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Gender Difference in Ocular Pressures Among Prehypertensive Individuals

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ABSTRACT

Background: Raised intraocular pressure (IOP) and reduced ocular perfusion pressure (OPP) are significant risk factors for glaucoma. It is important to study the factors which affect IOP and OPP, to prevent the development of glaucoma. Some of the factors include age, gender, systemic blood pressure, obesity etc. Though few studies have demonstrated the gender difference in IOP in normotensive individuals as well as in glaucoma patients, the results are inconsistent. It has also been proved that hypertension is more prevalent in males. Hence the present study was taken up to explore the gender difference in IOP levels among individuals with prehypertension, a predictor of hypertension in future.

Objective: To compare and evaluate the IOP and OPP values among males and females with prehypertension.

Methods: 100 voluntary participants with prehypertension (systolic blood pressure of 120–139 mmHg or diastolic blood pressure of 80–89 mmHg) were recruited from the ophthalmology clinic in Mysuru in the age group of 20 - 50 years. They were categorised into two groups based on their gender. Written informed consent was taken. IOP and blood pressure were recorded using rebound tonometer and sphygmomanometer respectively. Results: Males had a significantly higher IOP in both the eyes when compared to their female counterparts. There was no difference in their OPP values.

Conclusion: Since elevated IOP is seen in males than females, IOP could be a leading indicator for early diagnosis of glaucoma in males.

Key Words: Intra Ocular Pressure, Ocular Perfusion Pressure, Prehypertension

INTRODUCTION

Glaucoma is one of the commonest causes of irreversible blindness globally. Asia alone accounts for almost 60% of the world's total glaucoma cases.¹ India is estimated to become the second in the world with its increasing number of glaucoma cases.² Of the numerous risk factors attributed to glaucoma, ocular pressures such as Intra Ocular Pressure (IOP) and ocular perfusion pressure (OPP) are significant. IOP is the only proven treatable risk factor for glaucoma. Even in the absence of glaucoma, raised IOP is considered to be a cause of optic nerve damage.³ Hence it is essential to study the factors affecting IOP thus facilitating the prevention and early detection of glaucoma. Some of these factors include age, gender, race, ethnicity, genetic inheritance, systemic blood pressure, body mass index etc.^{4,5} Gender dissimilarity in general health exists in the literature but studies representing gender difference in IOP is not adequate.^{6,7}

OPP is determined by IOP and blood pressure (BP). A positive correlation between BP and IOP was observed in hypertensive individuals.⁷ Prehypertension, which is a warning sign for hypertension, is defined as above-optimal systolic and diastolic blood pressure of 120–139 or 80–89 mmHg respectively. It includes elevated hypertension and stage I hypertension.^{8,9} Since prehypertension remains asymptomatic, its mechanical and vascular effects on ocular tissues is complex and poorly understood. Raised IOP levels were noted in prehypertensive individuals as well.¹⁰ It has been observed that young adult males have higher levels of blood pressure when compared to the females of same age group.¹¹

Though few studies have demonstrated the gender difference in IOP in normotensive individuals as well as in glaucoma patients these results are inconsistent.^{12,13} Also, there is a lack of literature related to the gender difference in ocular pressures among prehypertensive -non-glaucomatous subjects.

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Hence the present study was taken up to compare and evaluate the IOP and OPP values among males and females with prehypertension.

MATERIAL AND METHODS

100 voluntary participants with prehypertension (systolic blood pressure of 120–139 mmHg or diastolic blood pressure of 80–89 mmHg) were recruited from the ophthalmology clinic in Mysuru in the age group of 20 - 50 years after screening for BP. They were categorised into two groups based on their gender. Subjects with conjunctivitis, h/o hypertension and diabetes mellitus, h/o smoking and alcohol consumption were excluded. Institutional ethical clearance was obtained for this cross-sectional study (IEC letter no. JSS/MC/IEC/18/1957/2015-16). After explaining the details of the procedure, informed written consent was taken. Subjects were asked to rest for 15min following which basal IOP and BP were recorded in sitting position using SW-500 rebound tonometer (Tianjin Suowei Electronic Technology Co., Ltd, Tianjin, China) and Sphygmomanometer respectively. All the recordings were done between 11 am and 1 pm to reduce the effects of diurnal variations on IOP.¹⁴

Mean arterial pressure (MAP) and Mean ocular perfusion pressure (MOPP) was calculated using the following formulas:

$$\text{MAP} = \text{Diastolic BP} + 1/3 (\text{Systolic BP} - \text{Diastolic BP})$$

$$\text{MOPP} = (2/3) \text{MAP} - \text{IOP}^{14}$$

Statistical Analysis

Data collected were entered in MS excel 2010 and analysed using SPSS version 23. Descriptive statistical measures like percentage, arithmetic mean and standard deviation were applied. Inferential statistical tests like independent unpaired t-test were applied. Normality of all the variables was checked before applying the statistical tests. P-value <0.05 was considered to be statistically significant.

RESULTS

This study comprised of 100 prehypertensive individuals. They were further grouped based on their gender with 50 participants in each group. The mean age was 37.70±10.76yrs and 33.82±9.47yrs in males and females respectively. There was no statistically significant difference in their body mass index. In our study males had statistically significant high levels of IOP in both the eyes when compared to the female group. There was no significant difference in their BP and OPP values (Table 1).

DISCUSSION

IOP plays a major role in glaucoma screening as it is a potential risk factor and its measurement is simple and -non-invasive. Early detection of elevated IOP can prevent the structural and functional damage to the optic nerve thus averting blindness. IOP is affected by multiple factors like age, gender, BMI, BP etc.

The present study aimed to analyse the gender difference in ocular pressures among prehypertensive individuals. It was observed that males had elevated IOP values when compared to females. However, there was no significant change in their BP and OPP values.^{15,16}

A similar finding of higher IOP levels in males were also noted in healthy North Indian, Korean and Japanese population.^{12,15,16} A study on glaucoma patients also revealed a similar trend in gender difference.¹³ This gender wise difference in IOP could be due to hormonal factors and environmental conditions. Contrary to our results, females had higher IOP levels when compared to males, in a study done on subjects who were above 40yrs of age.¹⁷ The probable mechanism for this reversal in gender difference in IOP could be due to changes in hormonal levels above 40yrs. Some studies reported no significant difference in IOP in both genders.^{4,18}

Prehypertensive individuals have elevated levels of IOP when compared to normotensive subjects.¹⁰ Among the prehypertensive individuals, it was observed that females had comparatively lower IOP levels than males. Health risk factors like obesity, alcohol use, smoking, hypertension and cardiovascular risk factors which are known to be more prevalent in men could be associated with high ocular pressure in them.^{19,20} It is hypothesized that the physiological differences between the genders may be ascribed to the effects of sex hormones on IOP and ocular blood flow. The hormone oestrogen with its vasodilator action affects aqueous humour outflow, ciliary body and trabecular meshwork. This could be the cause of a comparative reduction of IOP in females.^{21,22} Lack of this protective effect in males probably makes them more susceptible to the potential risk of elevated IOP. Prehypertension was found to be more prevalent in young males.²³ Moreover the presence of comorbidities like diabetes mellitus along with hypertension can aggravate the complexity of the interplay between BP, IOP and OPP.²⁴ Further longitudinal studies may reveal the exact causative factors and strengthen the association of gender differences with ocular pressures.

CONCLUSION

Since men had a significantly higher mean IOP levels than their female counterparts in our study, men could be at a higher risk of developing glaucoma due to raised IOP. Periodic screening of men for BP and IOP right from their

younger age could facilitate early detection of risk factors of glaucoma.

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Table 1: Comparison of Study variables among Males and Females

Parameters (mm Hg)	Males (n=50) (Mean±SD)	Females (n=50) (Mean±SD)	P value
SBP	123.82±4.84	123.16±4.24	0.47
DBP	81.00±2.11	80.40±1.21	0.08
MAP	95.27±2.61	94.65±1.84	0.17
R-IOP	16.60±0.93	15.98±1.08	<0.001*
L-IOP	16.56±0.81	15.96±1.21	<0.001*
R-OPP	46.92±1.88	47.12±1.55	0.55
L-OPP	46.96±1.80	47.14±1.44	0.57

*p<0.05

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure, R-IOP: Right intraocular pressure, L-IOP: Left intraocular pressure, R-OPP: Right ocular perfusion pressure, L-OPP: Left ocular perfusion pressure.