



**A STUDY OF ASSOCIATION BETWEEN INTRAOCULAR PRESSURE AND  
REFRACTIVE ERRORS – A COMPARATIVE CROSS SECTIONAL STUDY**

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**ABSTRACT**

**Introduction:** Glaucoma is the leading cause of irreversible complete blindness in the world. It comprises of a group of ocular diseases with progressive damage to the optic nerve. It is one of the ophthalmic emergencies which causes sudden loss of vision. In India, prevalence of glaucoma is estimated to be about 2.65%. The prevalence of primary open angle glaucoma (POAG) in south India above 40 years of age is estimated to be 1.7% in the Aravind Comprehensive Eye survey (ACES). Raised intraocular pressure is one of the modifiable risk factors for primary open angle glaucoma. An association between intraocular pressure (IOP) and high degree of myopia has been reported in some studies. Here it is proposed to find out intra ocular pressure in patients with myopia and hypermetropia and compare it with emmetropic subjects. **Materials & Methods:** 60 cases (30 myopic and 30 hypermetropic) and 30 emmetropic subjects were selected by automatic refraction and subjective refraction. Later they were subjected to Goldmann applanation tonometry with slit lamp mounted examination for measuring intra ocular pressure. **Results:** IOP is significantly higher in myopes ( $P < 0.05$ ), when compared to hypermetropes and emmetropes. **Conclusion:** The myopics are more prone to develop increased intraocular pressure than hypermetropics and emmetropics.

**KEYWORDS:** Intraocular Pressure, Myopia, Hypermetropia, Emmetropia, Glaucoma.

**INTRODUCTION**

**Refractive error:** Refractive error is one of the most common and a remedial cause of visual impairment around the world. It is the second leading cause of treatable blindness.<sup>[1]</sup> It affects all the people irrespective of their age, sex and ethnicity. According to the World Health Organization (WHO)'s estimation, 285 million people are visually impaired globally, of whom 39 million are blind. According to the data from 2010, avoidable visual impairment constitutes 80% of visual impairment. Approximately 90% of visually impaired people are in developing countries.<sup>[2]</sup> Refractive error occurs when the eye fails to correctly focus light from an object onto the retinal plane. This results in an image perceived by individual blurred. Refractive errors include myopia ('short or near-sightedness'), hyperopia ('long or far-sightedness') and astigmatism.<sup>[3]</sup> In myopia, light from the image is focused in front of retina, due to increased axial length of eyeball or excessive refraction of light by cornea or lens. In hyperopia, image from the object is focused behind the retina due to decreased short axis of eyeball or inadequate refraction by cornea or lens. In astigmatism, refractive power of eye is uneven due to

corneal irregularity. Refractive error may change as people age. The age-standardised prevalences of myopia, hyperopia and astigmatism are 35.6%, 17.0% and 32.6% respectively. Myopia is the most common refractive error in both children and adults in many countries.<sup>[4]</sup>

**Glaucoma**

Glaucoma, one of the leading causes of irreversible blindness, comprises a group of ocular diseases in which there is a progressive damage to the optic nerve, with characteristic structural changes to the optic disc and visual field defects.<sup>[5]</sup> It is one of the ophthalmic emergencies which may lead to sudden loss of vision. People in India affected with glaucoma is estimated to be about 2.65%. In Aravind comprehensive Eye Survey (ACES) study, the prevalence of primary open angle glaucoma among 40% population in rural south India is estimated as 1.7%.<sup>[6]</sup> Raised intraocular pressure (IOP) is the major modifiable risk factor for primary open angle glaucoma. Ocular hypertension is defined as IOP of  $>21$  mm Hg with absence of features of glaucoma in the optic disc or visual field.<sup>[5]</sup> The important risk factors for glaucoma are raised IOP, high degree of refractive

errors, hypertension, use of corticosteroids, diabetes, and smoking.<sup>[6]</sup>

### Intra ocular pressure and Refractive error

Intraocular pressure is one of the causative factors in pathogenesis of myopia. An association between intraocular pressure (IOP) and high degree of myopia has been reported in some studies. Hence it is proposed to analyze the intra ocular pressure in patients with myopia and hypermetropia and compare it with emmetropic subjects.

### METHODS AND MATERIALS

The study is a comparative cross sectional study. After obtaining institutional ethical committee clearance, 90 patients in the age group of 18 to 60 years were selected from outpatient department of Regional Institute of Ophthalmology and Government Ophthalmic Hospital, Egmore, Chennai. Patients with habit of smoking, Diabetes Mellitus, Hypertension, any other eye disorder

and recent eye surgery were excluded from the study. After obtaining informed consent from the patient, they were subjected to automatic refraction and subjective refraction. They were then diagnosed and classified as patients having myopia ( $< -0.5$  D), hypermetropia ( $> 0.5$ D) and emmetropia ( $\geq -0.5$  D to  $\leq 0.5$  D). 30 patients with each refractive error were selected randomly and the intra ocular pressure of the both eyes were measured using Goldmann applanation tonometry. Then intraocular pressure measured was expressed as mean  $\pm$ SD for patients with the refractive errors and statistical significance was evaluated by Unpaired Student t test using SPSS software 21.

### RESULTS

Mean Intraocular pressure in myopes is greater when compared to hypermetropes and emmetropes and also it is statistically significant ( $P < 0.05$ ). The results were shown in Table 1 and Table 2.

**Table 1: Intraocular Pressure between Myopes and Emmetropes.**

| Parameter                       | Myopes<br>(Mean $\pm$ SD) | Emmetropes<br>(Mean $\pm$ SD) | P<br>value |
|---------------------------------|---------------------------|-------------------------------|------------|
| Intraocular Pressure<br>(mm Hg) | 15.9 $\pm$ 2.69           | 14.7 $\pm$ 2.68               | 0.016 *    |
| * P < 0.05 is significant       |                           |                               |            |

**Table 2: Intraocular Pressure between Myopes and Hypermetropes.**

| Parameter                       | Myopes<br>(Mean $\pm$ SD) | Hypermetropes<br>(Mean $\pm$ SD) | P<br>value |
|---------------------------------|---------------------------|----------------------------------|------------|
| Intraocular Pressure<br>(mm Hg) | 15.9 $\pm$ 2.69           | 14.97 $\pm$ 1.82                 | 0.028*     |
| * P < 0.05 is significant       |                           |                                  |            |

Though mean intraocular pressure measured in hypermetropes is more than emmetropes, it is not

statistically significant ( $P > 0.05$ ). The results were shown in Table 3.

**Table 3: Intraocular Pressure between Emmetropes and Hypermetropes.**

| Parameter                         | Emmetropes<br>(Mean $\pm$ SD) | Hypermetropes<br>(Mean $\pm$ SD) | P<br>value |
|-----------------------------------|-------------------------------|----------------------------------|------------|
| Intraocular Pressure<br>( mm Hg ) | 14.7 $\pm$ 2.68               | 14.97 $\pm$ 1.82                 | 0.524      |
| * P < 0.05 is significant         |                               |                                  |            |

### DISCUSSION

In our study we classified the patients with age group of 18 – 60 years, who satisfy the inclusion and exclusion criteria. They were classified into 1) Myopics, if subjective refraction test shows patient having  $< -0.5$  D. 2) Hypermetropics, if subjective refraction test shows patient having  $> 0.5$  D and 3) Emmetropics, if subjective refraction test shows patient having  $\geq -0.5$  D to  $\leq 0.5$  D. Thirty patients from each refractive error were selected and intraocular pressure was measured using Gold Mann Tonometer with slit lamp mounted after instilling anaesthetic drops. Measuring IOP by Goldmann Tonometer is the gold standard method to measure IOP.

Our study shows that the intraocular pressure is significantly more in myopes who have mean IOP 15.9  $\pm$  2.69 mmHg when compared to non myopes (IOP in emmetropes were 14.7  $\pm$  2.68 mmHg and hypermetropes were 14.97  $\pm$  1.92 mmHg).

The result is supported by the population based study on Australian white community, The Blue mountains Eye study by Mitchell et al., 1999. The mean IOP for myopic eyes was 16.45 mmHg. Hyperopic eyes had a similar mean IOP (16.03 mm Hg) as emmetropic eyes (16.00 mmHg). Similar to this study, in our study the IOP in myopes was more when compared to emmetropes and it is statistically significant by student t test. But in the

Blue mountain Eye study, they confirmed the strong relationship between glaucoma and myopia where the subjects with myopia had a twofold to threefold increased risk of glaucoma when compared to that of non myopic subjects. But multivariate analysis done shows the risk of glaucoma in myopes was independent of IOP.<sup>[7]</sup>

The study by David et al., 1985, which shows that IOP measured among various refractive errors in southern Israel subjects above 40 years, shows that IOP measured was in increasing trend from hypermetropics to myopics. The proportion of myopes in the ocular hypertensive population is almost double that of the normotensive population, 12% and 20%, respectively. In this study, the mean IOP for the screened population was 14.86 mm Hg. The mean IOP increases incrementally by refractive status from a mean of 14.19 mm Hg among hypermetropes to 16.00 mm Hg among high myopes.<sup>[8]</sup> But in our study, the IOP measured is more in hypermetropes when compared to emmetropes.

Another population based study of white American persons aged 43 to 84 years by Wong et al., 2003 shows that myopia is having association between IOP and glaucoma and patients with myopia are 60% more likely to have glaucoma when compared to emmetropes. The study found that an increasing severity of myopia was associated with progressively higher IOP. The study also shows a prospective association between hypermetropia and five year risk of ocular hypertension. In the study, Myopes were having IOP of 15.71 mmHg, while that of hypermetropia and emmetropia were 15.22 mmHg and 15.41 mmHg respectively.<sup>[9]</sup> But in our study though it is not statistically significant, mean IOP in hypermetropes ( $14.97 \pm 1.92$  mmHg) is more when compared to emmetropes ( $14.7 \pm 2.68$  mmHg).

Many hypotheses were proposed for the increased intraocular pressure in myopes. The axial elongation and scleral thinning associated with myopia progression may lead to increased stress and decreased rigidity of the eyeball, thus an increasing trend of IOP.<sup>[10]</sup>

## CONCLUSION

From our study, it may be concluded that the intraocular pressure is more in myopes when compared to hypermetropes and emmetropes in the age group of 18 – 60 years, and hence they are prone to Primary Open Angle Glaucoma.

## LIMITATIONS

Measurement of axial diameter of eye ball, central corneal thickness and aqueous humor flow dynamics may help in supporting our views in our study. The increased sample size and sex matching of the study population would throw more light in our study.

## REFERENCES

1. Krishnaiah S, Srinivas M, Khanna RC, Rao GN. Prevalence and risk factors for refractive errors in the South Indian adult population: The Andhra Pradesh Eye disease study. *Clin Ophthalmol*, 2009; 3(1): 17–27.
2. Gomez-Salazar F, Campos-Romero A, Gomez-Campaña H, Cruz-Zamudio C, Chaidez-Felix M, Leon-Sicairos N, et al. Refractive errors among children, adolescents and adults attending eye clinics in Mexico. *Int J Ophthalmol*, 2017 May 18; 10(5): 796–802.
3. Williams KM, Verhoeven VJM, Cumberland P, Bertelsen G, Wolfram C, Buitendijk GHS, et al. Prevalence of refractive error in Europe: the European Eye Epidemiology (E3) Consortium. *Eur J Epidemiol*, 2015; 30(4): 305–15.
4. Joseph S, Krishnan T, Ravindran RD, Maraini G, Camparini M, Chakravarthy U, et al. Prevalence and risk factors for myopia and other refractive errors in an adult population in southern India. *Ophthalmic Physiol Opt*, 2018 May; 38(3): 346–58.
5. Chan MPY, Broadway DC, Khawaja AP, Yip JLY, Garway-Heath DF, Burr JM, et al. Glaucoma and intraocular pressure in EPIC-Norfolk Eye Study: cross sectional study. *BMJ*, 2017; 358: j3889.
6. Saxena R, Singh D, Vashist P. Glaucoma: An emerging peril. *Indian J Community Med*, 2013; 38(3): 135.
7. Mitchell P, Hourihan F, Sandbach J, Jin Wang J. The relationship between glaucoma and myopia. *Ophthalmology*, 2003; 106(10): 2010–5.
8. David R, Zangwill LM, Tessler Z. The Correlation Between Intraocular Pressure And Refractive Status. *Arch Ophthalmol*, 1985 Dec 1; 103(12): 1812–5.
9. Wong TY, Klein BEK, Klein R, Knudtson M, Lee KE. Refractive errors, intraocular pressure, and glaucoma in a white population. *Ophthalmology*, 2003 Jan; 110(1): 211–7.
10. He M, Zhang J, Han X, Yu S, Yan W, Guo X, et al. Longitudinal changes in intraocular pressure and association with systemic factors and refractive error: Lingtong Eye Cohort Study. *BMJ Open*, 2018; 8(2): e019416.