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A study on prevalence of intraocular pressure variation in relation to age, gender and systemic comorbid condition of hypertension and diabetes among the patients attending a tertiary care hospital, Bhubaneswar, Odisha

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ABSTRACT

Objective: To correlate intraocular pressure variation in relation to age and gender among patients attending a tertiary hospital in Bhubaneswar, Odisha.
Materials and Methods: This was a cross-sectional observational study from October 2020 to September 2021 following the inclusion criteria. Five hundred twenty-two male and female patients of age 20 years were studied in six groups. Intraocular pressure(IOP) was measured with Noncontact Tonometer including routine eye checkup and dilated fundoscopic examination.
Results: Among the 522 patients 272 were males and 252 were females (M:F =1.08:1.0). 48.83 ± 20.43 years was the mean age. The mean IOP of male was 15.45 ± 3.06 mmHg and female was 14.90 ± 2.75. IOP was higher in male than female without statistical significance. There were increase of IOP as age advances with variation in different age groups. There was significant difference of IOP in male and female of age group 50 – 59 years and 60 – 69 years. Diabetic and Hypertensive patients were having statistically significant higher IOP than nondiabetic and non hypertensives respectively.
Conclusions: There was increase of IOP on increasing age in both male and female age groups. In higher age group males were having higher IOP than female which is statistically significant. Diabetes and Hypertension was associated with raised IOP.

1. Introduction

Intraocular pressure is the dynamics of aqueous pressure in the eye. It is the inherent physiological mechanism of maintenance of ocular structure and function. Raised Intraocular pressure is a major risk factor for development of primary open-angle glaucoma (POAG).[1–3] Reduction of IOP even in normal tension glaucoma slows progression of visual acuity loss.[4] IOP is the only identifiable risk factor for glaucoma treatment. People having high IOP without open-angle glaucoma features are also at risk of optic nerve damage without having any ocular disease.[5] Many studies demonstrate IOP variability in normal and reported mean IOP between 14.3 to17.2 mmHg.

Numerous ocular and systemic factors are known on influencing IOP including age and sex. However IOP distribution and its association with age and various comorbidities are important clinically.[5] Considering IOP variability in different conditions and inconsistencies with age; it is a matter of study of IOP distribution and its associated factors on various ocular and systemic conditions of population groups. Many studies showing increasing IOP

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on advancing age.[2,6,7] On the contrary other shows negative relation.[8,9] No association was seen in other study.[10]

Distribution of IOP in relation to sex and changes on advancing age are not constant in many studies. The study by Mahmmed et al[11] showed male had lower IOP than female a highly significant difference of mean IOP; 15 ± 2.43 mm Hg and 16 ±3.28 mm Hg respectively. Similar result observed in Barbados eye study,[12] Rotterdam study,[13] Los Angeles Latino Eye Study[14] and Beaver Dam Eye Study.[6] On the contrary higher IOP was reported for male in Egma-NNeumarkt[4] and the Gutenberg Health Study;[15] while Framington Eye Study[16] and the Health and Nutrition Examination Study[17] reported no IOP association with male and female.

Goldmann Applanation Tonometer (GAT) is the gold standard for Intraocular pressure measurement. But Noncontact Tonometer (NCT) which is widely used and very popular for routine examination on daily basis correlates well with GAT.[18] Therefore in this study NCT was used for IOP measurement of the patients who were examined routinely in out patient department.

2. Objectives of the Study

To findout the IOP association in relation to age and sex among patients attending Ophthalmology Department during the study period.

3. Materials and Methods

This is a observational cross sectional study carried out in the Department of ophthalmology, conducted from October, 2000 to September, 2021.

All patients (Five hundred twenty two) attending the ophthalmology out patient department were included in this study and met the inclusion criteria. Patients aged 20 years or above were included in the study. Informed consents were obtained and study was followed the tenet of Helsinki Declaration

Patients with history of glaucoma, cup disc ratio 0.5 or more, cup disc asymmetry of 0.2 mm, under antiglaucoma medication, history of vitreoretinal surgery and corneal disorder were excluded from study.

Data recorded were age,sex, medical and family history including diabetes, hypertension, cataract surgery and refractive error. Study participants underwent detailed fundus examination by direct and indirect ophthalmolscope assessing disc details and retinal pathology. Intraocular pressure was measured using non contact tonometer (NCT) “Topcon Computerised Tonometer CT – 800, Topcon Corporation, Tokyo, Japan” for each eye. Three measurements were taken for each eye and if the error of three measurements exceed 2 mm Hg retest done after five minutes. The average of three valid readings of both eye are recorded. IOP measurements were undertaken usually between 8AM to 11AM. Patients were categorized into six groups ranging from 20 years of both male and female (Table 1).

3.1. Statistical analysis

Descriptive statistical analysis involved mean with standard deviation for numerical variables. Frequency and proportion for categorical variables. Unpaired t-test has been applied for comparison of mean IOP difference within two independent groups ie; male and female. All statistical analysis were done using SPSS (version 22.0). Data were presented as mean ± Standard Deviation (SD). p value of < 0.05 was considered statistically significant and > 0.05 not significant. Association between IOP and various factors such as age, sex, hypertention and diabetes were included in the analysis

4. Result

There are 522 subjects in this study comprising of 272 males and 250 females (M: F= 1.08 : 1.00). The mean age was 48.83± 20.43 years. There was no statistically significant age difference of male (42.9 ±13.8 years) and female (41.7±13.9 years). Of all the participants, 16.47% were in their 20-29 years of age, 14.76% in 30-39, 15.90% in 40-49, 21.84% in 50-59, 18.39% in 60- 69 and 12.64% in > 70 years in the study population (Table 1).

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Mean IOP of the total study participants was 15.16 ± 2.91 mmHg (range: 8 – 28). Mean IOP of males was 15.45 ± 3.06 compared to females 14.90 ± 2.75, which is statistically significant at 95% confidence limit (Table 2). IOP distribution in all the groups showed increasing trend as age advances (Table 3). The prevalence of raised IOP was found to be 16.3% among the patients.

On comparison of IOP variation in different age groups of both male and female showed a significant difference in IOP was noticed in 50 to 59 years of age group in comparison to the patients of 20 to 39 years of age group. Significant difference in mean IOP was also marked within 30 – 39 years and 60 – 69 years age group. Further significant difference in mean IOP was noticed within 20 -29 years and 70 – 79 years age group. A comparison between the age group 40 – 49 years and more than 70 years was made and the test was revealed to be highly statistically significant with p value < 0.0001 showing significant difference of mean IOP in both the groups (Table 4).

There were 14 (2.68%) Ocular hypertensive (Glaucoma suspect) patients where IOP was more than 21 mmHg and 508 (97.31%) patients were IOP less than 21 mmHg. These sub group patients were in the age group of 50 to 69 years; males were 8 and females were 6 numbers.

Table 1: Age group wise distribution of study participants with mean and S.D. and comparison within male and female participants

Age group in Years	Total Number (%)	No. of Male (%)	No. of Female (%)	Male Age Mean ± SD	Female Age Mean ± SD	t value	df	p value
20 – 29 (Group 1)	86 (16.47%)	39 (14.33%)	47 (18.80%)	24.64 ±2.89	24.81 ± 2.99	0.266	84	0-790 Statistically not significant
30 -39 (Group 2)	77 (14.76%)	40 (14.70%)	37 (14.80%)	34.5 ± 2.81	35.46 ± 2.71	1.52	75	0.1321 Statistically not significant
40 – 49 (Group 3)	83(15.90%)	47 (17.28%)	36 (14.40)	44.77 ± 3.00	44.72 ± 2.59	0.079	81	0.9367 Statistically not significant
50 -59 (Group 4)	114(21.84%)	61(22.43%)	53(21.20%)	54.92 ± 2.64	54.36 ± 3.04	1.05	112	0.2952 Statistically not significant
60 – 69 (Group 5)	96 (18.39%)	44 (16.18%)	52 (20.80%)	63.57 ± 3.03	62.23 ± 2.55	2.28	94	0.0246 Statistically significant
>70 (Group 6)	66 (12.64%)	41 (15.08%)	25 (10.00%)	75.20 ± 5.42	74.12 ± 4.78	0.82	64	0.4152 Statistically not significant
Total	522	272	250					

Table 2: Distribution of IOP in male and female study participants

Gender	Number(%)	Mean IOP ± SD	t value	df	p value
Male	272 (52%)	15.45 ± 3.06	2.15	520	0.0320 Statistically significant
Female	250 (48%)	14.90 ± 2.75			
Total	522				

Table 3: Age group was distribution of IOP of the study participants

Age Group in Years	Mean IOP	Age Group in Years	Mean IOP
20 – 29 (Group 1)	13.47±1.84	50-59 (Group 4)	15.88±2.83
30 – 39 (Group 2)	13.03±1.83	60-69 (Group 5)	16.53±3.27
40-49 (Group 3)	15.20±2.12	> 70 (Group 6)	16.88±3.86

Table 4: Comparison of age group wise distribution of IOP of the study participants

Age group in years	Mean IOP	Standard Deviation	N	t value	d.f.	p value
20 - 29	13.47	1.84	86	6.87	198	<0.0001 Statistically significant
50 - 59	15.88	2.83	114			
30 - 39	13.03	1.83	77	3.50	171	<0.0001 Statistically significant
60 - 69	16.53	3.27	96			
20 - 29	13.47	1.84	86	7.20	150	<0.0001 Statistically significant
> 70	16.88	3.86	66			
40 – 49	15.20	2.12	83	3.378	147	<0.0001 Highly Statistically significant
> 70	16.88	3.86	66			

Table 5: Age and gender wise IOP distribution of male and female study participant groups

Age Group	No. of Males	IOP Mean±SD	No of Females	IOP Mean±SD	P - value
20 – 29 (Group 1)	39	13.51±1.70	47	13.66±1.92	0.7057 Not Significant
30 – 39 (Group 2)	40	12.84±1.88	37	13.23±1.76	0.3527 Not Significant N.S
40 – 49 (Group 3)	47	15.26±2.16	36	15.11±2.10	0.7521 Not Significant.
50 – 59 (Group 4)	61	16.90±2.37	53	14.71±2.87	<0.0001 Significant
60 – 69 (Group 5)	44	16.91±2.39	52	16.41±3.13	0.3882 Not Significant
> 70 (Group 6)	41	15.26±2.16	25	15.11±2.10	0.7832 Not Significant
Total	272		250		

Table 6: Association of diabetes with IOP in study participants

Diabetes	Mean IOP ± SD	N	t value	p value
Present	15.52 ±1.74	97(18.6%)	9.29 df = 520	< 0.0001 Highly statistically significant
Absent	13.70 ± 1.74	97(18.6%)		

Table 7: Association of hypertension (Systolic > 150 and diastolic > 90 mm of Hg) with IOP

Hypertension	Mean IOP ± SD	No of participants	t value	p value
Present	15.71 ± 3.64	251(48.09%)	3.055 df=520	0.0024 Statistically Significant
Absent	14.89 ±2.41	271(51.91%)		

Gender wise IOP variation noticed in age group of 50 – 59 years showing higher IOP in males 16.90 ± 2.37 than females 14.71 ± 2.87 which is statistically significant of p value < 0.0001 at 95% confidence limit. In other groups showed no gender difference (Table 5). There were 356 (68.2%) phakic, 79 (15.13%) one eye pseudophakic and 87 (16.16%) both eye pseudophakic patients. Analysis of IOP of these sub groups did not reveal any significant differences.

In this study participants; 97 (18.6%) were found to be diabetic and 425 (81.4%) nondiabetics. Diabetic patients were having mild to moderate retinopathy features or without retinopathy. Diabetics showed higher mean IOP (15.52 ± 1.97) than nondiabetics (13.70 ± 1.74). While comparing within mean IOP of diabetic and nondiabetic paticipants un-paired t-test was applied and the test was highly statistically significant at 95% confidence limit with p value < 0.0001 (Table 6).

Out of 522 study participants 251(48.08%) were found to be hypertensive and 271(51.91%) normotensive. Hypertensives showed mean IOP 15.71 ± 3.64 mmHg in comparison to nonhypertensive 14.89 ± 2.41. This showed hypertensive patients had significantly higher mean IOP than normotensive patients with p value 0.0024 at 95% confidence limit (Table 7).

5. Discussion

Glaucoma is one of the common cause of nonreversible blindness attributed to several risk factors. Of the all the only modifiable factor is Intraocular pressure. To our knowledge this study was carried out on non-glaucomatous patients of age 20 or more to find out intraocular relation with age and gender of the patients attending the Ophthalmology department.

In our study there was no statistically difference of number of male and female patients (M:F = 1.08:1.00). The mean age of males and females were 42.9±13.8 years and 41.7±13.9 years respectively. Our study comprised of six groups (Group 1, 2, 3, 4, 5 and 6) consisting of 10 years in each group from 20 – 29 years to more than 70 years age group. IOP was measured by Noncontact Tonometer.

The result of our study showed the overall mean IOP was 15.16±2.91 mmHg with ranging from 8 – 28 mmHg. There was statistically significant difference of IOP in different age groups with lower IOP in ages 20 to 39 years and IOP increase from 40 to 69 years and decline beyond 70 years showing a positive association. Several studies showed conflicting reports of age and IOP association; some found a positive association[2,4–7,11,13,19] and others found negative association.[5,8,9] Increasing age is associated with decrease of aqueous humour production and at the sametime Trabecular meshwork structural change leading to decrease aqueous humor outflow there by increasing IOP.[1,20] The net IOP change is the balance between these processes. This vary across age groups, sex and co-morbidities. IOP variation in different groups of age also confounded to age changes in orbital tissue, ocular muscles, corneal curvature and systemic co-morbidities.

The result of our study revealed the mean IOP was 15.45±3.065 in male and 14.90±2.75 in female which was within the normal range of general population despite little more in males having no statistical significance. There is also no significant difference with overall IOP. In both the genders IOP increases on advancing age. Gender wise IOP variation noticed in age group of 50 – 59 years showing higher IOP in males (16.90 ± 2.37) than females (14,71 ± 2.87). This is statistically significant of p value < 0.0001 at 95% confidence limit. In other groups there was no difference in IOP of male and female.

There was increase IOP in male than female and this variation is significant statistically. Several studies shown variable reports; while some showed higher IOP in males,[4,6] other showed higher in females,[5,7] some showed no association.[2,6,13] Higher IOP in male may be caused by cardiac co-morbidy risk factors.[14,15] In Females hormonal imbalance and menopause may increase in IOP could be due to decrease in estrogen and progesterone level in post menopausal period.[21–23]

Our study shows diabetic and hypertensive patients are having significantly higher IOP. It coincides with previous studies which could be due to older age group and life style and other co-morbidities.[6,7,10,13,14,16,17,24] Our study revealed no statistical difference of IOP between phakic and pseudophakic patients. But studies showed slight difference in increasing IOP in nuclear cataract than pseudophakia and phakic.[6,21] There were 2.68% participants showed high IOP (ocular hypertension) ranging from 21 to 28 mmHg seen in association with older age group in phakic patients. It coincides with previous studies.[4,6,9]

We have not studied the ocular intrinsic variations such as central corneal thickness, axial length, orbital soft tissue changes in age and ocular musculature and systemic factors as obesity and systemic comorbidities.[10] Our study is a Hospital based cross-sectional study of volunteered people rather than population based study on random selection. Therefore, considering these variable factore further study of IOP distribution among male, female and age is required.

6. Conclusion

IOP increased on advancing age in both males and females. There was statistically significant difference of IOP in both male and female in advancing age groups. Males are having significant higher IOP than females. Higher IOP is also observed being associated with co-morbidities like hypertension and diabetes mellitus. Therefore we can conclude that IOP increases as age advances and the increase is significantly higher in males than females.

7. Source of Funding

None.

8. Conflict of Interest

There is no conflict of interest among authors.

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