Original Article

Intraocular Pressure Changes During Ramadan Fasting: Effect of Change in Weight and Review of Available Reports

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Abstract:

Background: Ramadan fasting (RF) alters many systemic milieus. Dehydration from fasting may cause weight loss, while sedentary lifestyle of some Muslims during fasting results in weight gain. RF is associated with low intraocular pressure (IOP). We aim to find out changes in IOP and its relationship to weight changes during and after Ramadan fasting.

Materials and Methods: IOP of eligible males was measured at 0900, 1200 and 1500 hours (hrs). Mean fasting IOP (FIOP) and non-fasting IOP (NFIOP) of both eyes at each period were calculated. Weights were also taken during fasting and after fasting. FIOP and NFIOP were compared using paired t-test for all participants category (1) and participants in different categories of weight changes found during fasting: Those who lost weight during fasting, category (2). Those whose weights were unchanged, category (3), and those who gained weight category (4)

Results: There were 51eligible males, category (1) consisting 38, 5 and 8 participants in categories 2, 3 and 4 respectively. Mean weight (Kg) of participants were: fasting 64.000, and non-fasting 65.853, $P < .001$. At 0900hrs, FIOP was higher than NFIOP but not reaching significant level in all categories. At 1500 hrs however, FIOP was significantly lower than NFIOP for categories 1 and 2 but not significantly for categories 3 and 4.

Conclusion: Findings of the few previous works are conflicting. IOP changes during Ramadan may be a manifestation of changes in weight only. We suggest further works should categorize participants according to weight changes during fasting before analysing IOP.

Keywords: Ramadan Fasting, Intraocular Pressure, Weight Effect.

Although the Muslim Ramadan fast (RF) may be the most widely advertised and observed, virtually all religions have some kind of fasting. The period of fasting, the time and type of food consumed differ greatly among the various religions.

Ramadan fasting can be defined as abstaining from taking food, drink and sexual activities from dawn until sunset, a period of approximately 14 hours in many regions of the world, for the whole month of Ramadan, the 9th Islamic lunar month.

Fasting has been reported to influence many physiological parameters[1-3]. Many of these exert impact on the ocular system[4, 5] Angiotensin binding sites have been found in bovine and human retinal vessels[4], while activation of ocular sympathetic nerves has been found to be directly related to the circadian elevation of intra ocular pressure (IOP)[5]. The fact that fasting affects diurnal fluctuation of IOP has been established by the few studies on this subject.[6-11] However, findings are divergent. Half, Dadeya[7], Rabbanikhah[8] and Kerimoglu[9] found statistically significant association between RF and IOP, while Half Kayikcioglu[6], Benatiya[10] and Assadi[11]

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found no statistically significant association.

Although their methods of investigation differ, these divergent findings indicate that there is need for more work to elucidate the real factors that affect IOP changes in RF.

Apart from the fact that fasting influences a variety of physiological parameters that can impact the IOP[3], many fasting observers modify their lifestyle during the fasting period.

Dehydration from fasting and reduced meal frequency may lead to weight loss while lifestyle modification such as sedentary lifestyle resulting from tendencies of devout Muslims to intensify religious activities throughout the month culminating in seclusion/retreat into the mosque as recommended in the last 10 days of RF by many may result in weight gain. Obesity has been found to be associated with a rise in IOP[12-15].

The interplay of these IOP-rising and IOP-lowering factors to which fasting observers are exposed calls for a closer look into the effect of weight changes on IOP fluctuation during RF.

MATERIALS AND METHODS:

This study was conducted from September 2010 to September 2011at the ophthalmic unit of the Federal Medical Centre, Azare, a tertiary health care centre in northern Nigeria, and from August to October 2012 at the Ophthalmology Department, University of Ilorin Teaching Hospital, Ilorin also in northern Nigeria. Seventy nine males who met inclusion criteria: (male, minimum aged of 18 years who had fasted continuously during the RF period) were recruited. Those with systemic and ocular diseases such as systemic hypertension, diabetes, ocular hypertension, glaucoma and family history of glaucoma were excluded. Females were also excluded since they are exempted from fasting during their menstrual period. The IOP of 3 patients was greater than 21 mmHg and 15 patients did not have complete IOP records and were excluded. Records of 51 participants (23 from Azare and 28 from Ilorin) who completed the examination sessions were analysed. Fasting IOP (FIOP) was measured at 0900, 1200 and 1500 hrs by Goldmann applanation tonometer in the 4th week of RF by a single observer (1) and an average of two readings was taken. The fasting weight (FW) in Kg, of the patients was also taken. Non-fasting IOP(NFIOP) measurement and non-fasting weight (NFW) were taken a month after the fasting period while subjects were on normal diet.

The study was conducted following the guidelines as contained in the declaration of Helsinki and ethical clearance was obtained from the ethical committees of the hospitals. Furthermore, informed consent was obtained from individual participants. The change to Ilorin was necessitated by poor patient recruitment opportunities at Azare due to relocation of the health facility to its permanent site, a few kilometres from the town.

During the process of weighing, 3 participants declared that they usually gain weight during RF. This was found to be true as the FW of 8 participants were found to be greater than their NFWT. This finding informed the analysis of the result in 4 categories based on change in weight of the participants during fasting and non-fasting periods as follows: 1. All the participants (51). 2. Those who lost weight during fasting (NFW) > (FW) (38). 3. Those whose weight was unchanged NFW=FW (5) 4. Those who gained weight NFW < FW (8).

The FIOP was compared with NFIOP using paired t-test.

The mean of the right eye IOP and the left eye IOP [(RIOP +LIOP) /2] was recorded for each participant and analysed in the 4 categories. The significance level was taken to be 0.05.

RESULTS:

A total of 79 males were recruited. 51 met the inclusion criteria and participated in the study. The mean age was 33.2 years and range was 22 to 52 years. The mean weights (Kg) of the participants were fasting 64.000, and non-fasting 65.853, P < .001. The means of FIOP and NFIOP of right and left eyes at 0900, 1200 and 1500 hrs are as shown in table 1. Table 1 shows that at 0900 hrs, the FIOP was higher than the NFIOP for all categories, though the difference was not statistically significant.

At 1200 hrs the NFIOP was higher than the FIOP but did not reach significant level in all categories. At 1500 hrs however, FIOP was significantly lower than NFIOP for categories 1 and 2 (All and those who lost weight) but not significantly for categories 3 and 4 : (those whose weight were unchanged and those who gained weight).

Table (1): Intraocular Pressure Changes during Fasting and Non-fasting Periods NFW, non-fasting weight; FW, fasting weight; IOP, intraocular pressure in millimetres of mercury (mmHg).

Participants' Category And IOP (mmHg)	0900 hrs	P-Value	1200 hrs	P-Value	1500 hrs	P-Value
All (n = 51)						
Fasting	13.3529	0.301	11.9118	0.065	11.3333	0.004
Non-fasting	13.0098		12.5882		12.2451	
NFW > FW (n = 38)						
Fasting	12.8947	0.799	11.5132	0.048	10.9079	0.005
Non-fasting	12.8026		12.3026		11.9342	
NFW = FW (n = 5)						
Fasting	14.7000	0.431	12.3000	0.258	13.2000	0.596
Non-fasting	13.8000		14.1000		13.6000	
NFW<FW (n = 8)						
Fasting	14.6875	0.303	13.5625	0.606	12.1875	0.482
Non-fasting	13.5000		13.0000		12.8750	

DISCUSSION:

Lowered IOP during fasting can lead to underestimation of initial IOP in newly diagnosed patients leading to misdiagnosis of primary open angle glaucoma (POAG) as normal tension glaucoma (NTG) and over estimation of treatment effectiveness of the patients on anti-glaucoma treatment.

Association between glaucoma and weight has been controversial. In 1995, Barbados eye study[16] indicated some protective effect of high body mass index (BMI) with risk of POAG. Conversely, Zang and Wynder[17] found glaucoma to be associated with high BMI and Gasser *et al*[18] found no statistical difference in BMI in glaucoma patients and controls. However; the Barbados study controlled for age only.

To our knowledge, this is the only study in Sub-Saharan African subjects.

Our findings show that at 0900 hrs FIOP was higher than NFIOP, though not statistically significant. This demonstrates the fluid loading effects at the predawn meal during which fasting observers drink

large quantities of fluid. To our knowledge this rise in IOP due to binging on water was first demonstrated by Kerimogluet al.[9]
At 1200 hrs FIOP was lower than NFIOP but did not reach significant level in all categories except in those who lost weight. At this stage the effect of binge drinking has worn off. At 1500 hrs, FIOP was statistically significantly lower than NFIOP for categories 1 [All consisting mainly (about 75%) of those who lost weight] and 2 NFW>FW, those who lost weight only but not significant for categories 3 and 4 (NFW=FW, those whose weight was unchanged and NFW<FW, those who gained weight).
Although many studies [13-15] have identified weight gain as a risk factor for raised IOP, none of the previous work on fasting and IOP changes has analysed changes in IOP with changes (loss and gain) in weight. Furthermore, none has reported weight gain during fasting though weight gain during FP has been reported[19]
All the six studies[6-11] on the effect of RF and IOP found IOP decrease but only three[7,9,10] found the decrease to be significant.
Only four studies[6-8,11] out of the six commented on the changes in weight during RF, three[6-8] of whom found significant decrease in weight. Table 2.
Two of the three studies[7,8] that found significant weight loss also found significant decrease in IOP during RF.
Studies in support of weight loss being associated with significant decrease in IOP include those of Dadeya[7] and Rabbanikkah[8]. Indirectly Assadi's finding of no significant weight loss in association with non-significant IOP decrease is also in support. Only the study by Kayikcioglu[6] found significant weight loss but no significant decrease in IOP. In this study however, IOP and weight were taken at 2-3 weeks of RF.

Table (2): Thes Studies on the effect of RF and IOP.

Author and Publication Year	Findings			
	Decreased IOP	Significant Decreased IOP	Weight Loss	Significant Weight Loss
Kayikcioglu[6] 2000	Y	N	Y	Y
Dadeya[7] 2002	Y	Y	Y	Y
Rabbanikhah[8] 2005	Y	Y	Y	Y
Indriss[9] 2008	Y	N	-	-
Kerimoglu[10] 2010	Y	Y	-	-
Assadi[11] 2011	Y	N	Y	N

Y:yes; N: no

Our findings also show that IOP decrease was significant in those who lost weight significantly.
The sample size of 51 in our series is rather small. Efforts should be made to mobilise participants to complete their participatory period.

CONCLUSION:
Our series show that those who lost weight had significant decrease in IOP while those who did not lose weight, though small in number, did not show significant decrease in IOP. Our findings of no weight loss during RF and even weight gain in this study are incidental. Further work on this

subject should categorise participants into various weight changes and analyse large samples in each category. IOP changes during Ramadan may be a manifestation of changes in weight only

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