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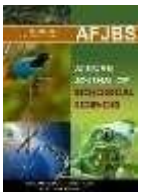

A study highlighting the changes in Intraocular Pressure with the effect of Body Mass Index among healthy adult males

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Abstract:
To assess the possible correlation between the body mass index and intraocular pressure (IOP) among healthy adult males in tamilnadu population.
Methodology: This observational study includes 150 healthy adult males among the age group of 15 to 40yrs without any systemic illness and ocular pathology. Among them height and weight of the subjects were measured with the help of stadiometer and weighing machine and BMI calculated (Kg/m2). Intraocular pressures of both eyes were noted using noncontact tonometer in sitting posture. Data were collected and entered in Microsoft excel sheet 2010 for further statistical analysis.
Results: The average age of these study participants was 27.1 ± 6.87 years with the mean BMI of them was 24.71 ± 3.02 kg/m2.The mean IOP of both eyes i.e. RE 14.87 ± 2.4 mmHg and LE 14.72 ± 2.6 mmHg shows significant positive correlation with BMI by Pearson Correlation (p=0.017*) (p=0.177) for right eye and left eye respectively.
Conclusion: IOP shows positive and significant correlation with BMI of healthy adult male individuals without any co-morbidities.

Keywords: Intraocular Pressure (IOP), Body Mass Index (BMI), Non-Contact Tonometer, glaucoma

Introduction:

In spite of various technological advances in diagnosis and treatment of human diseases, certain diseases have been a challenge to the medical fraternity eluding early diagnosis, hence resulting in eventual dreadful complications. These diseases typically develop very slowly and symptoms may not occur for years after the disease starts. Among these diseases, Glaucoma is a forerunner in causing irreversible blindness in India. It is said to be “Silent killer of vision”and it accounts for 10% blindness among adult population worldwide(Quigley & Broman, 2006)

The proportional increase of glaucoma in India confronts the economic, medical and social welfare of the concerned population. Intraocular pressure, the major determinant of Glaucoma is influenced by multitude of factors with obesity being the prime contributing factor. Further, numerous studies have also established that there exists a positive correlation between obesity and glaucoma. Increased BMI may be due to excess intraorbital fat tissue , an increase in epidural venous pressure and subsequentdecrease in outflow facility (De Albuquerque et al., 2013)

Obesity also known as“globesity” isconsidered to be the modern pandemic globally by WHO(Uccioli et al., 1994). The regulation of IOP is dependent on rate of aqueous formation, rate of outflow and episcleral venous pressure. Obesity contributes by excess intraorbital fat tissue and increase in epidural venous pressure. It effectuates the outflow resistance in episcleral vein by increasing blood viscosity by increasing red cell count, hemoglobin and hematocrit.Further obesity also increases the risk factor of diabetes and hypertension which also influence the IOP (Kohli et al., 2014). Yet in the

strong physiological arena, some epidemiological studies have examined the possible relation between BMI and IOP, but the association remains elusive and incomplete.In case of positive correlation by this study, intraocular pressure can be reduced by simple lifestyle modification and thereby the progression of glaucoma to blindness can be prevented.

Materials & Methods:

Type of study: Cross sectional study

Ethics:The study was performed with fulfillment of the ethical principles mentioned in declaration of Helsinki, which are with proper clinical practice and with suitable regulatory requirements.The institutional ethics committee (Chettinad Academy of Research & Education)approved the conduct of study.

Methodology:Thisstudy involved study 150 healthy adult males of age group 15 to 40 years and they were selected from the persons accompanying the outpatients department fulfilling our criteria with the help of self-designed questionnaire after getting their informed consent. The study participants were explained in detail about the nature and purpose of study in their regional language. Participant Information sheet were provided and queries if any were clarified. Informed consent was obtained from willing participants in written form. Study participants with co-morbidities like diabetes, hypertension, cardiovascular diseases and other ocular disorders including refractive errors were excluded from the study. Besides, those with habit of smoking, alcohol and any drug intake were also refrained from participation.

The height and weight of the subjects were recorded using stadiometer and weighing machine from which their BMI calculated (calibrated to the standard) from which BMI was calculated i.e. weight in kilogram/ height in meter square (Kg/m2).Then the intraocular pressure of both eyes were measured using noncontact tonometer with subjects in sitting posture. Data were entered in Microsoft excel sheet 2010 for further statistical analysis.

Statistical Analysis:

After data collection in Microsoft excel sheet 2010 consistency was checked and Statistical analysis was done using SPSS Software version 21.Mean of BMI and IOP of both eyes were calculated and they are subjected to Pearson correlation.

Results:

The study was conducted among 150 healthy male participants from 18 years to 40 years with average age of 27.1 ± 6.87 years. The BMI of these individuals varied from 15.94 – 32.66 kg/m2 with the mean BMI of 24.71 ± 3.02 kg/m2.The mean IOP of RE 14.87 ± 2.4 mmHg (Range 8-21mmHg) and LE 14.72 ± 2.6 mmHg (Range 9-25 mmHg).There was no statistical difference in the IOP of RE and LE (p=0.302).Table 1 and 2 shows the significant correlation in the mean of right and left eye IOP with BMI which was plotted in figure 1 and 2 respectively.

Table I*: Correlation of BMI with mean IOP - Right eye - significant at the 0.05 level (2-tailed)

		BMI	Mean IOP RE
BMI	Pearson Correlation	1	.185*
	Sig. (2-tailed)		.023
	N	150	150
mean=14.87	Pearson Correlation	.185*	1
	Sig. (2-tailed)	.023	
	N	150	150

Table II: Correlation of BMI with mean IOP - Left eye

		BMI	Mean IOP LE
BMI	Pearson Correlation	1	.099
	Sig. (2-tailed)		.230
	N	150	150
mean=14.72	Pearson Correlation	.099	1
	Sig. (2-tailed)	.230	

N	150	150

Figurel: Correlation of BMI with mean IOP – Right Eye

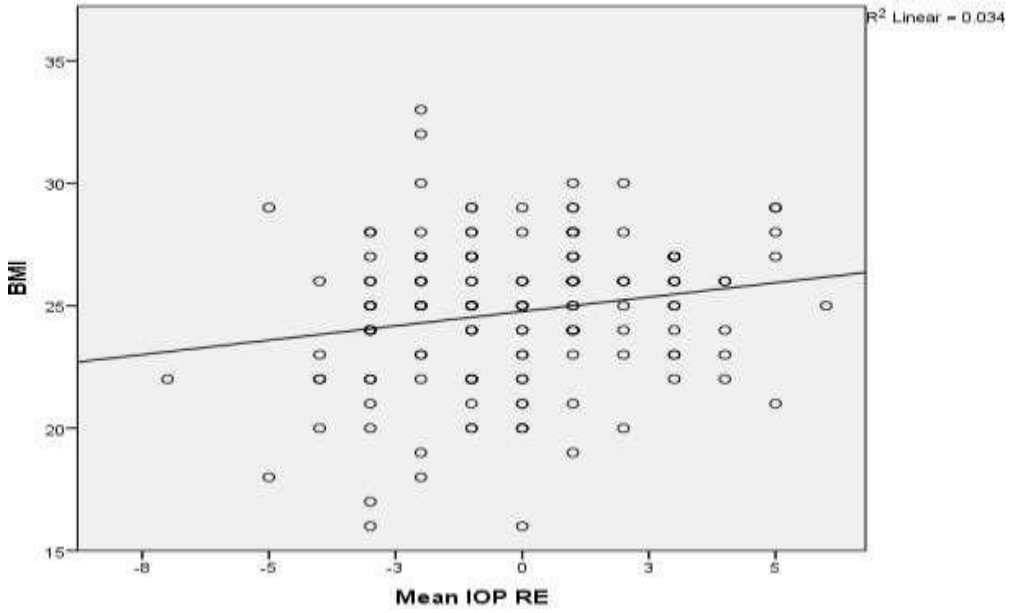
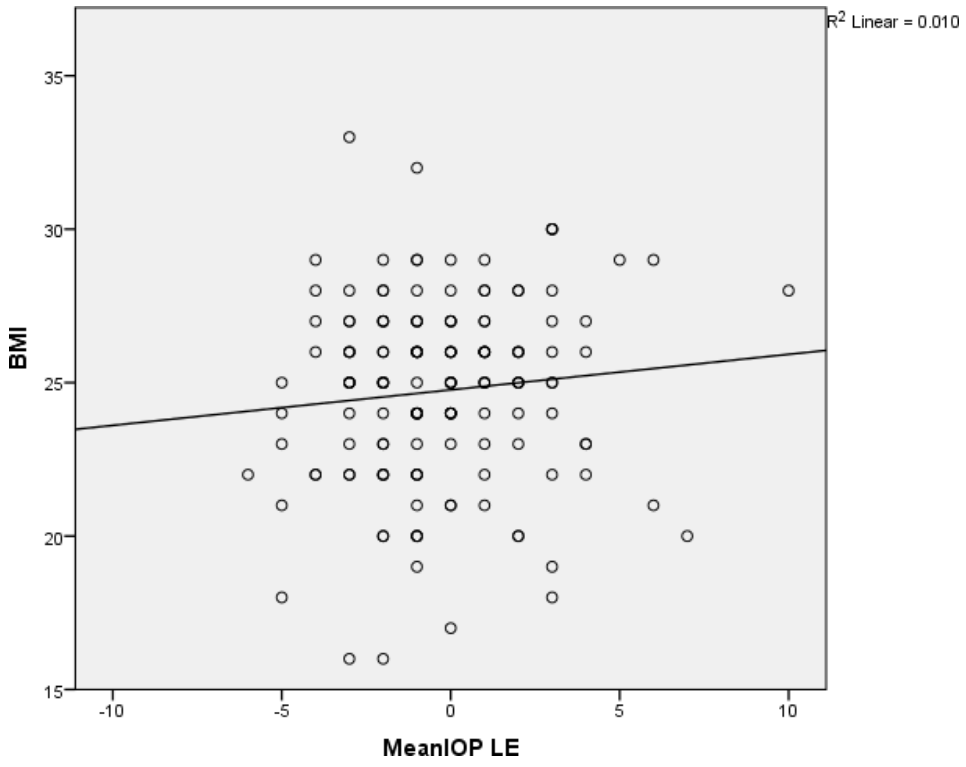


Figure II: Correlation of BMI with mean IOP – Left eye



Discussion:

The present study shows the association of BMI and intraocular pressure which was positively correlated. Obesity places a large burden on health care considered as a common and preventable disease and it is a major risk factor for the development of various non- communicable disease which leads to premature death (Warkentin, 2005). Though various studies reported the Influence of BMI on intraocular pressure were analyzed in various previous studies (Lee et al., 2002)(Bulpitt et al., 1975), this study being the first of its kind was exclusively done on normal healthy males of age group 15 to 40 years of age. The rationale behind involving only male participants is due influence of sex hormones over IOP during menstrual cycle, pregnancy and menopause. Studies have shown the variation of intraocular pressure in different phases of menstrual cycle and one such study reported an increase in intraocular pressure during luteal phase of menstrual cycle(Pai & Pai, 2004).

It has been also stated that intraocular pressure seems to be increased in post-menopausal women in Nigerian populations (Berhane et al., 2011).
This study also eludes persons with diabetes, hypertension and other ocular pathology. The persons with diabetes have greater risk for developing primary open angle glaucoma; they tend to have higher intraocular pressure when compared to non-diabetics(Berhane et al., 2011).The subjects with the personal history of smoking & alcohol intake were also excluded from the study as Influence IOP and we also asked the subjects to refrain from coffee or caffeine intake at least half an hour prior to this procedure. It has been shown that a typical cup of coffee causes increase in intraocular pressure by 1-4 mm of Hg which will last for about 90 minutes(Jiwani et al., 2012).
So this present study recorded the baseline IOP of both eyes without any confounding factor which influences IOP other than BMI. BMI is the estimation of body fat and it is a good gauge for the development of many diseases .It also acts as a risk factor for cardiac disorders like hypertension, elevated serum cholesterol and blood glucose which increase the blood viscosity. Increased Blood viscosity further reduces the aqueous flow resulting in increased IOP. Corticosteroid secretion is increased in obese person; perhaps this explains the association between IOP and BMI (Klein et al., 1992).IOP increases gradually with age and it was significantly higher in males than females and also shows positive correlation with BMI(Kumar et al., 2016).
Obesity acts as an independent risk factor for both increase in IOP and systemic BP that affects the ocular perfusion. Increase in IOP can reduce the risk of glaucoma in young obese adults, nevertheless long term effects of hypertension on blood vessels again provoke the risk for glaucoma(Rajalakshmi R., 2015). High Waist hip ratio can increase the risk for raising the IOP in both males and females(Baisakhiya et al., 2016).Butone study showed there is no correlation between BMI and IOP in case of children(De Albuquerque et al., 2013).Anyway we have to consider age because the risk of developing glaucoma increases with age due to increase in the thickness of crystalline lens and increase in the other associated systemic diseases like diabetes, hypertension etc. Depth and volume of the anterior chamber decreases with age predisposing to angle closure glaucoma.
BMI includes two main factors i.e. height and weight, increase in weight independently has more influence in raising the IOP than height. Males normally have more height and weight when compared to females so they have more influence on IOP(Iqbal et al., 2019). Further, it has also been reported that BMI increases progressively with age upto 60 years and declines thereafter. One study shows a strong correlation of BMI and IOP in both sexes among adult population(Zafar et al., 2010) and also BMI as an independent risk factor for affecting IOP and resulting in systemic hypertension and glaucoma(Kadu et al., 2018)(George, 2015).
Our study had participants whose BMI varied from 15.94 – 32.66 kg/m2 with mean value of 24.71 ± 3.02 kg/m2. The mean IOP of both eyes i.e. RE 14.87 ± 2.4 mmHg and LE 14.72 ± 2.6 mmHg positively correlated with the BMI, showed in table 1 and 2.As the BMI increases, IOP also shows significant increase in figure 1 and 2 for both right and left eye. There is no statistical difference in the IOP of RE and LE ($p=0.302$) which was recorded in sitting posture. IOP values in the right eye are slightly higher than the left eye and also IOP values are higher in morning when compare to evening within the normal range and also shows changes due to postural variation(Allingham., n.d.).

Conclusion:

The present study shows the positive correlation between increased BMI and IOP which can provoke the occurrence of glaucoma among young healthy adult males without any co-morbid conditions like hypertension, diabetes, systemic illness or any ocular pathology. Modification of lifestyle is critically important in the prevention of obesity and thereby to treat or prevent a range of diseases including glaucoma.Lifestyle modifications in the form of simple exercise, diet and periodic screening of intraocular pressure may avoid the development of glaucoma by which we can reduce the medical impact of blindness and can increase the social wellbeing in our society.

Limitations of the study:

The current study was a cross-sectional study; we suggest longitudinal study to see the trend of IOP in both gender with increasing age and also in obese individuals. The positive effect of weight reduction and life style modification need further research.

Declaration of interest: The author(s) report no conflict of interest

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