

## Original Article

# RELATIONSHIP OF AGE WITH INTRAOCULAR PRESSURE AND CENTRAL CORNEAL THICKNESS IN HYPERTENSIVE AND NON-HYPERTENSIVE PATIENTS

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### ABSTRACT

**Background:** Increased Intraocular Pressure (IOP) is the main risk factor for glaucoma and a principal cause of permanent blindness throughout the world. Glaucoma has been significantly linked with aging. The objective of this study is to correlate the effect of age on IOP and Central Corneal Thickness (CCT) in hypertensive and non-hypertensive subjects of the Pakistani population.

**Material and Methods:** 54 hypertensive and 54 non-hypertensive subjects, taken from Eye OPD Mayo Hospital, were studied. A mercuric sphygmomanometer was used to determine the blood pressure after written informed consent. Assessment of IOP was done by Goldmann applanation tonometer by using 2% fluorescein strips. An ultrasound pachymeter was used for the measurement of CCT.

**Results:** IOP decreased with age and depicted a weak and negative association in patients with hypertension while CCT showed a weak and positive association with age among hypertensives.

**Conclusion:** As age increases, the levels of IOP decrease and CCT shows a weak and positive correlation with age in hypertensive patients.

**Key Words:** Hypertension, Patients, Intraocular pressure, Body mass index

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## INTRODUCTION

Intraocular pressure (IOP) is the pressure felt in the eye. Due to the aqueous humor generation and drainage, it is controlled and kept in balance. Its value lies between 11 and 21 mmHg.<sup>1</sup>

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Age, blood pressure, CCT, diabetes, vascular disease, and myopia-related refractive error all affect it differently.<sup>1</sup> Since central corneal thickness (CCT) is the primary predictor of IOP and flattening of the cornea is associated with IOP measurement. Its normal thickness in the center is from 490 to 560 mmHg.<sup>2</sup> Clinically, CCT measurement is directly involved in the therapy of 15% of glaucoma patients.<sup>3</sup>

Hypertension is the foremost cause of renal failure, heart attacks and stroke. Predictably, almost about 17 million deaths every year occur due to cardiovascular diseases globally, of which 9.4 million are due to hypertension complications. Low physical activity, tobacco

use, a poor diet and a high salt intake all raise the risk of hypertension. Aging is a significant additional risk factor for hypertension.<sup>4</sup> Literature review shows that there is a strong correlation between age, IOP, central corneal thickness, and blood pressure.<sup>5</sup> A few studies concluded that with younger age, and with high systolic blood pressure, IOP increases.<sup>6</sup> Whereas a different study proved that IOP decreases with age.<sup>7</sup> Additionally, a different study found no link between CCT and age, gender, IOP, or hypertension.<sup>8</sup> Furthermore, the research found no evidence of a significant relationship between IOP and body mass index or age.<sup>9</sup>

The main risk factor for glaucomatous optic neuropathy is increased intraocular pressure (IOP), however moderate to high myopia and thinner central corneal thickness (CCT) are also risk factors.<sup>10</sup> along with some other ocular factors are also known to be the cause of glaucoma. In patients with elevated IOP, CCT plays a crucial part for being a parameter for determining the risk of developing glaucoma. Increased IOP is the main, and the only modifiable risk factor for glaucoma, and a principal cause of permanent blindness throughout the world.<sup>11</sup> Glaucoma has been significantly linked with aging.<sup>12</sup> Much cross-sectional research has already investigated the link between IOP and age. Some studies concluded an increase in IOP with age among South Asian and Japanese people.<sup>6-9</sup> On the contrary, most studies concluded a decrease in IOP as Asian people aged.<sup>13-15</sup> The relationship between age with IOP and CCT is still uncertain because of controversial results found in the literature review. Hence, the current study was done to determine the relationship between age with IOP and CCT among hypertensives versus non-hypertensives Pakistani population.

## MATERIAL AND METHODS

After taking approval from the Ethical committee of KEMU we conducted this Case

control study at the Physiology Department of KEMU, Lahore in collaboration with the Ophthalmology Department of Mayo Hospital, Lahore. A total of 108 subjects (54 controls and 54 hypertensives) were enrolled in our study. Informed written permission was taken from the patient aged between 45-65 years. Non-Probability purposive sampling was done. Registered and physician diagnosed cases of hypertension were included. Patients were excluded who have pre-existing ocular surface pathologies (like a corneal ulcer, corneal opacity) on slit lamp examination, history of contact lens wear during the last 6 months, history of intraocular surgery, laser or trauma during the last 6 months, Corneal astigmatism  $\geq 3$  diopters checked by autorefractor. A complete eye examination was done. Blood pressure was measured with a mercuric sphygmomanometer in a sitting position and an average of three readings was taken. IOP was measured by a Goldmann applanation tonometer after anesthetizing the eye with topical proparacaine 0.5% and 2% fluorescein strips. Three consecutive readings were recorded. 5 ml of blood sample was drawn using an aseptic measure for the determination of serum electrolytes by Easylyte Plus Na/K/Cl Analyzer.

SPSS 25 was used for data entry and analysis. Mean and SD was reported for normally distributed variables. Median and IQR were given for non-normally distributed variables. T-test was used to compare the mean between the two groups. Pearson correlation was applied to find out any correlation between variables.  $p$ -value  $\leq 0.05$  was considered statistically significant.

## RESULTS

The mean age of both groups hypertensive and non-hypertensive patients was  $56.37 \pm 6.71$  years and  $52.35 \pm 5.92$  years respectively. Gender distribution showed that there were 60 males and 48 females included in the study. i.e. (Hypertensive: Male: 30 & Female: 24 & Non-

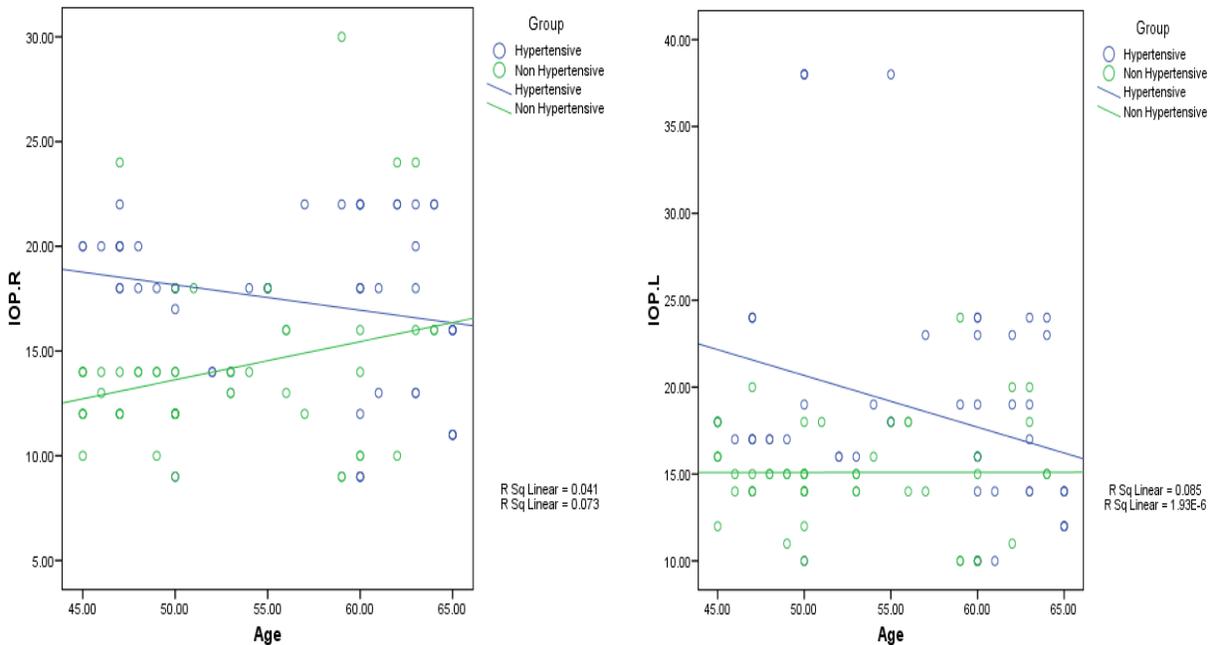
Hypertensive: Male: 30 & Female: 24). Comparison of study variables in both groups is given in Table 1 and Table 2 showed the correlation of study variables.

**Table-1:** Comparison of IOP and CCT in hypertensives and non-hypertensive subjects

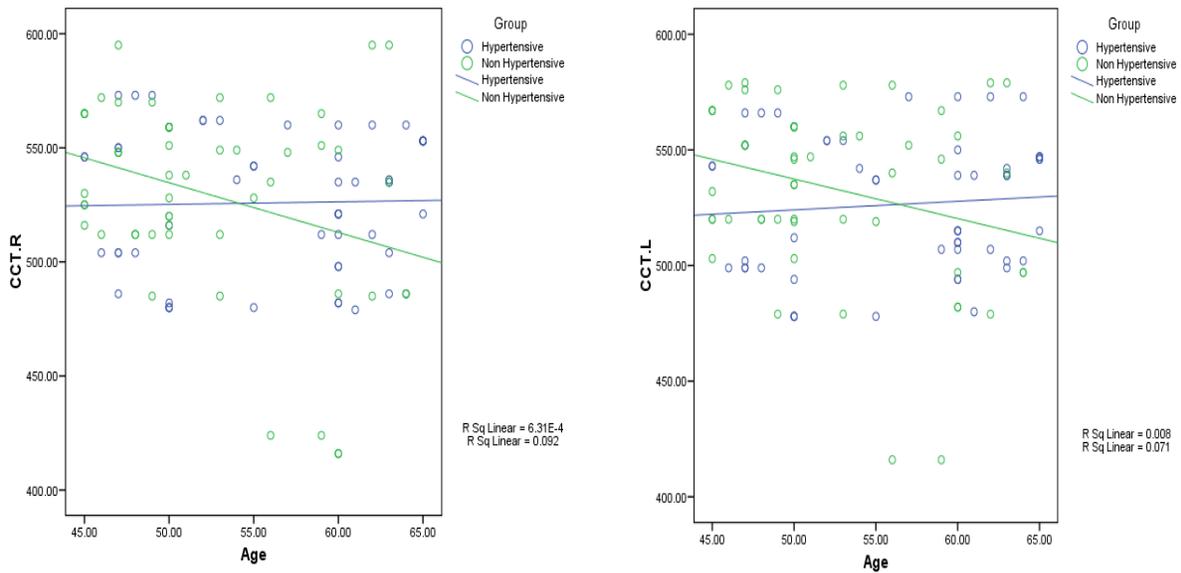
Parameters	Hypertensives	Non-hypertensives	p-value
Age (n=54)	56.37±6.71	52.35±5.92	
IOP (right eye)	17.38±3.99	14.05±3.98	0.000
IOP (left eye)	18.77±6.86	15.09±2.84	0.000
CCT (Right eye)	52.80±30.16	529.57±42.51	0.606
CCT (left eye)	52.42±28.84	533.38±37.93	0.285

**Table-2:** Correlation of IOP and CCT in hypertensive and non-hypertensive subjects

Parameters		Age	
		HTN	NON-HTN
IOP (right eye)	r / rho	-0.204	0.271
	p-value	0.140	0.048
	N	54	54
IOP (left eye)	r / rho	-0.291	0.001
	p-value	0.033	0.992
	N	54	54
CCT (right eye)	r / rho	0.025	-0.303
	p-value	0.857	0.026
	N	54	54
CCT (left eye)	r / rho	0.087	-0.267
	p-value	0.533	0.051
	N	54	54



**Figure-1:** Correlation between age and IOP in hypertensive and non-hypertensive subjects



**Figure-2:** Correlation between CCT and age in hypertensive and non-hypertensive subjects.

IOP was statistically high in hypertensives as compared to non-hypertensives in right and left eye. CCT was statistically the same in right and left eye in hypertensives and non-hypertensive patients. IOP showed weak and negative correlation with age in hypertensives. CCT showed weak and positive correlation with age in hypertensives. In normotensive subjects, IOP showed weak and positive correlation with age and CCT showed weak and negative correlation with age.

**DISCUSSION**

In hypertensive individuals, there is a link between age and IOP, according to our findings. IOP in the left eye exhibits a negative relationship with age among hypertensives. Many studies found a negative relationship between IOP and age.<sup>13-15</sup>

Our study along with research done on the East Asian population showed that IOP decreased with aging in Asians.<sup>16-18</sup>

IOP showed a significant positive correlation with age in non-HTN. The majority of the cross-sectional and longitudinal research done in Europe and America found that IOP rises with age. One study found that the trabecular

meshwork's age-related structural alterations considerably compensated for an individual's declining aqueous humor production.<sup>19-20</sup> Some research done in Africa came up with a similar correlation as well.<sup>21,22</sup> On the other hand, Asian studies have different results.<sup>23</sup> In China, the Handan Eye Study discovered an inverted U-shaped relationship between IOP and age.<sup>24</sup>

Yoshida and Fukuoka recognized the mismatch of Asian research findings with other, comparable studies and ascribed it to ethnic and environmental factors.<sup>25</sup> They hypothesized that in Europeans and Americans, the hypertensive effects of increased BP and BMI outweighed the hypotensive effects of age, leading IOP to seem to rise with age.<sup>25</sup> In contrast, because obesity and hypertension are less common in Japan, age-related hypotensive effects may predominate, causing an apparent drop in IOP with age.<sup>26</sup>

CCT showed a weak and positive correlation with age in HTN. CCT showed a significant negative correlation with age in non-HTN. CCT in the right and left eye showed a negative correlation with age in non-hypertensives.

Another Study has also shown a negative correlation between age and CCT.<sup>26</sup>

Cross-sectional studies conducted in the past have investigated the effect aging has on CCT but the results have been varying. Most of these concluded that there is no association,<sup>27</sup> while a negative association was found in the rest,<sup>28</sup> and only one research proved a positive association<sup>29</sup> of age and CCT. All the studies that had found a decrease in CCT with age had their thinning rates less than -one  $\mu\text{m}/\text{year}$ . The age-dependent CCT was done in some cross-sectional studies and the outcome is influenced by causes such as survival effects and age of cohorts.<sup>29,30</sup> It is increasingly acknowledged that as people get older, the function of aqueous humor production and outflow changes and IOP measurements on a representative group of older Asian populations are deficient.<sup>31,32</sup> Simultaneously, the rates of numerous systemic and chronic disorders and the use of systemic medication rise dramatically among people aged 40 and up. As there is a proven constant relationship between hypertension (HTN) and blood pressure (BP) levels with IOP,<sup>33</sup> the influence of BP and age on IOP is complex.

As of now, the evidence shows that the central cornea does get thinner with an increase in age, but the magnitude of change of CCT needs further explanation as to why is there a difference in untreated and healthy glaucomatous eyes.

## CONCLUSION

With aging, IOP displays a physiologic decline. We also discovered that IOP changes are related to changes in systemic BP in a direct and significant manner, particularly in patients with hypertension. Our findings emphasize the importance of BP management in glaucoma patients since this will result in a reduction in IOP over time. Given that high IOP is a key risk factor for glaucoma, it emphasizes the need of regulating blood pressure in older patients, who have a higher glaucoma burden.

## AUTHOR'S CONTRIBUTION

- FI: Research proposal development, data collection, analysis, article writing & reviewing  
 RKA: Research proposal development, analysis, article writing & reviewing  
 HS: Research proposal development & data collection  
 MI: Analysis, article writing & reviewing  
 MAN: Data collection, analysis & article writing  
 HS: Analysis, Article writing & reviewing

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