

# Association between Intraocular Pressure and Myopia Among Children Aged 7 to 16 years

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## ABSTRACT

**Objectives:** To investigate the association between high intraocular pressure and myopia in children and compare it to emmetropia, and to determine the relationship between elevated intraocular pressure and varying degrees of myopia.

**Study design and Setting:** Comparative cross-sectional study was performed at the tertiary eye care hospital, Rawalpindi for six months from July 2021 to December 2021.

**Methodology:** Patients with myopia of greater than 0.5Ds and emmetropes with visual acuity of 6/6 were included. All patients underwent visual acuity, cycloplegic refraction, and fundus examination in order to exclude the myopic patients with other systemic and ocular disorders. Intraocular pressure and central corneal thickness were measured using a Tonopen tonometer and Pachymeter respectively. Data was entered on SPSS version 26 for analysis. Independent sample T-test and one-way ANOVA was utilized for inferential statistics.

**Results:** A total of 218 subjects were included with a mean age of  $11.38 \pm 2.602$  ranging from 7 to 16 years. Females 50.9% (n=111) were outnumbered by male participants 49.1% (n=107). The mean IOP in emmetropes was  $13.35 \pm 2.433$  mmHg and in myopes was  $15.22 \pm 3$  mmHg and there is a statistically significant mean difference between these groups (P-value <0.05). There is also a statistically significant mean difference between IOP and varying degrees of myopia, that is; low ( $13.46 \pm 2.797$ ), moderate ( $16.62 \pm 2.981$ ), and high ( $19.215 \pm 2.184$ ).

**Conclusions:** The IOP was higher in high and moderate myopic eyes as compared to emmetropes. Moreover, a strong association was found between myopia and elevated IOP in children.

**Keywords:** Emmetropia, Glaucoma, Intra-ocular pressure, Myopia

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## INTRODUCTION:

Myopia is the most common form of refractive error and a risk factor for Primary Open Angle Glaucoma (POAG). Myopia is a worldwide public health concern that can cause visual impairment and blindness. Myopia risk has been linked to an increase in time spent performing near work, a decrease in outdoor activities, an increase in educational level, and a family history of myopia. Outdoor activities have been found to lessen myopia prevalence.<sup>1</sup>

Myopia is a refractive error in which light rays entering the eye parallel to the optical axis are focused in front of the retina when accommodation is relaxed.<sup>2</sup> Myopia is uncommon in young children, but its prevalence gradually grows to 25-80% in young adults. The prevalence of myopia was estimated to be 22.9% worldwide in 2001, and it is anticipated that by 2050, over 50% of the world's population will be myopic, and nearly 10% will have extreme myopia.<sup>3</sup>

The prevalence of myopia varies among people from various nations and races. When it comes to adult populations over 40 years old, the regional and racial differences are less pronounced. The prevalence of myopia in some urbanized areas of Asia has reached epidemic proportions; however, the prevalence varies with age. The age-specific prevalence

of myopia in Asia is not well evaluated and summarized. In Nepal, 10.9% of children aged 10 years, 16.5% of children aged 12 years, and 27.3% of children aged 15 years were myopic.<sup>4</sup> The prevalence of Myopia among children aged 5, 10, and 15 in India was 4.7%, 7.0%, and 10.8%, respectively.<sup>5</sup> The prevalence of myopia ( $SE < -0.5$  D) among Pakistani individuals over 30 years old was found to be 33.5% (n=487).<sup>6</sup>

Population-based research indicates that the risk of developing Glaucoma rises as myopia increases. According to research, moderate to severe myopia is related to an elevated risk of POAG.<sup>7</sup> Glaucoma is the progressive Optic Neuroretinopathy distinguished by the loss of Retinal Nerve Fiber (RNFL) tissues, resulting in visual field defect and loss of the Neuro-retinal rim of the Optic Nerve Head, also known as Glaucomatous Optic Neuropathy (GON).<sup>8</sup> In 2020, the global prevalence of glaucoma was estimated to be 52.68 million and is projected to reach 79.76 million by 2040.<sup>9</sup> Multiple investigations have demonstrated a correlation between myopia and POAG. IOP is the pressure produced by the constant replacement of fluids within the eye.<sup>10</sup>

This study is based on the association of myopia with raised IOP, while considering the raised IOP as a risk factor for the development of POAG. The patient with raised IOP should be screened by other modalities of glaucoma screening tests such as visual fields exam and fundus exam to rule out the presence of glaucoma. Such patients are counselled for biannual ophthalmic examination because of the risk of developing glaucoma.

This research aims to investigate the association between high intraocular pressure and myopia in children and compare it to emmetropia, and to determine the relationship between elevated intraocular pressure and varying degrees of myopia.

#### **METHODOLOGY:**

This Comparative Cross-sectional study included patients of both genders ages ranging from 7-16 years, with a myopia of  $>0.5$ D or emmetropia visited the children's outpatient department at Al-Shifa Trust Eye Hospital in Rawalpindi. The total sample size was 218 subjects and the sample size was calculated by using OPENEPI, online software, at a confidence interval of 95% and anticipated prevalence of 22.9%.<sup>3</sup> By using the universal non-probability sampling technique, data was collected from the participants during six months from July 2021 to December 2021. After obtaining written informed consent from the representative subset and ethical approval from the corresponding department, the researcher collected data from already labeled myopic patients or newly diagnosed myopic patients and normal patients with no refractive defect visiting hospital (who fit the inclusion criteria). Four patient classifications were defined according to their refractive condition. Group 0: Emmetropia ( $+0.5$  to  $-0.5$ D); Group 1: Low Myopia ( $-0.75$  to  $-3.00$ D); Group 2: Moderate Myopia ( $-3.25$  to  $-$

$5.00$ D); Group 3: High Myopia ( $>-5.00$ D).

After the patient was presented to OPD, visual acuity was recorded using the Snellen chart. Cycloplegic refraction was done to find out the refractive status of the patient. Myopes and emmetropes were then taken for further assessment. Then patient's detailed examination was held by an ophthalmologist to rule out any pathology of the posterior segment which was included in the exclusion criteria. To ensure the inclusion of only healthy eyes, patients with Astigmatism and Hyperopia  $>+0.5$  DS, ocular medications such as anti glaucoma medications and steroids, a family history of Glaucoma, the presence of Pseudoexfoliation, a history of previous ocular surgeries, and ocular trauma were excluded from the study. Myopia related to other systemic and ocular illnesses was excluded from the study.

Then demographic data was taken from the patient. Intraocular pressure was measured using a tonometer. Pachymetry was also performed for the correction factor for the Applanation tonometer for central corneal thickness. All the findings were recorded on a structured proforma. SPSS (version 26) was used for data analysis. The descriptive analysis was done on the categorical and continuous variables. Percentages and frequencies were reported for categorical variables and mean and standard deviation were reported for continuous variables. An independent sample t-test was used to compare between high intraocular pressure and myopia and compare it to emmetropia, and a one-way ANOVA test was utilized to determine the relationship between elevated intraocular pressure and varying degrees of myopia.

#### **RESULTS:**

In this study, 218 eyes were examined. The mean age of respondents was ( $11.38 \pm 2.602$ ), with a range between 7 and 16 years. 49.1% (n= 107) of the sample were male, while 50.9% (n = 111) were female. Among the participants, 21.2% (n= 46) eyes were Emmetropic, and 78.8% (n= 171) eyes were Myopic. In a sample of 218 eyes, 21.1% (n= 46) were Emmetropes (Group 0), 42.2% (n= 92) were mild Myopes (Group 1), 13.3% (n=29) were moderate Myopes (Group 3) and 23.4% (n=51) were having high Myopia (Group 3).

To compare the relationship between IOP in emmetropes and myopes, an independent sample T-test was applied. It was observed that the mean IOP in emmetropes was less ( $13.35 \pm 2.433$ ) than the mean IOP in Myopes which was  $15.22 \pm 3.516$ . The mean difference was  $-1.874$ , which was statistically significant (P value  $<0.05$ ). Table: 1 To compare the association of IOP with the three different categories of Myopia, that is, mild, moderate, and severe, a one-way ANOVA test was conducted and the mean IOP was a statistically significant different with a P-value of less than 0.001. Table: 2

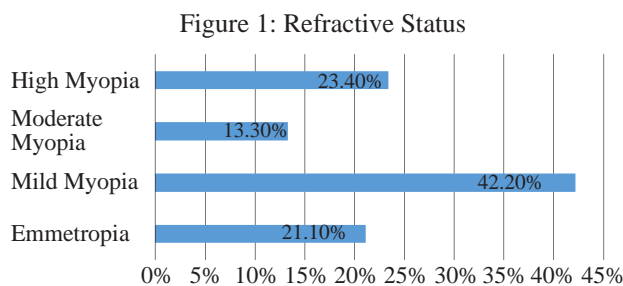


Table 1: Association of IOP with emmetropes and Myopes

Values	N	Mean	SD	T-test		
				t- value	d.f	Sig.
Emmetropes	46	13.35	2.433	-4.18	101.28	0.001
Myopes	171	15.22	3.516	-4.18		

Table 2: Association of IOP with different categories of Myopia

Variables	N	Mean IOP	S.D	F-value (df)	P-value
Mild myopia	91	13.46	2.7978	59.456 (2)	0.001
Moderate Myopia	29	16.620	2.9810		
Severe myopia	51	19.215	2.1846		

## DISCUSSION:

According to a study, the most prevalent type of refractive error is myopia (52%), followed by astigmatism (38.1%) and hypermetropia (9.8%).<sup>11</sup> For health authorities around the world, the existence of a growing myopia pandemic is an undeniable truth. The use of medications, surgical procedures, optometric correction techniques, and increased time spent outside are just a few of the potential remedies being researched by scientists to help youngsters who suffer from it.<sup>12</sup>

According to studies, as myopia grows, so does the risk of developing glaucoma. In the vast majority of research, moderate to severe myopia is related to an elevated risk of POAG. Globally, glaucoma is among the main causes of irreversible blindness in adult populations. Intraocular pressure is a crucial diagnostic and monitoring measure for glaucoma. IOP measurement accuracy is a defining characteristic of glaucoma patient care. Intraocular pressure is the only modifiable risk factor known to decrease the progression of this potentially blinding disease.<sup>13</sup> In the current study, 218 eyes were evaluated from the children OPD of Al-Shifa Trust Eye Hospital. 49.1% were female and 50.9% were male. Moreover, the current study included 46 emmetropic eyes and 171 myopic eyes. There is a moderate association between Intraocular pressure (IOP) and myopia; however, no association was found between IOP and emmetropic eyes, as proven by the current study.

According to the current investigation, this association between higher IOP and myopia in children was statistically

significant ( $P$  value  $< 0.05$ ). Comparing the mean IOP values of the various myopia groups demonstrated a positive association between myopic patients and intraocular pressure in Groups 2 and 3. High myopia and moderate myopia had significantly higher intraocular pressure than emmetropia and low myopia. These results were consistent with those of other studies conducted in our region and in other countries, such as a study conducted in India by Acharlu, which found that the mean IOP was higher in high and moderate myopic eyes than in emmetropic and low myopic eyes. In this study, IOP was measured using a Perkins tonometer on 150 eyes from 120 participants, and the mean IOP was compared. It was found that the mean IOP in high myopes was  $18.30 \pm 3.24$  and the mean IOP in moderate myopes was  $15.07 \pm 3.21$  which was higher as compared to the mean IOP in low myopes and emmetropes which was  $12.27 \pm 2.22$  and  $12.65 \pm 2.10$  respectively. Mean IOP was higher in high and moderate myopes, this difference was statistically significant and this supported our study.<sup>14</sup>

Some studies reported no variation in intraocular pressure (IOP) based on refractive status.<sup>15</sup> The employment of diverse procedures and samples may account for variations in study outcomes. One of the possibilities explaining the association between myopia and raised IOP is the increased stress on the global wall and decreased ocular stiffness in myopic eyes. In a study, a model was suggested that the myopic eye is subject to greater stress than the emmetropic eye with the same intraocular pressure. The increased risk of Open Angle Glaucoma in myopia may be thought that the axial length increase leads to the tilting of the optic disc, which causes damage to the axons in the lamina cribrosa.<sup>16</sup> In a study conducted by Bhagashree Sharma, the intraocular pressure variations of 35 patients with moderate to severe myopia were studied. The average IOP was calculated to be  $16.98 \pm 2.68$  mm Hg. There was no statistically significant difference between the two groups ( $p=0.231$ ). After controlling for factors, high myopes exhibited a somewhat higher intraocular pressure than moderate myopes. Other studies by Bonomi<sup>17</sup> and Sanaa Yasin (Saudi) also could not find any relation between IOP changes and refractive error.<sup>18</sup>

Our study findings are in contrast with it. Nonetheless, in a cohort Chinese study including 2653 participants, it was found that myopic progression is likely to have elevation of IOP with time.<sup>19</sup> The cornea in myopia is thinner than in emmetropia, according to Shukla, and this is likely true for the sclera.

Dini Sunny Joseph discovered a statistically significant ( $p < 0.05$ ) association between intraocular pressure (IOP) and myopia in groups with moderate and high myopia. Based on their refractive state, 178 eyes from 100 patients were divided into four groups for this study. Group 1 consisted of 74 eyes with a mean IOP of 12.32 (SD = 2.44), Group 2 consisted of 14 eyes with a mean IOP of 15.00 (SD =

2.25), and Group 3 consisted of 6 eyes with a mean IOP of 18.5. (SD=0.7). Low myopia and emmetropia exhibited no statistically significant difference in intraocular pressure, however moderate and severe myopia was related to greater IOP than emmetropia. <sup>20</sup>This study supported our conclusions.

It was a hospital based study in which only those patients were included who visited general department of hospital, so, further community based study should be conducted in future.

### CONCLUSION:

Those with moderate or high myopia have a higher risk of developing Primary Open Angle Glaucoma; therefore, glaucoma screening is crucial. The key to stopping the progression of glaucoma and preventing blindness is an early diagnosis. Therefore, myopes with elevated IOP should be advised to undergo biannual ophthalmic examinations to rule out glaucoma.

#### Authors Contribution:

**Arooshia Shahzadi:** Data Collection, Drafting

**Maryam Firdous:** Study Concept

**Fareeha Ayyub:** Statistical Analysis

**Sadaf Qayyum:** Drafting, Study Design

**Saifullah:** Critical Review

**Rabeeah Zafar:** Proof Reading

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