

Fasting in Ramadan Affects Cognitive and Physiological Function in Normal Subjects (Pilot Study)

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Abstract

Purpose: Our study aimed to investigate the effects of Ramadan fasting on cognitive and physiological function in a group of healthy Muslim subjects. **Methods:** We measured demographic, physiological (blood pressure), and cognitive function including attention switching task (AST) and delayed matching to sample (DMS) using the Cambridge Neuropsychological Test Automated Battery (CANTAB) at two periods of the study (before Ramadan, at the second week in Ramadan) in 15 subjects. **Results:** During fasting, performance on the AST test improved significantly for switching cost ($p = 0.030$) and for congruent condition of AST task ($p = 0.043$), for diastolic pressure decreased ($p = 0.069$) in healthy subjects. There was no significant effect for incongruent condition and number of errors and percent to complete task for DMS test and systolic blood pressure. **Conclusions:** The results suggest that Ramadan fasting is associated with significant changes in cognition, and causes a drop in diastolic blood pressure in healthy subject.

Keywords

Ramadan Fasting, Blood Pressure, Cognition

1. Introduction

Ramadan, the ninth month of the Islamic lunar calendar, is spent by adult Muslims fasting from all over the world. Fasting period commences just before dawn and lasts till sunset/dark [1]-[3]. During fasting Muslims remain away from drinking, eating, smoking, and sexual relations [4]. The duration of each period of fasting va-

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ries depending upon the solar calendar dates and geographical locations it occurs in. In summer months, it may last more than 16 hours a day.

A lot of research has been conducted to assess changes in different biological processes during Ramadan and their association with fasting [5]. Fasting in Ramadan may significantly affect daytime hydration, blood glucose and body temperature [6]-[8], circadian rhythms [9] [10], physiological [11], metabolic and endocrine functions [6] [8], serum levels of cholesterol, lipids [6]-[9]. In previous studies, effects of Ramadan on blood pressure were elaborated but such investigations were carried out in patients already suffering from hypertension and heart diseases [11] [12]. Limited data are available about effect of Ramadan fasting on normal individuals [13] [14].

Ramadan has marked impact on physical and cognitive performances [15]. Subjective alertness and memory functions are adversely affected [16]-[19]. On the other hand, relative robustness of memory, executive function, attention, information processing and verbal function during fasting has also been demonstrated in previous studies [20]-[23]. The conflicting findings may be attributed to methodological differences and the unavailability of sensitive computerized neuropsychological instruments in some studies.

Hence, our study was designed to examine the effect of Ramadan fasting in a group of healthy adult Muslim subjects on cognitive function and on blood pressure.

2. Material and Methods

2.1. Subjects

Fifteen healthy volunteers aged between 21 and 28 years (24.5 ± 2.7) were recruited from Riyadh, Saudi Arabia. Written informed consent was obtained and the study conducted in 2015. Questionnaires were given to all participants for knowing demographic data, diagnosed with diabetes, cognitive impairment, and visual analogue scale (Table 1). They were all enrolled in the study after receiving adequate verbal explanations about the research procedures and providing the informed consents.

2.2. Procedure

The study was conducted during the Ramadan fasting month. Participants were examined at two different points: two weeks before Ramadan, the 2nd week of fasting of Ramadan. Blood pressure and heart rate were measured during and after Ramadan.

2.3. Cognitive Function

Neuropsychological testing was performed using Cambridge Neuropsychological Test Automated Battery (CANTAB) research suite software (version 6. 0.37, Cambridge cognition). The entire battery required 25 - 30 min to complete the tests. First task was Delayed Matching to Sample (DMS), which assessed forced choice recognition memory for non-verbalisable patterns, testing both simultaneous matching and short-term visual memory. The participant was shown a complex visual pattern and then, after a brief delay, four similar patterns. The participant must touch the pattern, which exactly matches the sample. Second task was chosen from attention test, attention-switching task (AST). The test displayed an arrow, which can appear on either side of the screen (right or left) and can point in either direction (to the right or to the left). Each trial displayed a cue at the top of the screen that indicated to the participant whether they had to press the right or left button according to the "side on which the arrow appeared" or the "direction in which the arrow was pointing".

Table 1. Demographic data.

Variable Study group	Non fasting (N = 15)	Fasting (N = 15)
Age (Mean) =	24.8	24.8
Blood pressure		
Systolic (mmHg)	110.06	116.31
Diastolic	74.6	73.42
Heart rate BPM	71.86	69.47

BPM: Beats per minute, mmHg: Millimeters of mercury.

2.4. Statistical Analysis

DMS task was analyzed for the numbers of correct patterns selected, and statistical analysis measuring the probability of an error after a correct or incorrect response. AST test outcome measured include response latencies and error scores that reflected the participant's attention switching ability and the interference of congruent and incongruent task-irrelevant information. Statistical analysis was performed using SPSS software (version 19.0; SPSS Inc., Chicago, Illinois, USA). Comparison of quantitative data between Ramadan (fasting) and non-Ramadan (non-fasting) was performed using paired t-tests if normality assumptions were satisfied; otherwise non-parametric tests were used. Two-tailed statistics were used and statistical significance set at $p < 0.05$.

3. Results

Results from Fifteen adult healthy volunteers were analyzed in this investigation (**Table 1**).

During fasting, performance on the AST test improved ($p = 0.030$) significantly for switching cost from (202 ± 49.2 ms SEM) to (121 ± 25.4 , **Figure 1**) and improved latency (ms) for congruent condition ($p = 0.043$) from (491 ± 44.1) to (412 ± 32.1) of AST task (**Figure 2**) before and during Ramadan. There was non-significant ($p = 0.86$) from (508 ± 45.6) to (434 ± 32.8) for response time after Ramadan.

There was near to significant ($p = 0.006$) decreased for diastolic pressure from (77.4 ± 1.69) to (71.1 ± 2.09) in healthy subjects (**Table 1**). There was not significant effect for incongruent condition ($p = 0.149$) and no of errors ($p = 0.364$) and percent to complete task for DMS test ($p = 0.755$) and systolic blood pressure ($p = 0.882$).

4. Discussion

Our data from neuropsychological test proposed that Ramadan fasting affects cognitive function but not homogeneously. Ramadan had positive influence on performance in the domains of psychomotor function/processing speed and attention. Our data exhibited a marked decrease in values of diastolic blood pressure during Ramadan as compared to values obtained from healthy individuals before Ramadan. Since glucose is an essential substrate of central nervous system, cognitive activity is related to glucose metabolism [24] [25].

However, slower response times and performance decrements were observed [26]. Pivik *et al.* [27] investi-

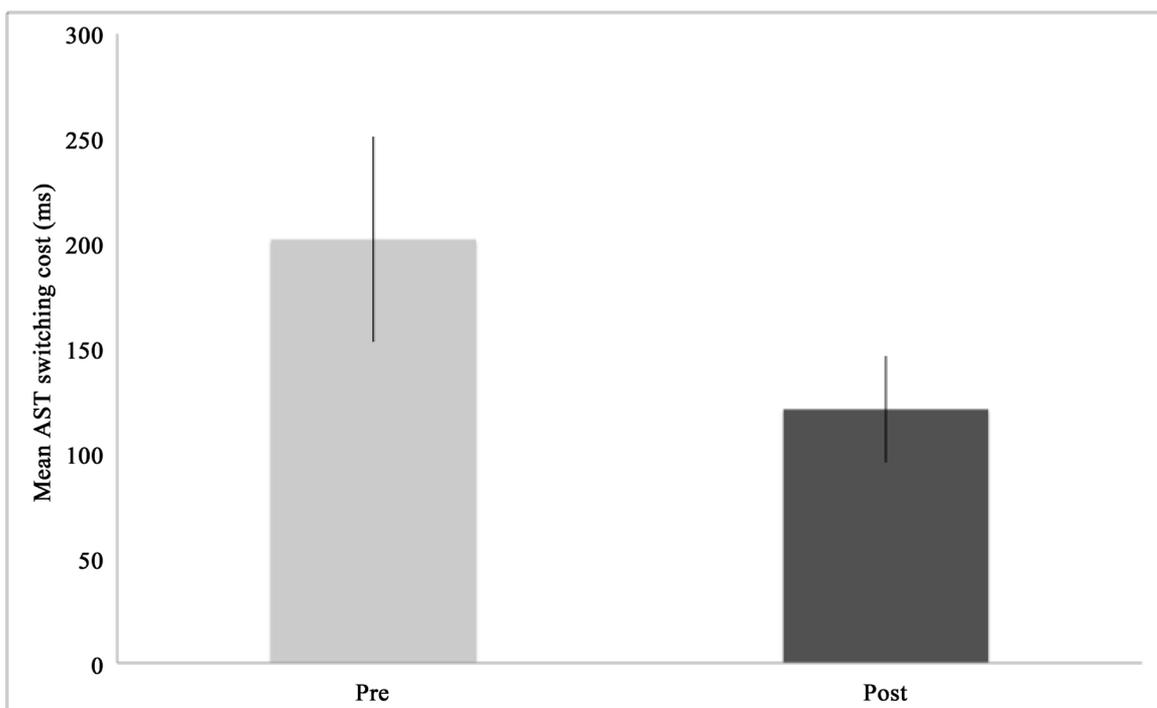


Figure 1. AST during non-fasting (pre) and fasting (post), for mean response time in (ms). Lower scores indicate better performance.

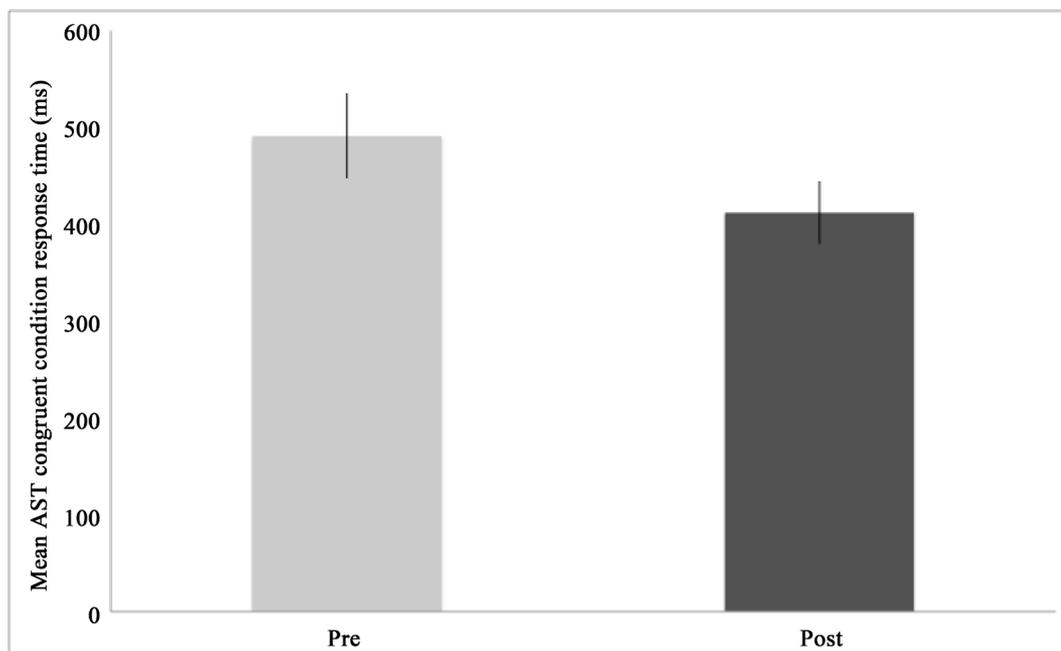


Figure 2. AST during non-fasting (pre) and fasting (post), for congruent condition mean response time in (ms). Lower scores indicate better performance.

gated effect of Ramadan fasting on occipital cortex and found that alpha frequency was not significantly altered in that specific area during fasting period. Similarly, in another Ramadan study, performance in occipital cortex domain was not declined in occipital cortex centered one-card learning and one-back memory tasks [15]-[17] [22].

Our data from Ramadan study are consistent with previously reported results. In our investigation, a significant drop of diastolic blood pressure (to 7.33 mmHg) was recorded during fasting. Dewanti *et al.* [28] observed comparable hypotensive effects on both fasting and non-fasting groups. In this way, these results cast suspicion on those studies in which effect of Ramadan fasting was investigated in patients diagnosed with hypertension. We recommend to record data with caution from those individuals who are habitual fasters and diagnosed with heart diseases. Large sample size containing female fasters and individuals from other ethnicities would be needed for further investigations.

5. Conclusion

Our results confirm that during Ramadan fasting, performance in cognitive functions requiring sustained rapid responses is better, whereas performance in non-speed dependent accuracy measures is more resilient.

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