

# Effect of Fasting on Intraocular Pressure

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## ABSTRACT

**Purpose:** To determine the effect of fasting on intraocular pressure (IOP) in fasting individuals.

**Study Design:** Cross sectional observational study.

**Place and Duration of Study:** District Headquarter Teaching Hospital/Sahiwal Medical College Sahiwal, from April 2020 to May 2020.

**Methods:** Four hundred eyes of two hundred healthy fasting subjects were included in this study. Intraocular pressure was measured one week before and during the second week of Ramadan using a non-contact tonometer. t-test was used to calculate the difference of means of intraocular pressure one week before and during the second week of Ramadan.

**Results:** Mean age of the subjects was  $34.56 \pm 12.52$  years. IOP in male subjects before and during Ramadan was 14.23 mm Hg and 13.20 mm Hg respectively, while IOP in female subjects before and during Ramadan was 14.43 mm Hg and 13.20 mm Hg respectively. Mean IOP before Ramadan in the right and left eye was  $14.38 \pm 3.00$  mm Hg and  $14.21 \pm 2.79$  mm Hg and during Ramadan it was  $13.24 \pm 2.87$  mm Hg and  $13.15 \pm 2.71$  mm Hg respectively. t-test indicated that the difference in means of IOP for right eye before and during Ramadan was 25.74 ( $p = 0.000$ ) while for the left eye it was 41.54 ( $p = 0.000$ ).

**Conclusion:** Fasting results in a decrease in intraocular pressure in normal population. There was no difference in intraocular pressure changes between male and female subjects. Intraocular Pressure was higher in older age group in both genders.

**Key Words:** Intraocular Pressure, Tonometry, Glaucoma.

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## INTRODUCTION

Physiology of eye is determined by its special anatomy that in turn depends on an intricate balance between tension inside the eye and the rigidity of its wall. This balance is important to maintain the normal spherical shape of the eye.<sup>1</sup> Intraocular pressure (IOP) is due to

the difference in aqueous humour production by ciliary processes and aqueous humour outflow through the trabecular meshwork and uveo-scleral pathways. Intraocular pressure range is 11 – 21 mm Hg in the normal eye when measured with an applanation tonometer.<sup>2</sup> Intraocular pressure is known to have diurnal fluctuation.<sup>3</sup> It is also affected by the temperature, season, exercise, blood pressure, respiration and medicine intake for ocular and systemic diseases.<sup>4,5,6</sup> Intraocular pressure in children is lower as compared to adults.<sup>7</sup> It also varies in different races and different parts of the world.<sup>8</sup>

Fasting is practised by followers of different religions. Muslims practice fasting during the month

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of Ramadan. As the Islamic calendar is based on lunar cycle so Ramadan can occur in different seasons. Muslims do not eat or drink while fasting from dawn until sunset.<sup>9</sup> They are allowed to eat and drink from the breaking of fast till the beginning of next fasting.<sup>10</sup> So, there is a considerable change in the dietary pattern.<sup>11,12</sup> There is also a change in sleeping and behavioural pattern during fasting.<sup>13</sup> Fasting is obligatory for all adult healthy Muslims. Relaxation is given for sick, travellers, pregnant, lactating and menstruating women.<sup>14</sup> They have to complete the count of fasting in other days when they are fit to do so.<sup>15</sup>

As millions of Muslims observe fasting so it is especially important to know its effects on ocular health. Due to variation in diet, climate, lifestyle practices, there are discrepancies in literature about the effect of Ramadan on IOP. Due to a change in dietary habits during fasting, IOP may be affected.<sup>16</sup>

This study was conducted to know the effect of fasting on intraocular pressure of the population of a particular region. This knowledge will help us in answering the question of people regarding the effect of Ramadan on ocular health.

## METHODS

In this cross-sectional study, four hundred eyes of two hundred healthy fasting subjects were included. The study was conducted at District Headquarter Teaching Hospital/Sahiwal Medical College Sahiwal, from April 2020 to May 2020.

Employees of the institution of both genders were included in the study. Age ranged from 20 to 60 years. Following individuals were excluded from the study: individuals with hypertension, Diabetes Mellitus and thyroid dysfunction. Individuals using steroids, persons with a history of ocular trauma or surgery, astigmatism higher than 4 dioptre, orbital malformations and positive history of glaucoma or having an abnormal cup to disc ratio were also excluded.

Convenient nonprobability sampling technique was used. Approval of the study was taken from the

institutional review board. Informed consent was taken from the participants of the study. A detailed history and clinical examination including visual acuity, slit-lamp examination of anterior and posterior segment was conducted. Intraocular pressure was measured using a non-contact tonometer. Keeler Pulsair desktop tonometer was used. Average of three readings of each eye was recorded. IOP readings were measured from 1 pm to 2 pm. All participants' IOP was recorded one week before and during the second week of Ramadan. Data was analysed using SPSS version 24. Mean and standard deviation of age and intraocular pressure were calculated. Frequency of male and female participants was also calculated. T-test was used to calculate difference in means of IOP before and during Ramadan.

## RESULTS

There were four hundred eyes of two hundred subjects in our study. One hundred and thirty-five (67.5%) males and sixty-five (32.5%) females were included in the study. Mean age of the subjects was  $34.56 \pm 12.52$  years. Intraocular pressure (IOP) one week before and during the second week of Ramadan is given in table number 1. p-value of  $\leq 0.05$  was considered statistically significant. Intraocular pressures in various age groups in females and males are given in table no. 2 and 3 respectively. Intraocular pressure was higher in older age group as compared to the younger age group in both genders before and during Ramadan. This difference was statistically significant with a p value of less than 0.05. There was no difference in intraocular pressure between two genders before and during Ramadan with a p value  $> 0.05$ .

**Table 1:** *Intraocular Pressure (IOP) One Week Before and During Second Week of Ramadan.*

IOP Measurement	IOP Right Eye (mm Hg)	IOP Left Eye (mm Hg)
One week Before Ramadan	$14.38 \pm 3.00$	$14.21 \pm 2.79$
During Second Week of Ramadan	$13.24 \pm 2.87$	$13.15 \pm 2.71$

**Table 2:** *Intraocular Pressure (IOP) in Female Subjects.*

Age Group (Years)	Number of Cases	IOP Before Ramadan (mmHg)		IOP During Ramadan (mmHg)	
		Right Eye	Left Eye	Right Eye	Left Eye
20 to 40	38	$13.40 \pm 3.15$	$13.47 \pm 2.84$	$12.53 \pm 2.96$	$12.37 \pm 2.71$
41 to 60	27	$15.85 \pm 3.03$	$15.81 \pm 2.63$	$14.04 \pm 2.77$	$14.49 \pm 2.44$
Total	65	$14.42 \pm 3.29$	$14.45 \pm 2.97$	$13.15 \pm 2.96$	$13.25 \pm 2.79$

**Table 3:** Intraocular Pressure (IOP) in Male Subjects.

Age Group (Years)	Number of Cases	IOP Before Ramadan (mm Hg)		IOP During Ramadan (mm Hg)	
		Right Eye	Left Eye	Right Eye	Left Eye
20 to 40	89	13.06 ± 2.22	13.18 ± 1.97	12.02 ± 2.20	12.19 ± 1.95
41 to 60	46	16.87 ± 2.23	15.89 ± 3.04	15.74 ± 2.26	14.87 ± 3.01
Total	135	14.36 ± 2.86	14.10 ± 2.70	13.29 ± 2.84	13.10 ± 2.68

  

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	IOP before ramadan Right eye - IOP in ramadan Right eye	1.13500	.62347	.04409	1.04806	1.22194	25.745	199	.000
Pair 2	IOP before ramadan Left eye - IOP in ramadan Left eye	1.06500	.36254	.02564	1.01445	1.11555	41.545	199	.000

## DISCUSSION

In the current study, mean age of subjects was 34.56 ± 12.52 years which was lesser than that of other studies. In a study conducted by Hassan and co-authors, the mean age of fasting subject was 42.3 ± 16.7 years.<sup>16</sup> In another study done by Assadi et al mean age of fasting subjects was 40.7 ± 7.1 years.<sup>9</sup>

In our study mean intraocular pressure in male subjects was 14.36 ± 2.86 mm Hg in right eye and 14.10 ± 2.70 mm Hg in left eye before Ramadan, while mean intraocular pressure was 13.29 ± 2.84 mm Hg in right eye and 13.10 ± 2.68 mm Hg in left eye during Ramadan. In female subjects mean intraocular pressure was 14.42 ± 3.29 mm Hg in right eye and 14.45 ± 2.97 mm Hg in left eye before Ramadan, while mean intraocular pressure was 13.15 ± 2.96 mm Hg in right eye and 13.25 ± 2.79 mm Hg in left eye during Ramadan. In a study conducted by Nomura and colleagues, mean intraocular pressure was 13.6 ± 2.6 mm Hg in male and 13.3 ± 2.6 mm Hg in female subjects.<sup>17</sup> The results of that study were comparable to the results of our study.

In the present study, there was a significant decrease in IOP pressure during fasting. Our results are in accordance with the results of Rabbanikhah and co-authors where there was a reduction of IOP of 1.1 mm Hg in the morning and 1.5 mm Hg in the afternoon during Ramadan fasting.<sup>18</sup> In contrast to the results of our study, there was no change in IOP during Ramadan fasting in a study done by Assadi and colleagues. A study conducted by Kerimoglu and co-authors showed an increase in IOP and tear production in the morning and decrease in IOP and tear

production in the evening during fasting. That change was due to fluid intake at the beginning of fasting and dehydration at the end of fasting.<sup>10</sup> Another research showed a difference in intraocular pressure between fasting and non-fasting persons. The IOP was lower in fasting individuals.<sup>19</sup> Our study results are comparable to the results of that study.

There is disparity in the effects of Ramadan fasting on intraocular pressure as is evident by the results of various studies mentioned above. The reason for such a difference may be because Ramadan occurs in different seasons of a year. Moreover, there may be a difference in lifestyle and dietary habits in different geographical regions of the world. Duration of fasting varies between 11 to 18 hours. Fasting affects the pattern of food intake, sleep pattern and physical activity.<sup>20</sup> These changes in lifestyle are different in different parts of the world and different seasons. This could be an explanation for the inconsistent effect of fasting on intraocular pressure.

Ramadan fasting results in a decrease in intraocular pressure within the normal range. This decrease in intraocular pressure is thought to be due to changes in serum electrolyte concentration and hydration status of the body. Due to fasting, serum sodium, potassium and selenium are decreased while serum phosphorus is elevated.<sup>21</sup> Change in serum electrolyte concentration and osmolality of plasma is thought to be the reason behind the decrease in intraocular pressure during Ramadan. Moreover, during fasting, there is also a change in the secretion of insulin and glucagon. Insulin secretion is decreased while glucagon secretion is increased.<sup>13</sup> There is also a

change in the lipid metabolism of the body. All these changes have profound effects on the homeostasis of the body.<sup>22</sup> These metabolic changes may be reason behind the changes in intraocular pressure during fasting.

The sample size of our study is not large enough that is a limitation of our study. In our study intraocular pressure was measured only at one time of the day and effects on diurnal fluctuation is not considered. Erroneous measurement of intraocular pressure can occur due to thick or thin corneas.<sup>23</sup> Effect of corneal thickness was not taken into consideration that constitutes another limitation of the present study. Measurement with Goldmann tonometer is considered the most accurate measurement of IOP. Air puff measurement of IOP can give an overestimation of the reading.<sup>24</sup> IOP was measured with the help of air puff tonometer in our study. As all the normal subjects were included in the study, our results cannot be applied to the patients with glaucoma. Further studies are needed to answer these limitations.

Nevertheless, our work described the change in IOP in normal individuals during fasting. Our work will help in explaining the effects of fasting on the ocular health of Pakistani population.

## CONCLUSION

Fasting results in a decrease in intraocular pressure in normal population. There was no difference in intraocular pressure changes between male and female subjects. Intraocular Pressure was higher in older age group in both genders.

## Ethical Approval

The study was approved by the Institutional review board/ Ethical review board. (30/DME/SLMC/SWL)

## Conflict of Interest

Authors declared no conflict of interest.

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### Authors' Designation and Contribution

Zahid Kamal; Professor: *Concept and design of study. Interpretation of data and manuscript writing.*

Ahmad Zeeshan Jamil; Associate Professor: *Literature search, drafting of the article, critical revision.*

Muhammad Khalid; Professor: *Manuscript writing and critical revision.*

Muhammad Luqman Ali Bahoo; Associate Professor and Head of Department: *Literature search and statistical analysis.*

Muhammad Junaid Iqbal; Assistant Director Medical Education: *Literature search and proof reading.*

Nauman Aziz; Assistant Professor of Physiology: *Literature search and drafting of article.*

