

# Are visual and auditory reaction times influenced by Ramadan fasting? Neuro performance study on healthy individuals

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## Abstract

**Aim:** The purpose of this study is to find out whether visual and auditory reaction time (VRT and ART) is influenced by Ramadan fasting in healthy individuals in terms of neuro performance.

**Materials and Methods:** 60 healthy individuals (30 male, 30 female) with the mean age of 20.22±1.45 years participated in the study. First reaction measurement was collected on the second week of the date Ramadan fasting started and this period was called fasting period. Second reaction measurement was collected five days after Ramadan fasting ended and this period was called post-fasting period. VRT and ART of the samples who participated in the study were made with reaction timer device. 10 trials for sound and light stimuli were taken from each sample. The first five trials were considered as exercise and the average of the last five trials was determined as reaction time. The analysis of VRT and ART in fasting and post-fasting periods was conducted with Wilcoxon matched pairs test. In addition, Mann Whitney U test was used to analyze whether there were differences between fasting and post-fasting periods of males and females in terms of VRT and ART.

**Results:** No statistical difference was found between the VRT and ART of males and females in fasting and post-fasting period ( $p>0.05$ ).

**Conclusion:** In this study which examined the effect of fasting on VRT and ART, it was found that males and females who participated in this study were not negatively influenced by Ramadan fasting in terms of neuro performance.

**Keywords:** Reaction time; neuro performance; ramadan; fasting.

## INTRODUCTION

Reaction time is a hereditary characteristic which determines the period between the first muscular reactions of an individual against stimuli or the period until the time a movement is made (1). In other words, reaction time is the amount of time passing from receiving a sudden signal to responding to this signal. It is a determinant factor in many daily activities and sport and it can be developed through regular training (2). The stimuli can be auditory, visual and tactual (3). It is stated that the responses given to auditory stimuli are shorter than responses given to visual stimuli (1). Reaction time depends on factors such as age, gender, level of education, type of stimulus, habits and being

alert (4), fatigue, alcohol and nicotine, altitude (5) and level of training. Reaction time in humans is directly associated with speed of neural transmission. Although this speed is 250 miles an hour, it takes some time for the message to travel from sense organs to the brain and from there to the suitable muscle groups (6). Physiologically, reaction time has components such as the emergence of a stimulus on the level of receptor, the transmission of the stimulus to the central nervous system (CNS), neurological transmission of the stimulus, effector signal production, transmission of the signal from MMS to the muscles and the stimulation of the muscle to generate a mechanical work. Most of the reaction time occurs in the phases of neurological transmission of the stimulant and effector signal generation (7).

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Biological clock (Circadian clock) is located to suprachiasmatic nucleus in the hypothalamus. Pineal gland secreting melatonin includes in epithalamus and provides control of sleepiness and awareness. It has been observed that there are fibers which in optical chiasm connected with suprachiasmatic nucleus, diencephalon, mesencephalon and pineal gland. Biological clock regulates feeding, sleeping patterns, metabolic processes (heart rate, the number of breathing, alertness), the production of melanin and cortisol. According to studies, there is no significant changes on pituitary gland's hormones out of corticotropin (ACTH) serum levels, thyroid, pancreas gland hormones during Ramadan fasting (8).

Ramadan fasting is a religious service fulfilled each year by Muslims all over the world. This religious belief includes staying away from food and liquid intake completely from sunrise to sunset. Ramadan fasting resembles intermittent fasting (8, 9). Not taking food for a long time negatively influences both health and performance (9, 10). In individuals who are not athletes, resting blood glucose is not influenced much and stays within normal clinical limits during the Ramadan month (11). If an athlete gets sufficient food and liquid in Ramadan, small changes will occur in blood glucose and athletic performance will not be influenced (12). The purpose of this study is to find out whether VRT and ART time is influenced by Ramadan fasting in healthy individuals in terms of neuro performance.

## MATERIAL and METHODS

### Study design and participants

This study was conducted with 2018/109 coded permission of Inonu University Clinical Researches Ethical Board. A total of 60 healthy individuals with the mean age of  $20.22 \pm 1.45$  years, 30 males with the mean age of  $20.21 \pm 1.67$  years and 30 females with the mean age of  $20.24 \pm 1.36$  years, participated in this study. The data were collected on the second week of the date Ramadan fasting started and the day after fasting ended. Individuals who were physically healthy, who had not received any resistance exercise at least until 6 months before the study started, who did not have any medical obstacles to participate in the study, those who had not used any medication during the study, who had not used any supplements such as creatine, those who did not have any diseases and those who had not received orthopedic surgery previously were included in the study. All the subjects were sufficiently informed about the study; informed consent forms were read and signed. The experimental procedures were conducted in line with the Helsinki protocol.

### Reaction Time Measurements

VRT and ART measurements of the participants in the study were conducted with Hubbard Scientific Reaction Timer (Model: 6027, USA) device. Reaction Timer device can give 2 different warnings as visual (light) and auditory (sound). The first measurements were made on the second week of Ramadan fasting and the second measurement was made right after fasting ended, between 10:00 and

11:00 in a noise free and sufficiently lighted environment. Information form was prepared for each participant beforehand to record the measurement results. Reaction Timer button was placed 10 cm away from the table in front of the subject and the subject was asked to put his/her dominant hand on the table. When one of the sound or light stimulants was given with the "ready" command, the subject was asked to press the buttons in shortest time possible according to the stimulants. The results were recorded on previously prepared measurement result papers. 10 trials for sound and light stimuli were taken from each sample. The first five trials were considered as exercise and the average of the last five trials were determined as reaction time (13).

### Statistical Analysis

Kolmogorov Smirnov test was used to examine whether the data were normally distributed and it was found that the data were not normally distributed. The analyses of VRT and ART in fasting and post-fasting periods were made with Wilcoxon matched pairs test. In addition, Mann Whitney U test was used to analyze whether there were differences between fasting and post-fasting periods of males and females in terms of VRT and ART. Median and minimum (min) and maximum (max) values of the data that were not normally distributed were given.  $p < 0.05$  value was considered as significant. While calculating the sample size, the 95% confidence interval in the G-Power 3.1.7 package program was calculated for The Paired Samples t test at the beginning of the study. The minimum sample size for  $\alpha = 0.05$  and  $1 - \beta = 0.80$  was calculated to be 36 (18 males, 18 females) in order to determine at least 1 ms of change in VRT and ART. IBM SPSS Statistics 22.0 for Windows was used for statistical analyses.

## RESULTS

The mean age of the male participants was  $20.21 \pm 1.67$  years, while the mean age of the female participants was  $20.24 \pm 1.36$  years.

The median value of visual reaction time was found as 29 ms in males' fasting period and as 29.6 ms in post-fasting period, while it was found as 31 ms in females' fasting and post-fasting period. The median value of auditory reaction time was found as 34.8 ms in males' fasting period and as 32.1 ms in post-fasting period, while it was found as 35 ms in females' fasting period and as 36.6 ms in post-fasting period. According to the analysis results of Wilcoxon matched pairs test conducted, no difference was found between male and female participants' fasting and post-fasting period VRT and ART ( $p > 0.05$ ), (Table 1).

Mann Whitney U Analysis was conducted on the data to find out whether there were differences between VRT and ART of male and female participants in fasting and post-fasting period. According to the analysis results, no statistical difference was found between male and female participants' VRT and ART in fasting and post-fasting period ( $p > 0.05$ ), (Table 2).

**Table 1. Median (min-max) values of visual and auditory reaction times of male and female participants in fasting and post-fasting periods and Wilcoxon matched pairs test analysis results**

Sex	Visual Reaction Times			Auditory Reaction Times		
	fasting	post-fasting	P	fasting	post-fasting	P
Males	29 (24-36.3)	29.6 (24-20.7)	.438	34.8 (25.3-51.7)	32.1 (26.7-45.7)	.877
Females	31 (23.7-47.7)	31 (25-48)	.566	35 (26.3-62)	36.6 (28-44)	.525

**Table 2. Analysis results of fasting and post fasting periods between males and female**

Test	fasting	post-fasting
Visual Reaction Times	.094	.294
Auditory Reaction Times	.202	.055

## DISCUSSION

In this study which examined the effect of Ramadan fasting on VRT and ART, it was found that male and female participants were not negatively influenced by Ramadan fasting in terms of neuro performance. In addition, when male and female participants' reaction times were compared, no statistical differences were found.

In a study conducted on Algerian young people during Ramadan, no changes were found in fasting blood glucose (14). Kassab et al. (2003) showed that during Ramadan, serum leptin levels increased with a rate of 37% and 39% in obese and non-obese individuals, respectively and argued that serum leptin level and insulin level increased proportionally and this in turn resulted from the fact that insulin hormone regulates leptin oscillation (15).

In addition, a lot of studies observed that there is no considerable change in terms of thyroid, pancreas gland hormones during Ramadan. Also, the levels of adrenaline hormone did not significantly decreased (16). In the other word, Ramadan fasting not affect negatively the circuit of Biological clock. Therefore, this study investigated whether VRT and ART is influenced by Ramadan fasting in healthy individuals in terms of neuro performance.

Ramadan fasting is a religious service characterized by the change in eating program and frequency. People eat only at night and more rarely, which can influence energy and food intake. For this reason, the existing findings have shown that total calorie intake during Ramadan decreases significantly when compared with the pre-Ramadan period (17). While some studies state that Ramadan fasting decreases performance (17,18), other studies argue that it does not influence sportive performance (19,20). These differences can be due to the period of food and water restriction based on the season Ramadan takes place in, differences in performance tests or environmental conditions (21). There are also studies arguing that psychomotor and cognitive performances are influenced by Ramadan fasting (22).

Previous studies arguing the influence of Ramadan on neuro performance have mostly been conducted on students or athletes. Roky et al. (2000) reported longer reaction times on the sixth day of Ramadan month ( $p < 0.05$ ); however, they found that these returned to normal values on days 15 and 28 (22). In their study, Tian et al. (2011) found that the participants had better reaction times in the second half of Ramadan (23). Dolu et al. (2007) found that in the first week of Ramadan, medical faculty students had lower concentration ( $p < 0.01$ ), (24). Lotfi et al. (2010) found a positive improvement in the visual perceptions of sport school students in the first and third week of Ramadan (25). In a study they conducted on 20 healthy individuals, Mertens et al. (2015) found that Ramadan fasting did not affect neuro performance parameters and did not have any influence on reaction time and visual perception (26). Memari et al. (2011) conducted 4 measurements on 12 female taekwondo athletes between the ages of 15 and 27, as one week before Ramadan, on the second week of Ramadan, on the fourth week of Ramadan and 3 weeks after Ramadan. In this study, they showed that balance did not undergo any significant change during Ramadan (16). In a study they conducted with judo athletes with the mean age of  $22.5 \pm 2.8$  years, Souissi et al. found that Ramadan fasting had a negative influence on dynamic postural balance. In the measurement conducted 3 weeks after Ramadan, they found that the negative influence had improved. It was thought that these changes were caused by the fact that the partial sleep deprivation in Ramadan disrupted the sleep-awakeness cycle and thus caused the postural balance to deteriorate (27). In their study, Cay et al. (2018) found that Ramadan fasting impaired the proprioceptive sense, although partly (28).

Data on neuro performance parameters are scarce and results are contradictory. Two studies found a slower reaction speed during the first week of Ramadan (24, 29), while measurements in the second half of Ramadan showed no effect on reaction speed (22,23). Information processing speed and concentration were decreased in the first week of Ramadan in one study (29), but were better than normal in another study (25). Short time memory was better during Ramadan in one study (25), while unaffected in another (23). Gutierrez et al. (2001) stated that while 3-day-long hunger caused decreases in working capacity, it did not cause any change in reaction time (30).

Although there were more subjects in this study when

compared with other studies, this study could have been conducted with higher number of participants. In addition, since there wasn't enough participation in our study in the first week of Ramadan fasting, we couldn't take measurements in the first week. For these reasons, our study has such limitations.

## CONCLUSION

This study found that male and female participants were not negatively influenced by Ramadan fasting in terms of neuro performance. In general, when the results of studies above are taken into consideration, it can be seen that the disrupted concentration in the first week of Ramadan fasting and the increasing reaction time return to normal values in the second week of Ramadan fasting. Since all our measurements were conducted in the first week of Ramadan, the results of our study are in parallel with these studies. We believe that the study we conducted will be a resource for future studies.

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