

## Determining Association of Myopia and Primary Open Angle Glaucoma

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### ABSTRACT

**Objective:** To determine the association between myopia and primary open-angle glaucoma.

**Study Design:** Comparative cross-sectional study.

**Place and Duration of Study:** Department of Ophthalmology, Liaquat University Hospital Jamshoro from Jan to Jun 2015.

**Methodology:** A sample of 170 diagnosed cases of myopia and 170 subjects without myopia were selected. Inclusion criteria were age 35-60 years, both genders, cases with myopia >1.0 D and controls - without myopic error. Visual status was determined by the Huwitz autorefractor (model 8800) machine. Retinoscopy, Goldmann's Applanation tonometry, gonioscopy, vertical cup to disc (VCD) ratio and visual field defects were detected.

**Results:** Age of group - 1 and -2 was  $55.7 \pm 8.6$  and  $52.3 \pm 7.3$  years respectively ( $p=0.071$ ). VCD ratio in group-1 was  $0.6 \pm 0.13$  compared to  $0.5 \pm 0.02$  in group-2 ( $p<0.001$ ). Normal and abnormal VCD ratio in cases and control was noted as 161 (94.7%) vs. 168 (98.8%) and 9 (5.2%) vs. 2 (1.1%) respectively ( $p<0.03$ ). 23 (13.5%) of group-1 show visual field defects compared to 6 (3.5%) in group-2. Intraocular pressure was found elevated in group-1  $16.8 \pm 2.3$  mmHg compared to  $14.0 \pm 2.7$  in group-2 ( $p<0.001$ ). POAG was observed in 9 (5.2%) myopes group-1 compared to 2 (1.1%) in group-2 ( $p<0.003$ ).

**Conclusion:** The present study concludes that myopia is associated with primary open-angle glaucoma, and the risk of glaucoma is high in these patients.

**Keywords:** Intraocular pressure (IOL), Myopia, Primary open angle glaucoma (POAG).

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## INTRODUCTION

Glaucoma is a condition of eye disorder characterized by raised intraocular pressure sufficient to damage optic nerve head fibres, resulting in progressive and permanent visual field defects and vision loss.<sup>1,2</sup> Glaucoma is the third commonest cause of eye blindness. The prevalence of blindness is 2.7% in Pakistan. It creates socioeconomic consequences for the community and loss of individual economy.<sup>1,3</sup> A study from Lahore reported that 23% of blindness was due to glaucoma. Estimates of glaucoma are expected to rise by 80 million in 2020. Of these, 74% will have Primary open-angle glaucoma (POAG).<sup>1-3</sup> POAG is a progressive disorder remaining asymptomatic till the late stage. Lowering intraocular pressure (IOL) slows disease progression and spares the vision.<sup>1</sup> POAG is globally the most common type of glaucoma in population-based studies. It is the frequent cause of irreversible visual loss throughout the globe.<sup>1-3</sup> Many reports have shown the association between myopia and primary

open-angle glaucoma. Prominent prevalence of glaucoma in myopic eyes has been suggested compared to the emmetropic eye and other types of refractive errors.<sup>4</sup>

Myopia is equally linked with POAG throughout the globe among white and black populations.<sup>5</sup> Whilst the phenomenon responsible for the link between glaucoma and myopia is poorly apprehended, a pressure-mediated relationship has been proposed.<sup>6</sup> Increased IOP is one of the principal risk factors for the advancement of POAG and its therapeutic index.<sup>7</sup> An association of myopia as a risk factor for ocular hypertension has been reported.<sup>6,8</sup> Myopia is suggested as an independent risk factor of ocular hypertension.<sup>9</sup> An increase in IOP correlates with increasing myopia buttressing the hypothesis of an association of myopia with POAG.<sup>5,9</sup> Other studies have signified the increased occurrence of glaucoma in myopias independent of increased IOP, suggesting a mechanism independent of high intraocular pressures.<sup>10</sup>

Such studies on the association of myopia and POAG are fewer conducted in-country. Hence, the present study was conducted to compare the intraocular

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pressure in myopes and its association to primary open-angle glaucoma in indigenous populations to ascertain whether proclivity to glaucoma is intraocular pressure independent in myopes. So that myopes may be screened at an earlier stage to prevent primary open-angle glaucoma. The present study may play an important role in improving the early diagnosis of glaucoma in myopic patients to improve visual health.

**METHODOLOGY**

The comparative cross-sectional study was conducted at the Department of Ophthalmology, Liaquat University of Medical and Health Sciences, Jamshoro/Hyderabad. The prior written permission of the Ethics Committee was taken from the institute. The study period extends from January to June 2015. A sample of 170 diagnosed cases of myopia (group-1) and 170 subjects without (-) myopia (group-2) was selected according to the non-probability consecutive sampling. The sample size was calculated considering the power of the test of 80%, Confidence interval (CI) of 95%, and least extreme odds ratio of 6.63.<sup>11</sup> Group-1 (cases) and group-2 (control) were selected according to the inclusion and exclusion criteria.

**Inclusion Criteria:** Patients of age 35 to 60 years, both genders, group-1 with myopia >1.0 D and group-2 controls without myopic error were included in the study.

**Exclusion Criteria:** Patients with cataract (grade 3-4), cataract surgery, retinal haemorrhages, inflammatory retina, retinal detachment, other types of glaucoma, previous glaucoma surgery, corneal ulcer and dystrophy, corneal degeneration and corneal opacities were excluded from the study.

A senior registrar scrutinized patients presenting to the outpatient department and wards. When selecting cases and control, the inclusion criteria were strictly followed. Volunteers who gave consent to voluntary participation entered the study protocol. Cases of age 35-60 years were examined by a senior registrar and then referred to the consultant. Control belonged to a similar age group. Both genders were included in cases and control according to the study protocol. Cases were examined of visual status by Huwitz auto-refractor (model 8800) machine as routine assessment. The expert optician performed a retinoscopy. Diagnosed cases of myopia were examined by the principal chief investigator (R4). The principal investigator segregated the cases and control according to inclusion and exclusion criteria. Bias was avoided by strict adherence to inclusion criteria. Only diagnosed cases

of myopia fulfilled the inclusion criteria and were included. The control was non-myopes, age and gender-matched. Cases and control were examined keenly by the chief investigator for the findings of primary open-angle glaucoma (POAG). Goldmann's Goldmann's Applanation tonometry measured intraocular pressure (IOL). The 3-mirror gonioscopy assessed the angle of the anterior chamber. The vertical cup to disc (VCD) ratio was measured/assessed by slit-lamp and 90 D lens examinations. Octopus 30-2 perimetry was performed for the visual field defects. All ocular findings were rechecked and reviewed by a Consultant Ophthalmologist. Research findings of the study were noted in a pre-structured proforma.

Statistical Package for Social Sciences (SPSS) version 21.0 was used for the data analysis. Categorical variables were analyzed by Chi-square (x<sup>2</sup>) test & presented as frequency (N) and percentage (%) for data like gender, age categories, glaucoma, gonioscopy findings, and visual field defects (VFD) and vertical cup-disc ratio (VCD ratio). Continuous variables were calculated b t-test and presented as mean ± SD for data like age, myopia duration and intraocular pressure (IOP). The p-value of ≤0.05 was considered statistically significant.

**RESULTS**

Mean age of group-1 and group-2 was found as 55.7 ± 8.6 years and 52.3±7.3 years respectively (p<0.071) (Table-I).

**Table-I: Age, Intraocular pressure and VCD ration in study groups (n=340).**

Parameters	Group-1	Group-2	p-value
Age	55.7 ± 8.6	52.3 ± 7.3	0.071
Intraocular Pressure (mmHg)	16.8 ± 2.3	14.0 ± 2.7	<0.001
VCD ratio	0.6 ± 0.13	0.5 ± 0.02	<0.001

Of total 340 patients, 190 (55.8%) of study subjects belonged to 46-50 years, 133 (39.1%) to 51-60 years and 17 (5.0%) to 35-45 age groups. Gender distribution is shown in Table-II. VCD ratio in group-1 was 0.6 ± 0.13 compared to 0.5 ± 0.02 in group-2 (p<0.001). Normal and abnormal VCD ratio in group-1 and group-2 was noted as 161 (94.7%) vs. 168 (98.8%) and 9 (5.2%) vs. 2 (1.1%) respectively (p<0.03) (Figure-1). 23 (13.5%) of group-1 showed visual field defects compared to 6 (3.5%) in group-2 (Table-II). Intraocular pressure was found elevated in group-1 16.8 ± 2.3 mmHg compared to 14.0 ± 2.7 in group-2 (p<0.001). POAG was observed in 9 (5.2%) myopes group-1 compared to 2 (1.1%) in group-2 (Table-II) (p<0.003) (Figure-2).

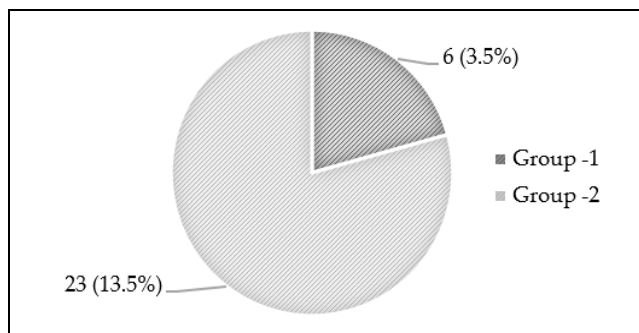


Figure-1: Visual field defects on perimetry in group 1 and control group.

Table-II: Gender distribution and visual findings in study groups (n=340).

Parameters	Group-1	Group-2	p-value
	n (%)	n (%)	
Male	87 (51.1)	93 (54.7)	<0.001
Female	83 (48.8)	77 (45.2)	0.002
Normal VCD ratio	161 (94.8)	168 (98.9)	0.03
Abnormal VCD ratio	9 (5.2)	2 (1.11)	<0.001
Gonioscopy - Grade III	16 (9.4)	13 (7.6)	0.031
Gonioscopy - Grade IV	142 (83.5)	138 (81.1)	0.037
Visual field defects	23 (13.5)	6 (3.5)	0.006
Primary open angle glaucoma	9 (5.2)	2 (1.1)	0.003

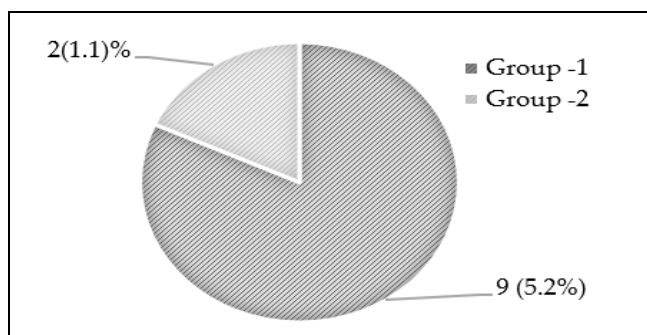


Figure-2: Frequency of Primary open angle glaucoma (POAG) in group-1 and control group.

### DISCUSSION

The present study was the first research reporting on the association between myopia and primary open-angle glaucoma (POAG) from a tertiary care hospital in Sindh. We found that Intraocular pressure was elevated in the group-1 ( $16.8 \pm 2.3$  mmHg) compared to ( $14.0 \pm 2.7$ ) group-2 control ( $p < 0.001$ ) (Table-I). POAG was observed in 9 (5.2%) myopes (group-1) compared to 2 (1.1%) in group-2 (control) ( $p < 0.003$ ). The findings are in agreement with previous studies.<sup>10-12</sup> It has been suggested that myopia may increase the intraocular pressure (IOP), causing glaucomatous damage. The association between myopia and POAG was suggested decades ago by Loyo- Berrios *et al.*<sup>13</sup> The previous study review showed that IOP is one of the major risk

factors for POAG, among others. Myopia itself influences the IOP raising the chances of glaucoma. A low IOP is shown to slow the progression of glaucoma. A previous study by Perera *et al.*<sup>14</sup> showed that myopia was significantly associated with ocular hypertension. A study by David *et al.*<sup>15</sup> analyzed 2403 patients and reported a significant relationship between myopia and ocular hypertension, particularly in those of Asian and North African descent. The above studies are kept in line with the present study. Other previous studies Ribeiro *et al.*<sup>16</sup> Quinn *et al.*<sup>17</sup> and Tomlinson *et al.*<sup>18</sup> had reported raised Applanation pressures in myopes that occur due to abnormal flattening of the cornea in these patients. Similar findings of ocular hypertension have been reported in children by Quinn *et al.*<sup>17</sup> and in patients with increased axial length by Tomlinson *et al.*<sup>18</sup> The findings are in keeping with the present study. Another study by Ahmed *et al.*<sup>19</sup> found the relationship between myopia with low-tension glaucoma. Another study by Doshi *et al.*<sup>20</sup> from China reported controversial results of no glaucoma progression in myopes on seven-year follow-up. Controversial findings of a few studies may be due to the different geographical areas, ethnicity, sample size, research bias, etc. Two studies by Sakata *et al.*<sup>21</sup> and Araie *et al.*<sup>22</sup> from Japan stated that myopia is a preventive factor for the progression of glaucoma, which is a paradoxical and highly controversial finding. This may be due to the different study populations. Because high myopic eyes cause aggressive pathological changes in the posterior pole of the eye, leading to further deterioration of ocular hypertension. A previous study by Kimura *et al.*<sup>23</sup> reported that highly myopic and non-highly myopic eyes show a difference in the progression of glaucoma changes. Reddy *et al.*<sup>10</sup> evaluated the effect of myopia on POAG by dividing the 120 patients into three categories; those with non-myopic glaucoma (NMG) and highly myopic glaucoma (HMG) and mild-moderate myopic glaucoma (HMG) respectively. They reported mixed results of no glaucoma progression in 14 myopes and progression of glaucoma in 5 myopes. Gupta *et al.*<sup>11</sup> analyzed the juvenile-onset open-angle glaucoma (JOAG) and its effects on myopia. They reported that myopia development in JOAG may aggravate the progression of glaucoma, and such patients may be followed up more rigorously. The findings of the above study are in agreement with the present study findings. A study by Khalid *et al.*<sup>12</sup> from Pakistan examined 115 high myopic eyes and POAG frequency. They reported a high incidence of POAG in myopic patients found to be statistically significant. The findings of the above studies are

highly consistent with the present study. Osaiyuwu *et al*,<sup>24</sup> analyzed the Nigerian population and demonstrated that myopes had higher mean IOP compared to hypermetropic. They added that the myopes had more incidence of POAG that was associated with IOP in a Nigerian population. Gnanadurai *et al*,<sup>25</sup> studied 150 subjects to analyze the relationship between IOP and refractive errors (myopia and hypermetropia) and assessed the risk of glaucoma in middle-aged adults compared to normal emmetropic subjects. They reported that the IOP was raised in moderate and high myopes, and these patients' risk of developing glaucoma increased. They concluded a routine checkup of intraocular pressure in myopes. The findings are in full agreement with the present study. The findings of the present study are also supported by other previous studies Mathapathi *et al*,<sup>4</sup> Joseph *et al*,<sup>8</sup> Tham *et al*,<sup>25</sup> Only limitations of the present study are that we could not measure thickness and curvature of the cornea and axial length that may affect the intraocular pressure and may influence the correlation of myopia and intraocular pressure. However, the findings are worth notifying because of the prospective study design, and the sample size was included according to inclusion criteria.

### CONCLUSION

The present study concludes that myopia is associated with primary open-angle glaucoma, and the risk of developing glaucoma is high in these patients. Furthermore, the study suggests that myopia is a major risk factor for developing primary open-angle glaucoma. Hence, it is advised to routinely examine intraocular pressure in myopes to prevent the development of glaucoma, and timely intervention may halt the disease progression.

**Conflict of Interest:** None.

### Authors' Contribution

MUA., GKM: Data collection, AAM., AAR., AAS: Result compilation, MLM., SMUI., NZ: Write up.

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