



## Effect of Ramadan Fasting on Cognitive Functions Using P300 Event Related Potential and the Cancellation Test

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### ABSTRACT:

Muslims abstain from eating, drinking, sexual activity from sunrise to sunset during the fasting month of Ramadan. This study is aimed at investigating the effect of Ramadan fasting on plasma glucose levels and cognitive functions such as attention, memory, decision making. The study was carried out with 15 healthy adult participants. P300 recordings and plasma glucose levels were taken from all participants in fasting and subsequently non-fasting period as control group. The cancellation test was also administered to assess sustained attention in both periods. P300 was recorded using auditory oddball paradigm which consisted of 120 standard and 40 target stimuli. Latencies and amplitudes of P300 to target and standard stimuli were analyzed. P300 wave is important component of auditory event-related potentials (ERPs) commonly used to examine cognitive function in decision making processes. The biological drive to eat is linked to the satiating power of food. Satiating power, or satiating efficiency, describes the capacity of a food to suppress and to inhibit further eating. Food causes this effect by certain mediating processes that can be roughly classified as sensory, cognitive, post-ingestive (pre-absorptive) and post-absorptive. These processes are operated by the impact of food on physiological and biochemical mechanisms, and collectively these processes have been referred to as the satiety Free eating is allowed from sunset to dawn. We investigated cognitive changes linked to time of year and time of day as a result of abstaining from routine physiologic requirements.

Our experiments were carried out 16 healthy male students ( $19.75 \pm 0.17$ ) from Medical Faculty of Erciyes University. All subjects were reported no neurological or psychiatric problems and had normal hearing sensitivity. They were from a similar ethnic background, had no history of any systemic and

ocular disease and all were nonsmoking. All subjects gave informed consent. All experiments were performed according to the guidelines of the Erciyes University Ethics Committee. Records were taken from

each student twice; once, during fasting ( $n=16$ ), and once when non-fasting condition ( $n=16$ ). There was one month between the measurements. Blood glucose levels were also determined in each group. EEG activity was recorded at the Fz, Cz, Pz and Oz electrode sites of the International 10-20 system using Ag/AgCl electrodes, affixed with electrode paste and tape; with impedance of 10 k or less. Reference electrode was attached to the right earlobe, and the ground electrode was attached to the left earlobe. The signals were filtered with a band-pass filter (0.03-100 Hz), and EEG was digitalized at 2000 Hz with a 1024 ms prestimulus baseline. Waveforms were collected and averaged off-line by a Pentium computer, which also controlled stimulus presentation. Automatic artifact rejection was used, based on signal amplitude ( $>50$  V) or  $<50$  V) in Fz. Twenty responses to target stimuli were averaged at each location.

In this study the glucose levels of the students during Ramadan in fasting group is significantly lower when compared to glucose levels after Ramadan in non-fasting group which is parallel to the other research results in literature. P300 latencies are decreased in all regions during non-fasting when compared to fasting group ( $p < 0.05$ ) in all regions. On the other hand there is an increase in P300 amplitude in non-fasting group when compared to fasting group in all regions but this increase is only significant in Oz region ( $p < 0.05$ ).

The working hours and daily routine physical activities of medical faculty students included in our study during Ramadan were continued as before or after the Ramadan. They didn't take any medication or chemicals during, before or after the Ramadan. Their sleeping hours were decreased only 1 hour during Ramadan when compared to normal period and their daily diet content didn't change during Ramadan fasting when compared to non-fasting times. Only their meal times had changed. All the records were taken at the same time of the day (15.00-17.00) and only male students were included in the study. In this study we elicited those long-term changes in routine physiologic requirements as not to eat and drink for 12 hours period in Ramadan and rhythm changes in routine sleeping habit may affect given attention and memory.

### References

1. Dye L, Blundell J (2002) Functional foods psychological and behavioural functions. *Br J Nutr* 88: 187-211.
2. Bellisle F, Blundell J, Dye I, Fantino M, Fern E, et al. (1998) Functional food science and behaviour and psychological functions. *Br J Nutr* 80: 173-193.
3. Kaplan RJ, Greenwood CE, Winocur G, Wolever TMS (2000) Cognitive performance is associated with glucose regulation in healthy elderly persons and can be enhanced with glucose and dietary carbohydrates. *Am J Clin Nutr* 72: 825-836.
4. Strachan MWJ, Deary IJ, Ewing FME, Frier BM (1997) Is type II diabetes associated with an increased risk of cognitive dysfunction? A critical review of published studies. *Diabetes Care* 20: 438-445.
5. Roky R, Houti I, Moussamih S, Qotbi S, Aadil N (2004) Physiological and chronobiological changes during Ramadan intermittent fasting. *Annual Nutrition Metabolism* 48: 296-303.
6. Rugg MD (1995) *Electrophysiology of mind*. Oxford: Oxford University Press.
7. Jimenez-escrig A, Fernandez-Lorente J, Herrero A, Baron M, Lousa M, et al. (2002) Event-related evoked potential P300 in frontotemporal dementia. *Geriatric Cognitive Disorders* 13: 27-32.
8. Donchin E, Michael GHC (1988) Is the P300 component a manifestation of context updating. *Behaviour & Brain Science* 11: 355-372.
9. McCarthy G, Donchin E (1981) Metric for thought: a comparison of P300 latency and reaction time. *Science* 211: 77-80.

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