed), attention, visual learning and memory, working memory (executive function), and verbal learning and memory of the participants. The obtained results indicated no significant changes at the four test periods ( $P < 0.05$ ).
<i>Keywords:</i> Ramadan Fasting Cognitive function	Despite the disturbances observed in the meals, working hours, and sleep duration, Ramadan fasting had no impact on the cognitive function of the medical students.
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## Introduction

In psychology, the concept of cognition is closely associated with performance, understanding, and interaction with the environment in various situations (1). Cognition allows attention, learning, developing new skills, and problem-solving (2). In fasting individuals, the level of cognition is affected, which in turn influences the performance of individuals (1).

Across the world, adult Muslims have a religious obligation to fast every day during the holy month of Ramadan, which is the ninth month of the lunar calendar (3).

The duration of fasting varies depending on the season and geographical region (4), varying from nine hours a day in winter to 20 hours in summer, following high latitudes (5). The fasting period begins before sunrise and lasts until sunset (7). During Ramadan, fasting individuals only have two main meals per day; one is Sahur, which is served before dawn, and the other is Iftar, which is served after sunset. Therefore, the patterns of daily meals differ from the three daily

meals, which are common before and after Ramadan month.

In Ramadan fasting, Muslims refrain from eating, drinking, smoking, and sexual intercourse (8). There are also some exceptions to these rules; for instance, women break their Ramadan fast during menstruation, and the elderly, ill individuals, and the children who have not reached puberty are also exempted from Ramadan fasting (6,9). Several studies have evaluated the changes in various biological mechanisms during Ramadan, as well as their association with fasting (7). Accordingly, Ramadan fasting affects the physical and cognitive performance of individuals (10). On the other hand, a significant reduction has been reported in memory, executive function, attention, information processing, and verbal function during Ramadan fasting toward the end of the day. Low blood glucose and accumulated sleep loss diminish some cognitive functions and humor (11, 12). Physical activity and exercise positively influence the brain (13). Exercise

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could also affect learning and memory through activating the secretion of a growth factor (IGF-I), which is involved in synaptic plasticity, stimulates the synthesis and release of neurotransmitters, and supports cognitive functions (16).

The prefrontal cortex is a zone in the brain that targets stress and is responsible for higher order cognitive abilities, such as executive functions (6, 14, 15).

To date, few studies have been focused on the combined impact of sleep and dietary changes on the cognitive performance and influence of Ramadan fasting on the cognitive performance of healthy adults (16,18), and no research has evaluated the cognitive function of fasting medical students in Ramadan.

The present study aimed to evaluate the effect of Ramadan fasting on the cognitive function of Muslim medical students.

## Materials and Methods

### Subjects

This study was conducted in Ramadan 2017-2018 on the medical students of the Faculty of Medicine and Pharmacy of Casablanca in Morocco. In total, 41 male medical students recruited before Ramadan in order to compare their cognitive performances before, during, and after this fasting period. A pilot study was initially carried out at the psychiatry center of the university. Prior to participation, the students received Adequate verbal explanations of the research procedures, and written informed was obtained from each participant. The study was carried out during Ramadan 2017-2018 after the approval of the Ethics Committee of the Faculty of Medicine and Pharmacy of Casablanca.

**Table 1.** CogState tasks results

CogStateTasks	Cognitive Domain	Performance Measurement	Means	F	P-value
Detection Task	Psychomotor Function	Speed (Log10 milliseconds) <sup>1</sup>	2.572±0.236	1.888	0.134
Identification Task	Vigilance (attention)	Speed (Log10 milliseconds) <sup>1</sup>	2.719±0.928	0.936	0.140
One-card Learning	Visual and Learning Memory	Accuracy (arcsine proportion) <sup>2</sup>	0.9780±0.155	1.277	0.284
N-Back Memory	Executive Function (working memory)	Accuracy (arcsine proportion) <sup>2</sup>	1.294±0.262	0.733	0.534
International Shopping List Recall	Verbal and Learning Memory	Number of Correct Responses <sup>3</sup>	1.265±0.272	0.953	0.420

1: log10 transformed reaction times for correct responses, 2: Arcsine transformation of square root of proportion of correct responses, 3: total number of correct responses in remembering list after delay

Data were collected using a checklist containing data on the frequency of the meals, mode of sleep, nap habits, and tiredness, which was completed twice (before and during Ramadan). The subjects aged more than 30 years, those who were not students, those with smoking habits, and female students were excluded from the study.

### Cognitive Function

Neuropsychological tests were performed using a CogState research battery (version 6.0) to measure the five domains of cognitive functions, including the psychomotor function, attention, verbal memory, executive functions, and visual memory. CogState is a validated computer-based assessment tool, which uses the technology of a computer with a touch screen to measure cognitive functions.

The entire battery required 15-20 minutes to complete the tests in the form of five tasks (Table 1), and the test sequence was identical in all the sessions. Every task was presented in the form of games of cards on a green background. Written instructions were initially displayed, and the participants were provided with an interactive demonstration before each task. After they became accustomed to a sufficient number of correct answers, the task would begin. The participants used the same computer in each session, and the battery was administered in the same order throughout the intervention. The use of computerized tests allows the standardized and accurate recording of reaction times, capturing, and electronic data processing,

thereby reducing human error and response bias.

The evaluations were performed one week before Ramadan (W1), during the second week of

Ramadan (W2) and the third week of Ramadan (W3), and four weeks after Ramadan (W4) (Figure 1). The calendar of the evaluation was set at 9-12 hours for each week.

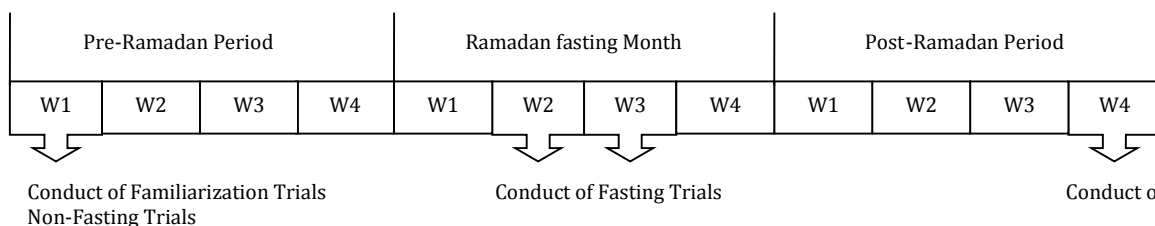


Figure 1. Study Design

**Statistical Analysis**

Data analysis was performed in SPSS version 20.0 using the two-factor repeated measures analysis of variance (ANOVA) with one repeated factor (weeks) and one grouping factor (task). In all the statistical analyses, the P-value of less than 0.05 was considered significant.

**Results**

In this study, all the participants were male, with the mean age of 24.5±2.7 years. Initially, 65 students were enrolled in the study, and 41 participants could complete the research. According to the findings, one month of fasting reduced the body weight and body mass index (BMI) of the subjects (Table 2).

Table 2. Age, Height, Weight, and BMI before and after Fasting (Data expressed as mean and standard deviation)

Parameter	Before Fasting	After Fasting
Age (year)	24.5±2.7	
Height (cm)	181.0±4.5	
Weight (kg)	89.3±12.8	86.8±12.0
BMI (kg/m <sup>2</sup> )	27.3±3.8	26.4±3.7

BMI: body mass index.

**Cognitive Function**

In the current research, the participants were evaluated in four sessions in terms of the cognitive function. The detection task measured the processing speed (F=1.888P=0.134), the identification task measured attention (F=0.140; P=0.935), the one-card learning measured visual learning and memory (F=1.277; P=0.284), the n-back memory measured the working memory (F=0.733; P=0.534), and the International Shopping List Recall measured verbal learning and memory (F=0.953; P=0.420) (Table 1). In the mentioned measurements, the P-value was higher than the threshold (P<0.05).

According to the obtained results, processing speed, attention, visual learning and memory, working memory, and verbal learning and memory were not statistically significant (Table 1). Furthermore, no significant interaction was observed between the weekly intervals (W1, W2, W3, and W4) and the cognitive function, while the psychomotor function, attention, visual memory, verbal memory, and executive function were almost similar (Figure 2).

**Discussion**

The present study aimed to assess the effect of Ramadan fasting on the cognitive function of medical students. Despite the modest decrease in the body weight and BMI and a more pronounced sense of starvation, no changes were observed in the other parameters. The major findings of the current research indicated that Ramadan fasting in healthy students had no effect on their cognitive function.

To the best of our knowledge, this was the first study to investigate the effects of fasting on the cognitive state of students. Conflicting results have been proposed on the effects of fasting due to the differences in the composition of Ramadan meals (rich in carbohydrates and fats or high-protein), applied terminology, methodology, and samples populations (19).

Our findings are consistent with the previous studies in this regard as we observed no difference in the cognitive function of the students before, during and after one month of fasting, and fasting had no significant effects on the visual learning and working memory of the students (13). Some studies have indicated that

fasting adversely affects the cognitive function (20, 21), while no such effect has been denoted in other investigations (1).

On the other hand, some studies have demonstrated that performance in spatial planning and the working memory capacity test has increased significantly during the fourth week of fasting (22). The results of the present study are inconsistent with the studies denoting cognitive deterioration during Ramadan fasting (20, 23). This discrepancy could be due to the obvious differences in the cognitive profile of athletes and non-athletes as it has been

frequently reported that sports activities are associated with higher performance in various cognitive domains (24, 25).

According to a study, Ramadan fasting could affect performance in certain mental and physical tasks, while this was not the case in all the subjects (26). The results of the present study should be interpreted in the context of its limitations, such as the small sample size and selecting a particular sample population (medical students). Notably, the medical students ate nothing for several hours during their shifts.

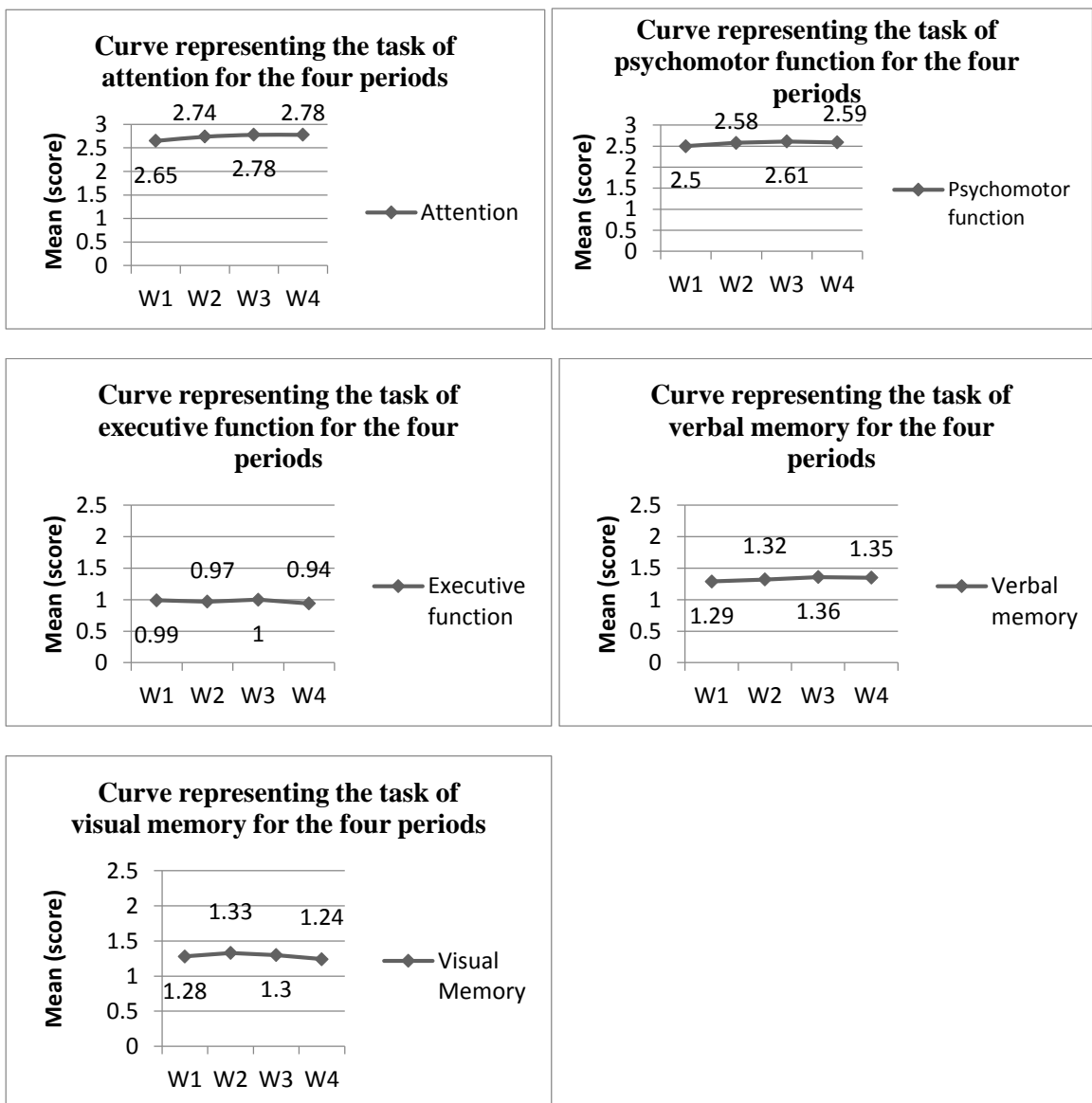


Figure 2. Comparison of Cognitive Domains in Subjects during and after Ramadan

## Conclusion

According to the results, Ramadan fasting had no effect on the short-term cognitive function of the medical students. For the first time, we have documented such results in the medical students in Morocco.

## Conflicts of Interest

None declared

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