



# Cross sectional comparison of IOP among diabetic and non diabetic men and women

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## Abstract

A study was conducted in order to compare IOP differences among diabetic and non diabetic men and women. This gender based study was conducted in Post Graduate Department of Physiology in collaboration with the postgraduate department of ophthalmology in Government Medical College, Srinagar. The study comprised diagnosed Type II Diabetic patients (n=180) obtained from Outpatient Department (OPD) at Shri Maharaja Hari Singh (SMHS) Hospital, Srinagar. For comparison purpose, non diabetic subjects (n=180), were also obtained. Men as well as women (diabetic and non diabetic) comprised the sample. The study was conducted for a period of two years. The statistical measures applied under the study were per cents and frequencies; Levels of Significance and chi-squared test, ( $\chi^2$ ). The results thus obtained revealed that IOP is observed more in right eyes of diabetic men than their left eyes. Diabetic women have shown more IOP in their left eyes than their right eyes. Men are found more diabetic and women. IOP has shown insignificant association with gender.

**Keywords:** IOP, gender, diabetic and non-diabetic

## Introduction

Intraocular pressure (IOP) may be defined as that pressure which does not lead to glaucomatous damage of the optic nerve head. IOP is a definite and important risk factor for developing glaucomatous damage but is not sufficient for a diagnosis. The prevalence of glaucoma is higher with increasing IOP<sup>[1]</sup>. As a general rule, IOPs are similar in the right and left eyes of normal individuals. Although differences of 4 mmHg or more between the eyes are seen in less than 4% of normal individuals<sup>[2, 3]</sup>, such differences are common in patients with glaucoma. Study designed by Matsuoka *et al.*, (2012)<sup>[4]</sup> found that IOP in each diabetic retinopathy group was significantly higher than that in the non-diabetic group ( $P < 0.001$ ) but there was no significant difference between the diabetic retinopathy groups. In their study the highest IOP was reported in the PDR group ( $18.0 \pm 2.2$ ). A pooled analysis of population-based studies by Yau *et al.* (2012)<sup>[5]</sup> estimated that the total number of people with DR worldwide was approximately 93 million and of these, 28 million (30.1 per cent) had vision-threatening DR. Dharmadhikari *et al.* (2015)<sup>[6]</sup> estimated more than 75% of the diabetics had no evidence of diabetic retinopathy (DR). Half of the diabetics with glaucoma had primary open angle glaucoma. The presence of glaucoma was significantly associated to the duration of diabetes (Chi-square = 10.1, degree of freedom = 3,  $P = 0.001$ ). Briggs, Osuagwu and, AlHarthi (2016)<sup>[7]</sup> found that diabetic patients had higher IOP compared to non diabetic subjects. Song *et al.* (2016)<sup>[8]</sup> found that diabetes mellitus represent a growing international public health issue with a near quadrupling in its worldwide prevalence since 1980.

## Material and Method

The study was based primary data collected directly from the

subjects. Written informed consent was obtained from all participants. Such data have proven helpful in understanding the association of IOP with diabetic and normal subjects. The present study was conducted in the Post graduate Department of Physiology in collaboration with the postgraduate department of ophthalmology in Government Medical College, Srinagar. For the purpose, Institutional Ethical Clearance was obtained through proper channel. The study was supposed to be completed within the period of 18 months. However, due to COVID pandemic, it took more than two years to complete the study. The study design involved 360 subjects, who shall be categorized into two groups, namely:

### Group 1

This was an experimental group comprised of Diagnosed Type II Diabetic patients. This study group was obtained from Outpatient Department (OPD) at Shri Maharaja Hari Singh (SMHS) Hospital, Srinagar (n=180). Patients who satisfied any one of the inclusion criteria were selected.

### Group 2

This was a healthy controlled group, non diabetic (n=150), which were compared with Group A on similar parameters.

### Inclusive and Exclusive Criteria

Men as well as women comprised the sample. The age group under study were adults Group A as well as for Group B. The inclusion criteria comprised: diagnosed Type II diabetic Patients; IOP > 21 mmHg (by Applanation Tonometry among Type II Diabetic subjects); and normal IOP with asymmetry of IOP in both eyes of > 5 mmHg. The exclusion criteria included: closed angle on gonioscopy; drug induced (corticosteroids);

myopia; hypertension; any Ocular Surgery and other intra ocular pathology.

### Techniques Used

Tools used under the study include: Tonometry with Applanation tonometer, Gonioscopy, Ophthalmoscopy, Visual acuity, Slit lamp examination, Corneal Pachymetry.

### Covariate Methods

Each participant underwent through an interview schedule/questionnaire. It comprised address, age, gender, duration of Type II Diabetes Mellitus, dwelling, past history, occupation, family history, personal history, drug history and ocular pathology. Height and weight was measured using light clothes and body-mass index was calculated as weight divided by squared height in meters. Blood pressure (BP) measurements were taken using the validated oscillometric device. Three measurements were taken at one-minute intervals. The mean of the two latest BP measurements was considered as the clinical BP.

### Data Analysis

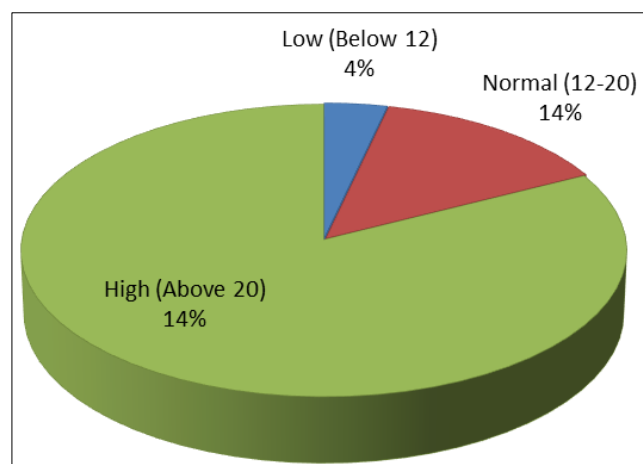
Under the study, the various parameters were evaluated in relation to diabetic and normal subjects. Content analysis using quantitative as well as qualitative approach was done to understand the research study. Data was scrutinised and analysed keeping objectives in view. The statistical analysis of data was done wherever applicable. Appropriate statistical techniques were employed in order to understand the problem under consideration and to draw the right inferences out of it.

The software packages namely 'SPSS' was used for the purpose, computing required measures wherever applicable.

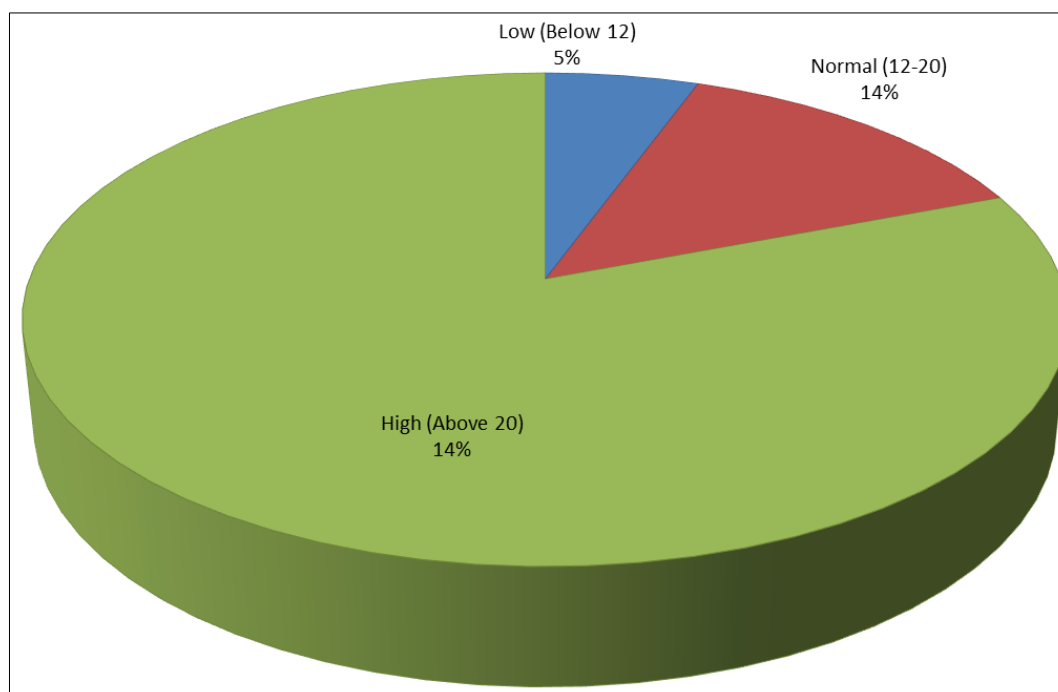
### Observations

**Table 1:** IOP of Subjects under Study

IOP	Right Eye		Left Eye	
	No.	%	No.	%
Low (Below 12)	13	3.61	20	5.56
Average (12-20)	50	13.89	49	13.61
High (Above 20)	297	82.50	291	80.83
All	360	100.00	360	100.00



**Fig 1(a):** IOP Right Eye of Subjects under Study



**Fig 1b:** IOP Left Eye of Subjects under Study

**Table 2:** IOP of Subjects as per their Health Status

IOP (mm/Hg)	Health Status				$\chi$ Αναλυσισ
	Diabetic		Non Diabetic		
	F	%	F	%	
Right Eye					
Low (Below 12)	8	4.44	5	2.78	

Normal (12-20)	38	21.11	160	88.89	$\chi^2 = 1.973$ df = 2 p-value = 0.001
High (Above 20)	134	74.44	15	8.33	
All	180	100	180	100	
Left Eye					
Low (Below 12)	5	2.78	13	7.22	$\chi^2 = 4.59$ df = 2 p-value = 0.000
Normal (12-20)	46	25.56	162	90	
High (Above 20)	129	71.67	5	2.78	
All	180	100	180	100	

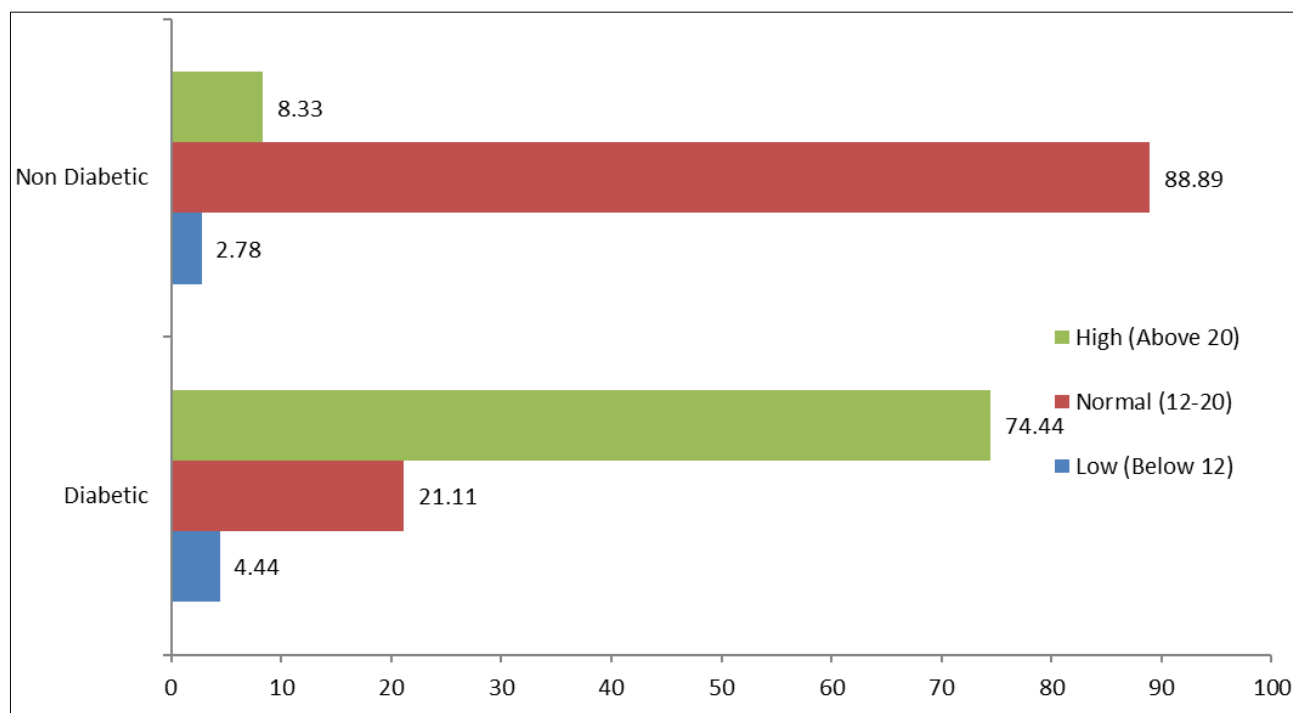


Fig 2(a): IOP Right Eye of Subjects as per their Health Status

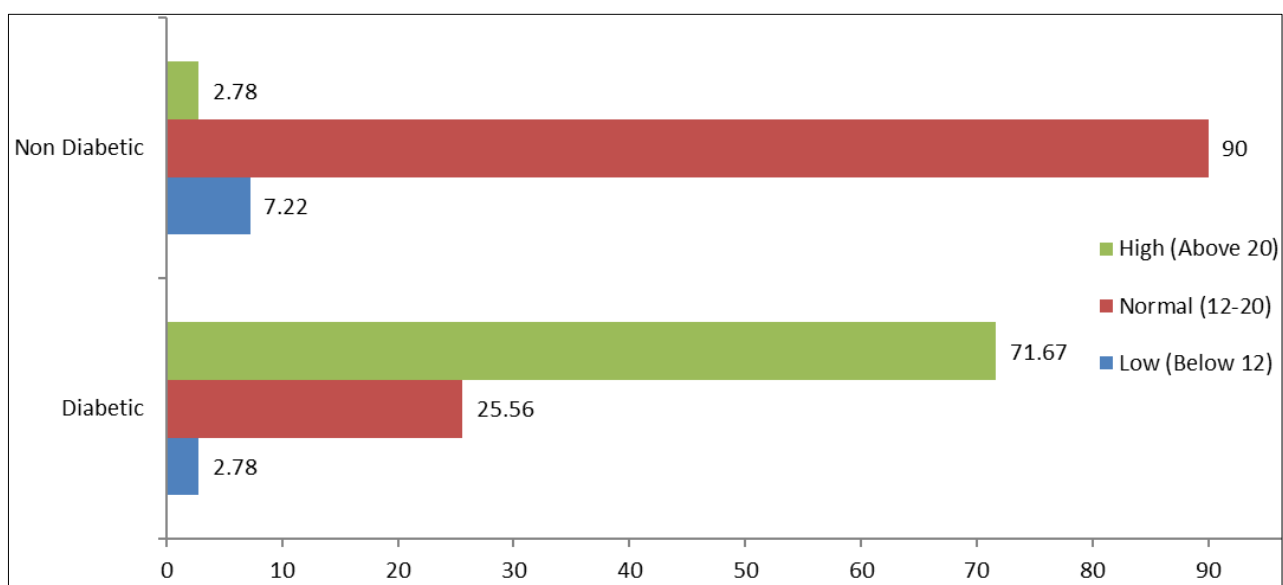


Fig 2(b): IOP Left Eye of Subjects as per their Health Status

Table 3: IOP of Male Subjects as per their Health Status

IOP (mm/Hg)	Health Status of Men				$\chi^2$ Analysis
	Diabetic		Non Diabetic		
	F	%	F	%	
Right Eye					
Low (Below 12)	3	2.54	3	2.54	$\chi^2 = 15.167$ df = 2 p-value = 0.001
Normal (12-20)	27	22.88	115	92.00	
High (Above 20)	88	74.58	7	5.60	

All	118	100.00	125	100.00	
Left Eye					
Low (Below 12)	2	1.69	9	7.20	$\chi^2 = 39.303$ $df = 2$ $p\text{-value} = 0.000$
Normal (12-20)	35	29.66	114	91.20	
High (Above 20)	81	68.64	2	1.60	
All	118	100.00	125	100.00	

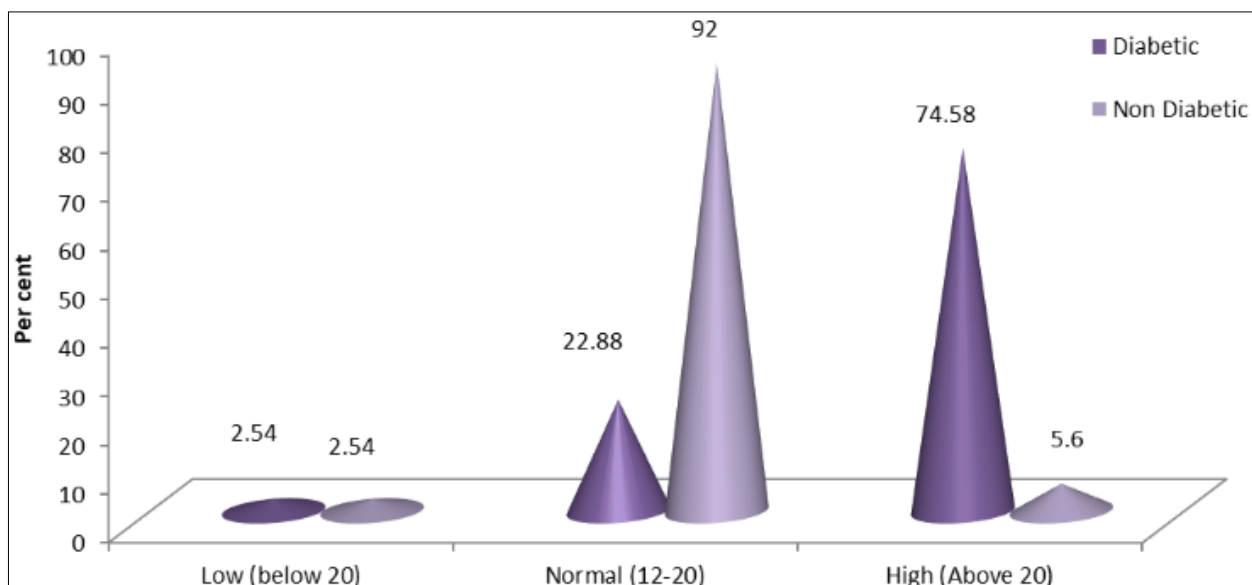


Fig 3(a): IOP Right Eye among Male Subjects as per their Health Status (Km/m2)

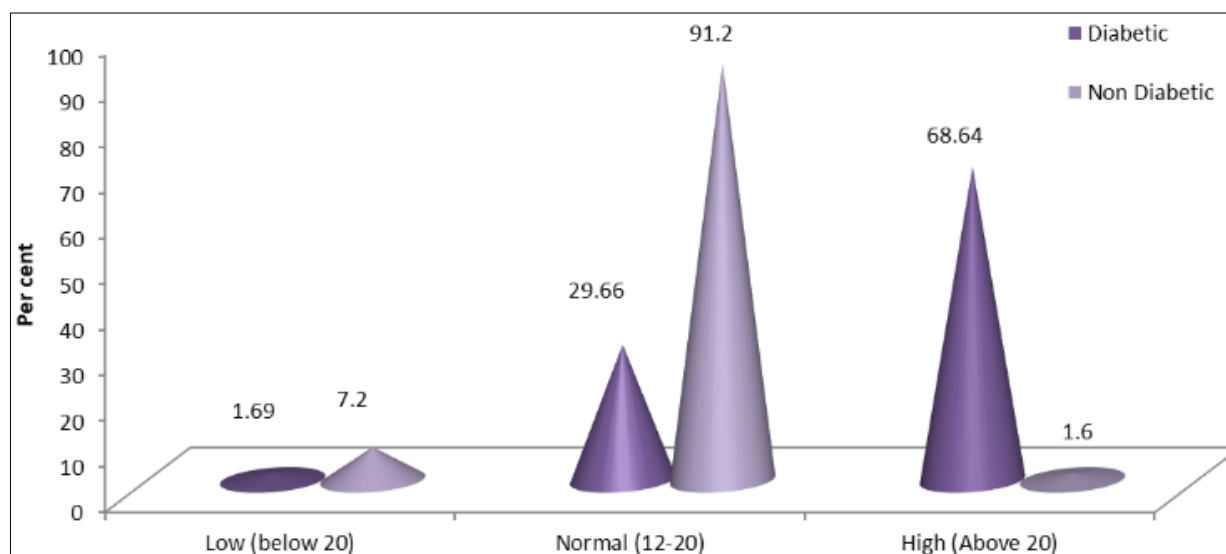
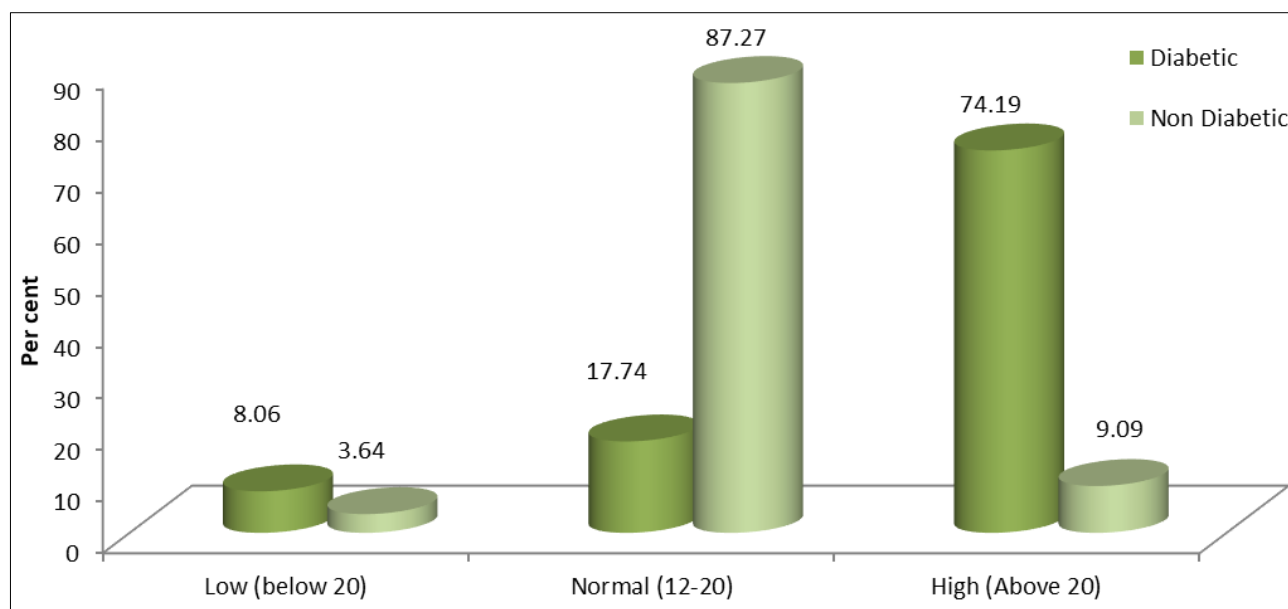


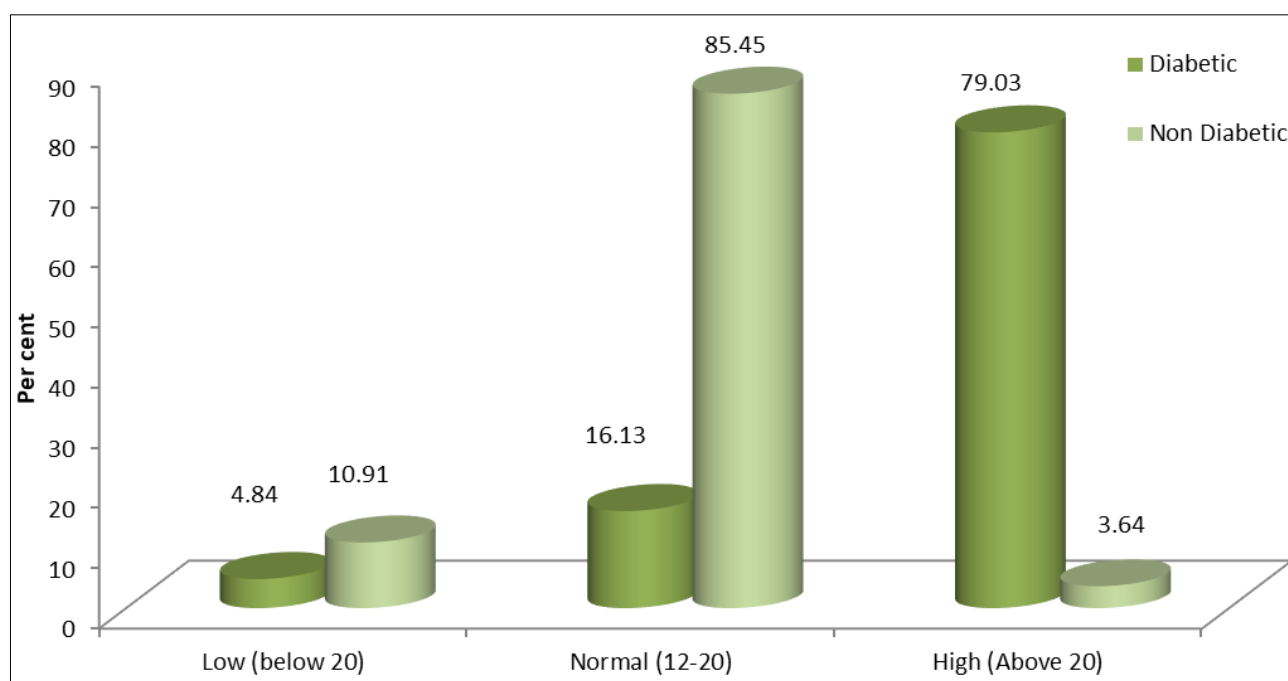
Fig 3(b): IOP Left Eye among Male Subjects as per their Health Status (Km/m2)

Table 4: IOP of Female Subjects as per their Health Status

IOP (mm/Hg)	Health Status of Women				$\chi^2$ Analysis
	Diabetic		Non Diabetic		
	F	%	F	%	
Right Eye					
Low (Below 12)	5	8.06	2	3.64	$\chi^2 = 3.171$ df = 2 p-value = 0.205
Normal (12-20)	11	17.74	48	87.27	
High (Above 20)	46	74.19	5	9.09	
All	62	100.00	55	100.00	
Left Eye					
Low (Below 12)	3	4.84	6	10.91	$\chi^2 = 5.978$ df = 2 p-value = 0.039
Normal (12-20)	10	16.13	47	85.45	
High (Above 20)	49	79.03	2	3.64	
All	62	100.00	55	100.00	



**Fig 4(a):** IOP Right Eye among Female Subjects as per their Health Status (Km/m<sup>2</sup>)



**Fig 4(b):** IOP Left Eye among Female Subjects as per their Health Status (Km/m<sup>2</sup>)

### Interpretation

Table 1 and figure 1a & 1b show the IOP of subjects under study. It was observed high at 82.50 per cent (f=297) in right eye and 80.83 per cent (f=291) in left eye, average (12-20) IOP by 13.89 per cent (f=50) in right eye and 13.61 per cent (f=49) in left eye. Only among 3.61 per cent (f=13), IOP was observed low in right eye and 5.56 per cent (f=20) in left eye (below 12) IOP.

Table 2 and figure 2a & 2b show the IOP of subjects as per their health Status under study. It was found that 74.44 per cent (f=14) diabetic subjects have high IOP in their right eye and 71.67 per cent (f=129) diabetic patients have High IOP in their left eye. While as, 88.89 per cent (f=160) right eye and 90 per cent (f=162) left eye having normal IOP were found in non-diabetic subjects. Similarly, subjects having normal IOP i.e., 21.11 per cent (f=38) in right eye and 25.56 per cent (f=46) in left eye were found diabetic. While as 8.33 per cent (f=15) right

eye IOP and 2.78 per cent (f=5) left eye IOP were found non-diabetic. In context to IOP of diabetic and non diabetic subjects, highly significant differences were found between their health Statuses under study.

Table 3 and figure 3a & 3b show the IOP of male subjects as per their health Status under study. It was found high among 74.58 per cent (f=88) right eye IOP and 68.64 per cent (f=81) left eye IOP in diabetic men. While as, 92 per cent (f=115) right eye IOP and 91.20 per cent (f=114) left eye IOP is found normal among non-diabetic men subjects. Similarly, subjects having normal IOP comprise 22.88 per cent (f=27) right eye IOP and 29.66 per cent (f=35) left eye IOP among diabetic men; while as 5.60 per cent (f=7) right eye IOP and 1.60 per cent (f=2) left eye IOP were found among non-diabetic. In context to IOP of diabetic and non diabetic men, highly significant differences were found between their health status under study.

Table 4 and figure 4a & 4b depict the IOP of female subjects as per their health Status under study. It depicts high IOP among 74.19 per cent (f=46) in right eye and 79.03 per cent (f=49) in left eye in women diabetic subjects. While as, 87.27 per cent (f=48) right eye IOP and 85.45 per cent (f=47) left eye IOP is observed as normal among non-diabetic women subjects. Similarly, diabetic women reveal normal IOP by 17.74 per cent (f=11) in right eye and 16.13 per cent (f=10) in left eye. While as 9.09 per cent (f=5) right eye IOP and 3.64 per cent (f=2) left eye IOP were found high among non-diabetic women subjects.

## Discussion

The present study shows significant differences in IOP of men and women subjects. While the study of Ejimadu et.al (2018) [9] reveal insignificant differences in IOP in males than females. Several studies have shown conflicting results; while some showed higher IOP in males [10-11] others showed higher values in females [12-16] and some showed no association [17-18]. It has been hypothesized that the higher IOP in men could be due to a higher prevalence of cardiovascular risk factors in men [15-20]. Hormonal differences and the effect of menopause may also explain some gender differences in IOP [21]. Estrogen may affect the inflow of aqueous humor, the ciliary body, and the trabecular meshwork [22]. An Indian study showed that the IOP in postmenopausal women was higher compared with premenopausal women and attributed this difference to the higher levels of testosterone and the decrease in estrogen and progesterone levels with the onset of menopause [23-24]. Raymond et. al., (2019) noted elevated IOP leading to the risk for incident or severe MetS in men but not in women. Evidence on this temporal sequence revealed the possibility of showing signs of elevated IOP before the development of MetS, which indicates the necessity of monitoring IOP in routine health check-up for prevention of MetS-related chronic diseases.

The present study shows, the IOP of males higher than that of females although the differences are statistically non-significant. Gender wise difference reported in IOP in studies from various regions has shown variable results. Some studies report higher IOP among females while others report higher IOP in males. The gender wise difference in IOP could be due to hormonal factors, environmental conditions or inherent constituents [25]. Similar to our findings, a study done on Central Indian population found no statistically significant difference between the IOP of males and females [26]. Shiose et al., also reported a higher mean IOP of 12.0 mm of Hg in males as compared to 11.5 mm of Hg in females by non-contact tonometry but the difference was non-significant [27]. A trend of higher IOP in males was also seen in Korean population. Also a high blood pressure and obesity index was noted among the males as compared to females hence the difference could be indirectly attributed to the systemic parameters. The findings of previous investigator suggest that with growing age the difference of IOP among males and females tend to decrease reaching similar-values for subjects above 70 years of age. However, in younger age group males have higher IOP as compared to females [25]. We have also seen this trend in our findings the mean IOP of females in sixth and seventh decade was higher than the male counterparts in the same age group. Higher IOP in females have also been documented by few researchers [28].

## Summary and Conclusion

The IOP among diabetic patients is more than non diabetic subjects. IOP right eye is highly and significantly correlated with IOP of left eyes. Highly significant differences are found in IOPs of diabetic and normal subjects. IOP of right eyes as well as left eyes are found higher among diabetic patients than normal subjects. Diabetic men have more IOP in their left eyes as well as their right eyes than non diabetic subjects. Significant differences are found in IOP of diabetic women and non diabetic women. IOP is observed more in right eyes of diabetic men than their left eyes. Diabetic women have shown more IOP in their left eyes than their right eyes. Men are found more diabetic and women. IOP has shown insignificant association with gender. Thus the study paves way for further research.

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