

The Effect of Ramadan Fasting on Intra Ocular Pressure Changes in Healthy Subjects

Rahil Karimirad¹, Mohsen Nematy², Mohamad-Reza Sedaghat³, Farshad Askarizade^{4,5}, Tahereh Rakhshandadi⁶, Zahra Mahmoudi⁶, Mehrane Mehramiz⁷, Javad Heravian^{5,8*}

1. Nutrition Research Group, Student Research Committee, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
2. Associate Professor of Nutrition, Biochemistry and Nutrition, Endoscopic and Minimally Invasive Surgery, Cancer Research Centers, Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
3. Associate Professor of Ophthalmology, Cornea Research Center, Khatam Al Anbia Hospital, Mashhad University of Medical Sciences, Mashhad, Iran
4. PhD Candidate in Optometry, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran
5. Refractive Errors Research Center, Mashhad of Medical Sciences, Mashhad, Iran
6. MSc Student of Optometry, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran
7. Nutrition Research Group, Student Research Committee, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
8. Professor of Optometry, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran

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ABSTRACT

Introduction: Annually, millions of Muslims all over the world observe the fasting rules based on its measures; this highlights the importance of studies in this field as a worthwhile model for intermittent fasting. It is obvious that changes in lifestyle over fasting have outstanding effects on physiological parameters. The current study was carried out to investigate the IOP and serum electrolytes as two important factors that are influenced by human lifestyle.

Methods: Eighty-nine fasting and healthy participants including men and women with mean age of 34.97 were included in our study based on the inclusion and exclusion parameters. During this project, Ramadan coincided with the summer (between June and July 2015). All participants were monitored by an expert examiner and blood samples were collected and IOP was measured by tonometer (Topcon, 1-75, Hasunuma-cho, Itabashi-KU, Tokyo, Japan 2014). The participants were examined one week before and one week after Ramadan.

Results: There was a significant reduction in physiological IOP in healthy people after Ramadan. In line with this, the serum electrolytes were altered by fasting so that Na, K, Se experienced a significant decrease while serum phosphorous increased ($P < 0.05$).

Conclusion: Prolonged intermittent fasting in Ramadan changed IOP and serum electrolytes in healthy people within a normal range.

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Introduction

Intermittent fasting during a given period of time is common in many religions worldwide and during this period, the changes in nutritional and sleeping patterns have considerable effects on human health. Ramadan is one of such fasting ceremonies during which over one billion Muslims worldwide abstain from eating and drinking (1). Although fasting is a religious obligation for all healthy adult individuals; children, travelers, patients, pregnant and lactating women, and menstruating women are exempt. Muslims fast during the daylight hours

from dawn to sunset (2, 3). People in Iftar break their fast by warm refreshments and then eat other foods and in Sahur, before dawn, the meal is served and the most popular refreshment is water (4). The Islamic calendar is based on lunar cycles so it retrogresses about two weeks every year. Ramadan can occur in different seasons, therefore it lasts 29-30 days and 10-17 hours based on the visual sightings of the crescent moon and different geographical regions. (5). A vast body of studies has evaluated the consequences of Ramadan fasting on

* Corresponding author: Javad Heravian, Department of Optometry, School of Paramedical Science, Mashhad University of Medical Sciences, Mashhad, Iran. Email: Heraviansj@mums.ac.ir

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physiological functions (6-8). Changes in physiological parameters would also involve electrolytes serum and ocular system. As data showed normal range of IOP (Intra Ocular Pressure) is between 15-21 mmHg by Applanation method (9). IOP can be affected by different factors such as length of day, weight, liquid intake and consumption of systemic drugs and variations during the day time. In the morning, it is more than its level in the evening, which might be due to the body liquid reduction during the day (10). The amount of water each fasting individual drinks between Iftar and Sahar is more than the usual days, which results in an increase in IOP. However, the reasons behind this issue are controversial (1). Different studies suggested that, fasting affects the physiology of the ocular system e.g. it decreases insulin secretion; on the contrary, it increases glucagon level and sympathetic activity which can cause releasing of free fatty acids. In line with these elevations in cortisol and norepinephrine hormones, it is proposed that these changes increase IOP and retinal hyper perfusion. Consistent with these observations, several studies revealed the effect of fasting on lipid profile and level of serum electrolytes, melatonin and cortisol that have considerable effect on ocular function (5, 11). Routinely, the dehydration and weight loss that follow fasting and water deprivation remarkably change serum electrolytes and lead to disputable changes in IOP and ocular blood flow(12).

The aim of this study was to investigate the effects of fasting on IOP and blood electrolytes and their changes during Ramadan in Iranian population.

Material and methods

A population based study utilizing multi step random sampling techniques was carried out among healthy adult Muslims in Iranian population. They were examined one week before and one week after Ramadan, in Mashhad, north east of Iran in 2015. In the current study, Ramadan coincided with June and July in summer and mean hours of fasting was about 17 hours. Informed written consent was provided by all participants. The Ethical Committee of Mashhad University of Medical Science approved the protocol of the current study (ethical code: 940149). At first 100

healthy, fasting volunteers enrolled in the study. The inclusion criteria were: non-existence of any systemic or ocular disease, fasting for a minimum of 20 days, and an age of 20-50 years old. Exclusion criteria were: subjects with a current or prior history of the Diabetes, HTN, glaucoma etc., and consumption of any special drugs. Finally, a total of 89 subjects with mean age of 34.97 years entered the study including 51 males and 38 females. All participants were inspected by an expert examiner and blood samples were taken. IOP of the right eye was measured in the afternoon by tonometer (Topcon '1-75 'Hasunuma-cho ' Itabashi-KU ' Tokyo' Japan 2014). All samples from the same patient were run in duplicate in the same assay. Blood samples were taken from the brachial vein in the morning after at least 12 hours fasting by (Micro life, BP AG!-20, Japan). Data were analyzed for normal distribution (IOP, serum electrolytes). Paired sample T-test was used for comparing these data. Pearson Correlation coefficient was also calculated. P-value <0.05 was considered statistically significant. Data analysis was performed with SPSS 16.0(IBM Company, Chicago, USA).

Results

89 healthy participants who were fasting were examined before and after Ramadan. Mean age of patients was 34.97 and 57% of them were men. IOP and serum electrolytes level was measured among volunteers one week before and one week after Ramadan for detecting the effect of fasting on these parameters.

As shown in Table 1, the mean of IOP dropped significantly across men after Ramadan. Although reduction in the mean of IOP in total population was statistically significant, the changes in women was not significant (P>0.05).

Regarding blood electrolytes, the results demonstrated in Table 2 reveal that after Ramadan, the serum levels of sodium, potassium and selenium decreased significantly, while serum phosphor was ruled out and other

Table 1. Subjects IOP Pre- and Post-Ramadan

IOP	Pre-Ramadan	Post-Ramadan	95% CI
	Mean(SD)	Mean(SD)	
Men*	15.26(3.26)	14.57(3.15)	1.29, 0.08
Women	16.26(3.45)	15.89(3.59)	1.19, -0.45
All*	15.68(3.36)	15.12(3.39)	1.03, 0.07

Intraocular pressure (IOP)

*P<0.05

Table 2. Serum electrolytes Pre- and Post-Ramadan.

ION	Pre-Ramadan Mean(SD)	Post-Ramadan Mean(SD)
Sodium *(mg/dl)	139(2.74)	138(2.21)
Potassium*(mg/dl)	4.19(0.24)	4.11(0.24)
Selenium* (mg/dl)	87.17(13.71)	82.78(13.30)
Phosphor* (mg/dl)	4.5 (0.7)	4.8(0.7)

*P<0.05

Table 3. Correlation between serum electrolytes and IOP

	Parameter	Serum Na	Serum phosphor
IOP	r	-0.2	-0.2
	p value	0.049	0.04

electrolytes remained stable.

The results of correlation analysis noted that there was a negative and linear correlation between serum sodium ($r=-0.2$, $P=0.049$) and serum phosphor ($r=-0.2$, $P=0.04$) with IOP (Table 3).

Discussion

The results of the present study proved that physiological IOP of healthy fasting individuals decreased during Ramadan, although it remained within the normal range. It is proposed that the changes in lifestyle especially in nutritional habits cause significant changes in body metabolism(13). Intermittent daytime fasting during Ramadan for one month leads to changes in the nutritional condition of the fasting individuals. Studying this group of subjects allows us to get worthwhile knowledge about the fasting metabolism(14). In the present study, we investigated the effect of fasting on IOP changes and serum electrolytes before and after Ramadan. The know-how of the association between fasting and IOP is currently unknown; however, the results have been controversial.

Similar results were obtained from Kerimoglu study on healthy volunteers. They performed a study on 31 healthy fasting individuals and the results demonstrated that fluid intake in Sahar meal may increase the IOP and tear in the morning and decreases remarkably at Iftar by dehydration (10). Similar results were obtained from other studies performed in Turkey, India, Nigeria (11, 15-16). In another study by Soleymani *et al.* it was shown that in the morning there was a significant difference in IOP between fasting and non-fasting individuals (17). Still in another study, the results of 2nd and 4th weeks after

Ramadan pointed to a reduction of 1.1 mmHg of IOP in the morning and 1.5 mmHg in the afternoon in healthy volunteers (18).

Reduction of serum electrolytes in fasting individuals is well-documented (11, 18). Emerging evidences showed that changes in electrolytes can affect the IOP (19, 20). In Ramadan, fasting people drink more of water and other fluid resources such as tea and milk before dawn and after Iftar. The abundance of water reduces plasma osmolality and finally increases physiological IOP in healthy individuals(10). In line with these studies, the present study stated that not only was the IOP reduced (in normal range) but serum electrolytes (Na, K and Se) also dropped, while serum phosphor experienced a rise (10, 11, 18-20). Vaajanen A et al. reported that changes in electrolytes, carbonic anhydrase activity and renin-angiotensin system can alter IOP (20).

However other studies mentioned no changes of IOP level during Ramadan (12). Assadi et al. studied 58 healthy fasting male participants with a mean age of 40.7. They found that Islamic Ramadan fasting has no effect on IOP and other factors related to eye health condition in healthy volunteers.

Controversies

The results from various studies in different population are inconsistent. This may be due to the fact that Ramadan occurs in different seasons in different regions or even in the same region, therefore time of fasting varies between 11-18 hours and in different season affects the individual's life style such as food and drink intakes, sleep duration and their physical activities. Obviously, the percentage of humidity and temperature in different seasons have remarkable effects on fasting studies and could be considered as confounders (21).

It is worth noting that the previously-mentioned studies were carried out among the healthy population. Changes in normal ranges of either IOP or serum electrolytes may not be crucial, however, IOP is more serious in patients who suffer from glaucoma. To the best of our knowledge, there is one study which reported a reduction in IOP after Ramadan in fasting glaucoma patients (22).

There were a number of limitations in our study. Firstly, IOP was measured once only.

Secondly, the study populations were young adults. The latter is a factor that causes age-related biases.

Conclusion

To conclude, the current results revealed that although IOP decreased after Ramadan fasting, the changes were at normal range. IOP changes in this study weren't noticeable, although one important point is this study was on healthy subjects and we cannot generalize this result to patient with glaucoma and others with increased IOP. We also found that fasting leads to a decrease in three ions (Na, K, Se) however, it elevates the level of serum Phosphorous. In addition, there were reverse correlations between IOP changes and changes of serum Sodium and serum Phosphorus. Although these changes of some serum electrolytes affect the IOP but there was in normal range and wasn't clinically remarkable.

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