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ORIGINAL ARTICLE

CORRELATION OF BODY MASS INDEX AND INTRA OCULAR PRESSURE IN DIABETIC AND NON- DIABETIC ADULTS IN INDIAN POPULATION

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ABSTRACT: INTRODUCTION: Obesity is one of the most prevalent disorders of the world. Obesity possesses an increased risk for both elevated IOP and systemic vascular abnormalities such as hypertension and arteriosclerosis. There are conflicting reports regarding the relationship between BMI and IOP. There is a need to evaluate these contradicting findings in our environment. **AIM:** To determine the relationship between intraocular pressure and body mass index, in diabetics and non-diabetic adults in Indian population. **MATERIALS AND METHODS**: The present study was a cross-sectional analysis based on data obtained at a one day screening programme of a general population in an Eye camp conducted in Mysore. 115 subjects were studied after obtaining an informed consent. Participants underwent standardized examinations including anthropometric indices, measurement of blood pressure, rebound tonometry and ocular examination including fundoscopy and intra ocular pressure. Random blood sugar was measured for all the subjects. **RESULTS**: out of 115 subjects, there were 90 males (78.26%) and 25 females (21.73%). The mean age was 44.34 years +/- 11.75 years. 31 (26.95%) of them were diabetic and 84(73.04%) of them were non-diabetic. Maximum number of males i.e 42(46.66%) were overweight and 9 females (36%) were overweight. Out of 51 overweight subjects, 41(80.4%) had IOP < 21mmHg and 10(19.6%) had IOP >21 mmHg. Out of the 23 obese subjects, 4(17.4%) had IOP < 21mmHg and 19(82.6%) had IOP>21mmHg which was statistically significant. The mean IOP amongst diabetics was 18.45mmHg +/- 3.8 mmHg and amongst non-diabetics was 19.16 mmHg +/- 3.92 mmHg which was not statistically significant. **CONCLUSION**: In a population of 115 screened, there was a significant correlation between IOP and BMI but there was no statistically significant relationship between BMI and diabetes.

KEYWORDS: Body Mass Index, Diabetes Mellitus, Intra ocular pressure, obesity.

INTRODUCTION: Glaucoma is the world's leading cause of acquired blindness.[1] Glaucoma is an optic neuropathy characterized by progressive degeneration of retinal ganglion cells and their axons, manifested by increasing optic disc cupping and deterioration of visual function.[2] The round firm shape to the eyeball is caused by the intra ocular pressure(IOP) within the eyeball which is caused by the aqueous humour and vitreous body. Importance of IOP is in maintaining the structural and functional integrity of the eye.[1] High intraocular pressure is more often associated with glaucomatous optic nerve damage. IOP is not the only risk factor for optic nerve damage, but is one of the modifiable risk factor for emergence of glaucoma and is the only amendable risk factor that can be treated.[3]

It is estimated that more than 60 million cases of glaucoma worldwide exists and it may increase to 80 million by 2020.[4] Above 40 years of age the estimated prevalence of glaucoma is 2.65%. Globally, primary open-angle glaucoma (POAG) is more prevalent than primary angle closure

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glaucoma (PACG) and responsible for around three fourth of all glaucoma cases. Overall glaucoma is the second major cause of blindness after cataract and refractive errors.[5] Glaucoma is the most common cause of irreversible blindness globally. It is estimated that more than 3 million people are blind due to glaucoma.[5]

Obesity is one of the most prevalent disorders of the world. It constitutes an important risk factor for several diseases such as type II diabetes, hypertension, stroke, osteoarthritis, cancer etc and a number of eye diseases have also been reported to be associated with obesity like cataract, glaucoma[1,6]etc. Glaucoma most of the times is unnoticed in initial stage. Raised IOP has been associated with risk factors like age, sex, BMI, hypertension, diabetes, smoking, alcoholism, myopia, family history leading to visual impairment and blindness.[6,7,8]

IOP is the only modifiable risk factor needs to be assessed concurrently with other risk factors. Link between diabetes and IOP studied by many groups support a weak association.[13,14]

MATERIALS AND METHODS: The present study was a cross-sectional analysis based on data obtained at a one day screening programme of a general population in an Eye camp conducted in Mysore. 115 subjects aged above 20 years, out of which 31 diabetics and 84 non diabetics (controls) were studied after obtaining an informed consent. Exclusion criteria included subjects with hypertension, receiving IOP lowering agents, ocular diseases/surgeries and endocrine disorders. Participants underwent standardized examinations including anthropometric indices, measurement of blood pressure, rebound tonometry and ocular examination including fundoscopy. IOP was assessed in both eyes using I- Care rebound tonometer and recorded as the average of three measurements. Subject's height was measured using a standard scale, weight using a standard weighing machine, blood pressure using a sphygmomanometer and pulse rate. BMI was calculated as weight in kilogram/ (height in m^2)[8] and the random blood sugar was measured for all subjects.

The association of IOP and body mass index (BMI) with age was analysed in a linear regression model. Partial correlation coefficients among IOP and BMI controlled for age were examined in males and females. Gender was entered as a dichotomous variable (male= 0, female = 1). The relationship between BMI and IOP controlled for age and gender also studied by analysis of covariance (ANCOVA).

RESULTS: A total of 115 subjects were screened. There were 90 males (78.26%) and 25 females (21.73%) giving a male to female ratio of 3.6:1. (Table 1). Out of 115 subjects screened, 34 subjects (29.6%) belonged to the age group 51-60 yrs followed by 30 subjects (26.1%) in 41-50 years age group and so on as shown in table 2 with mean age being 44.34 years +/- 11.75 years. Under-weight was considered with BMI<18.5, acceptable range 18.5-24.9, over weight >25-29.9, obese >30-39.9 and morbidly obese >40. Among 115 subjects, 1 subject (0.9%) was underweight, 40 subjects (34.8%) were in the acceptable range, 51 (44.3%) were overweight, 23 (20%) were obese and none were morbidly obese. (Table 3). Out of 115 subjects, 31 (26.95%) of them were diabetic and 84(73.04%) of them were non-diabetic. Overweight was observed in 42 males (46.66%) and 9 females (36%) (Table 4) which was not statistically significant. (p=0.612). Maximum number of overweight subjects 19 (55.88%) were in the age group of 51-60 years and maximum number of obese subjects 7 (28%) were in the age group of 31-40 years which was not statistically significant. (p=0.629) (Table 5). Out of 51 overweight subjects, 41 (80.4%) had IOP < 21mm Hg and 10 (19.6%)

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had IOP > 21 mmHg. Out of the 23 obese subjects, 4 (17.4%) had IOP < 21mmHg and 19 (82.6%) had IOP> 21mmHg (Table 6) with p value 0.000 which is statistically significant. Table 7 shows mean IOP amongst diabetics was 18.45mmHg +/- 3.8 mmHg and amongst non-diabetics was 19.16 mmHg +/- 3.92 mmHg with p value 0.092 which was statistically not significant.

DISCUSSION: Obesity and BMI have also been associated with increased intraocular pressure, however the relationship between obesity, increased BMI and risk of glaucoma is not understood.[10] BMI should be maintained and simple lifestyle modifications like change in dietary habits, exercise, meditation can go a long way in achieving this goal.[8] Obesity is also a risk factor for hypertension and diabetes which also have effect on IOP. So weight control is important in preventing an increase in IOP. Obesity increases blood viscosity by increasing red cell count, haemoglobin and hematocrit, thus increasing outflow resistance of episcleral veins.[6] obesity results in increased insulin resistance and corticosteroid secretion.[11] Thus by various combined mechanism contribute to the development of raised IOP. The relationship between BMI and IOP has been well established. So exercise can have significant effect on keeping IOP in check. Most of the other factors also may be directly or indirectly related to BMI.[1,6,7]

The Barbados[11] Eye Study found larger body size as measured by BMI was associated with increase in IOP. Rotherdam[12] Eye Study reported that there is positive correlation between BMI and IOP in women which is in concordance with the present study.[12] This result is similar to that of the study by Dr. Poonam Kohli[1] et al indicating that high BMI is independent risk factor for IOP in both cross sectional and longitudinal studies.

The pathogenesis for this positive relationship has been suggested to be due to excess orbital fat in obese patients with high BMI, which may increase episcleral venous pressure and reduce aqueous outflow facility and cause a rise in intraocular pressure. Alternatively, the deposition of lipids in obesity has been suggested to reduce aqueous outflow facility.[1,6,7] Increase in BMI appears to be a positive additive determinant of raising IOP.

On the contrary the study by C.N. Pedro Egbe[2] et al showed no association between BMI and IOP. Similarly, in a study by Shailaja Patil[3] et al found that off springs of diabetic patients may be less prone for primary open angle glaucoma as they had negative correlation between IOP and BMI.

In the present study low IOP was observed in diabetics compared to non-diabetics this concords the study by Armaly[16] et al. The present study had constrains like small sample size so further large population based studies are recommended. A few early studies found no evidence of increased intraocular pressure in diabetes.[13,14,15] Etiological links between IOP and diabetes remain unclear several hypothesis has been advanced. Genetical factors also play a role.[10] MYOC gene is found to be associated with POAG and diabetes.[10] There is also evidence that autonomic dysfunction is likely to raise IOP in diabetics.[3,12]

CONCLUSION: The present cross sectional study showed a significant correlation between IOP and BMI. Hence weight control with dietary modifications, meditation, positive attitude is the most natural primary intervention method in the inter-relation of obesity, diabetes and subsequently preventing elevated IOP. Most other factors affect BMI and IOP directly and indirectly. IOP is found to be strongly associated with BMI. However, the study did not show a correlation between IOP and DM. This may be because of the small sample size as hypertensives are excluded. Further studies

involving community based larger sample size may have to be conducted before a reasonable conclusion is drawn.

REFERENCES:

1 Kohli P G, Kaur H, Maini H. Relation of Body mass index with intraocular pressure. Indian Journal of Basic and Applied Medical Research. 2014; 3 (2): 679-81.
2 Pedro-Egbe C N, Awoyesuku E A, Nathaniel G I, Komolafe R O. The relationship between Body mass Index and Intraocular Pressure in Port Harcourt Nigeria. Br J of Medicine& Medical Research. 2013; 3 (3): 589-95.
3 Patil S, Herur A, Shashikala G V, Chinnagudi S, Manjula R, Ankad R. Corelation of IOP with blood pressure and BMI in offsprings of diabetic patients: A Cross sectional study. Int J Med Res Health Sci. 2014; 3 (3): 566-9.
4 Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol. 2006; 90: 262-7.
5 Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. Br J Ophthalmol. 2012; 96: 614-8.
6 Leske M C, The epidemiology of open angle glaucoma: a review. Am J Epidemiol 1983: 118 (2): 166-91.
7 Allingham R, Freedman S F,.Moroi S E, Rhee D J. Shield's Textbook of Glaucoma.6th ed. Wolter's kluwer, Lippincot Williams and Wilkins 2011; 25-7.
8 Walker B R, Colledge N R, Ralston S H. Davidson's principles and practice of Medicine.22nd ed Churchill Livingstone Elsevier 2013; 117-9.
9 Yoshida M, Ishikawa M. Association of Lifestyle with Intraocular pressure in middle aged and older Japanese residents. Jpn J Ophthalmol 2003; 47: 191-8.
10 Zafar D, Malik R, Ahmed I. Corelation between body mass index and intraocular pressure in adults,Gomal Journal of Medical Sciences. January-june 2010; (1).
11 Pai S, Pai S, Pai A, Ramaswamy C, Kini R D. A Corelative Study of BMI and Non-Diabetic South Indian Population. Thai journal of physiological sciences. 2008; 21 (2).
12 Klein B E, Klein R, Linton K L. Intraocular pressure in an American community. The Beaver Dam Eye Study. Invest ophthalmol Vis Sci. 1992; 33 (7): 2224-8.
13 Tielsch J M, Katz J, Quigley HA,et al. Diabetes, Intraocular Pressure and Primary Open Angle Glaucoma in Baltimore Eye Survey. Ophthalmology 1995; 102: 48-53.
14 L M Weigh, B N Mukesh, C. A. Mc Carty, et al. Taylor. Association of Demographic, Familial, Medical and Ocular Factors with Intraocular Pressure Arch Ophthalmol. 2001; 119 (6): 875-80.
15 Mitchell P, Smith W, Chey T, Healey P R. Open angle glaucoma and diabetes: the Blue Mountains eye study, Australia. Ophthalmology.1997; 104 (4): 712-8.

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Table 1: 78.26% males (n=90) and 21.73% females (n=25) giving a male to female ratio of 3.6:1.

Sex	Number	Percentage
Male	90	78.26%
female	25	21.73%
Total	115	100%

Table 1: sex distribution

Table 2: Mean age being 44.34 years +/- 11.75 years.

Age	Male	Percentage	Female	Percentage	Total	Percentage
21-30	13	14.4	6	24	19	16.5
31-40	22	24.4	3	12	25	21.7
41-50	23	25.6	7	28	30	26.1
51-60	**25**	**27.8**	**9**	**36**	**34**	**29.6**
61-70	6	6.7	0	0	6	5.2
70-80	1	1.1	0	0	1	0.9
Total	**90**	**100**	**25**	**100**	**115**	**100**

Table 2: Age and sex distribution

Table3: BMI was in the acceptable range in34.8%(n= 40), 44.3%(n=51) were overweight, 20% (n=23) were obese.

BMI	Frequency	Percentage
<18.5(underweight)	1	9
18.5-24.9(normal)	40	34.8
25-29.9(overweight)	51	44.3
30-39.9(obese)	23	20
>40(morbidly obese)	0	0
Total	**115**	**100**

Table 3: BMI frequency

Table 4: Overweight was observed in 46.66% males (n=42) and 36% females (n=9).

BMI	Male	percentage	female	percentage	Total	percentage
<18.5	1	1.1	0	0	1	0.00
18.5-24.9	31	34.4	9	36	40	34.7
25-29	42	46.6	9	36	51	44.3
30-39.9	16	17.7	7	28	23	20.0
Total	**90**	**100**	**25**	**100**	**115**	**100**

Table 4: BMI and sex distribution

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Table 5: Maximum number of overweight subjects 55.88% (n=19) were in the age group of 51-60 years and maximum number of obese subjects 28% (n=7) were in the age group of 31-40 years.

Age			BMI							
	<18.5	**%**	**18.5-24.9**	**%**	**25-29.9**	**%**	**30-39.9**	**%**	**total**	**%**
21-30	1	100	9	22.5	6	11.8	3	13.0	19	16.5
31-40	0	0	9	22.5	9	17.6	7	30.4	25	21.7
41-50	0	0	9	22.5	15	29.4	6	26.1	30	26.1
51-60	0	0	9	22.5	19	37.3	6	26.1	34	29.6
61-70	0	0	3	7.5	2	3.9	1	4.3	6	5.2
>70	0	0	1	2.5	0	0	0	0	1	0.9
Total	**1**	**100**	**40**	**100**	**51**	**100**	**23**	**100**	**115**	**100**

Table 5: BMI and age distribution

Table 6: Out of the 23 obese subjects, 82.6%(n=19) %) had IOP> 21mmHg and17.4%(n=4) had IOP < 21mmHg , with p value 0.000 which is statistically significant.

BMI	mmHg	IOP	mmHg			
	<21	**percentage**	**>21**	**percentage**	**total**	**Percentage**
<18.5	1	100	0	0	1	0.86
18.5-24.9	37	92.5	3	7.5	40	34.7
25-29	41	80.4	10	19.6	51	44.3
30-39.9	4	17.4	19	82.6	23	20
	83	100	32	100	115	100

Table 6: BMI and IOP distribution

Table 7: Mean IOP amongst diabetics was 18.45mmHg +/- 3.8 mmHg and amongst non-diabetics was 19.16 mmHg +/- 3.92 mmHg with p value 0.092 which was statistically not significant.

	BMI	N	Percentage	Mean IOP
DM	18.51-24.9	10	32.2	17.00
	25-29	13	41.9	17.26
	29.1+	8	25.8	22.18
	Total	**31**	**100**	**18.45**
ND	<18.5	1	0.01	15.50
	18.51-24.9	30	35.7	17.15
	25-29	38	45.2	19.01
	30-39.9	15	17.8	23.83
	Total	**84**	**100**	**19.16**

Table 7: IOP in DM v/s non-DM distribution

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