ORIGINAL RESEARCH PAPER

Ophthalmology

# CORRELATION BETWEEN BODY MASS INDEX AND INTRAOCULAR PRESSURE IN A TERTIARY CARE CENTER

**KEY WORDS:** Body Mass Index, Intraocular Pressure, Glaucoma

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**ABSTRACT**

**BACKGROUND:** To assess the relationship between Intraocular Pressure(IOP) and Body Mass Index(BMI).

**MATERIALS AND METHODS:** 203 subjects of age 30-70 years of either sex are included. BMI was calculated as subject's weight divided by square of height in meters and categorized as underweight (<18.5kg/m2), normal weight(18.5-22.9kg/m2), overweight (23.0-24.9kg/m2) and obese(>25kg/m2). Detailed ophthalmologic examination was done and IOP was measured using Goldmann Applanation Tonometer.

**RESULTS:**203 subjects, 85 males and 118 females. Mean age of males was 61.58 years and females was 57.72 years. Subjects with underweight, normal weight, overweight and obese were 32, 130, 35, 6. The mean IOP among males in right eye and left eye was 13.33 +/- 3.36 mmHg and 13.81 +/- 3.57 mm Hg. The mean IOP among females in right eye and left eye was 13.48+/- 3.35 mmHg and 13.73+/- 3.48 mmHg. The mean IOP of right eye in underweight , normal weight, overweight and obese individuals was 14.08 +/-3.55 mmHg, 13.14+/-3.18 mmHg, 13.57+/-3.86 mmHg and 15.16+/-2.04 mmHg respectively. The mean IOP of left eye in underweight, normal weight, overweight and obese individuals were 14.34+/-3.97 mmHg, 13.56+/- 3.44 mmHg, 13.80+/-3.48 mmHg and 15.00+/-2.68 mmHg respectively.

**CONCLUSION:** Obesity is a risk factor for increased IOP.

## INTRODUCTION:

Glaucoma is defined as a chronic progressive optic neuropathy, with characteristic optic nerve head changes and visual field loss, for which raised intraocular pressure is considered one of the risk factors. It is the second most common cause of bilateral blindness worldwide.[1] Intraocular pressure depends on the rate of aqueous humor production, the resistance to aqueous outflow, and episcleral venous pressure; while raised IOP is mainly due to increase in the resistance to aqueous outflow. IOP varies with a number of factors, including age, sex, position of body, exercise, time of the day, topical and systemic medications, and lifestyle. Obesity is one of the most prevalent disorders in the world and is a risk factor for hypertension, diabetes mellitus type 2, stroke, osteoarthritis.

BMI is one of the most specific measurements of obesity, and increased BMI associated with hyperlipidemia is shown to have a possible correlation with raised IOP. Obesity related to hyperlipidemia might increase IOP due to excess intraorbital fat tissue, leading to an increase in episcleral venous pressure, and a consequent decrease in outflow facility thus predisposing the person to glaucoma.

## AIM:

The aim of the study is to evaluate the relation if any, between body mass index and intraocular pressure.

## MATERIALS AND METHODS:

This is an observational study conducted on 203 subjects, of ages 30-70 years and of either sex, over a period of 1 year from August 2018 to August 2019 at a tertiary care center. Patients with chronic ocular and systemic diseases and those with ocular trauma were excluded from the study. Informed consent was obtained from all the patients.

Intraocular pressure was measured using Goldmann applanation tonometer. Patient's cornea was anaesthetized with 4% xylocaine and stained with fluorescein strips. Necessary adjustments were made so that flattened area with 2 semi circles of equal size are seen in the middle of view. The pressure on the eye is then increased by turning the measuring drum until the inner borders of the 2 fluorescein rings just touch each other. Reading on the measuring drum is multiplied by 10 to get IOP in mmHg. 3 readings were taken and an average was calculated and considered as the final IOP.

Detailed ophthalmic examination was performed for all the cases including visual acuity, examination of anterior segment with a slit lamp and fundus examination using a 90D lens. Body Mass Index was calculated as weight in kilograms divided by the square of height in meters (kg/m2). The patients were categorized as underweight if the BMI was <18.5kg/m2, normal if BMI was 18.5-22.9kg/m2, overweight if BMI was 23.0-24.9kg/$m^2$, and obese if BMI was >25kg/m2 based on consensus guidelines for India. All the data was tabulated and statistically analyzed. A p value less than 0.05 was considered to be significant.

## RESULTS:

203 patients were enrolled in the study. 85(42%) patients were males and 118 (58%) were females. The mean age of males was 61.58 years and females was 57.72 years. Among the 203 patients, 130 were of normal weight, 32 were under weight, 35 were overweight and 6 were obese.

The mean IOP among males in right eye was 13.33 +/- 3.36mm Hg and in left eye was 13.81 +/- 3.57 mm Hg .The mean IOP among females in right eye was 13.48+/- 3.35mm Hg and in left eye was 13.73+/- 3.48mm Hg.

**Table 1: IOP according to sex**

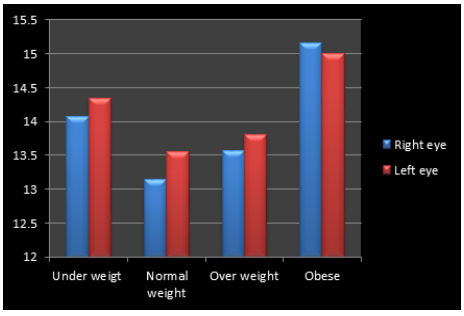
| Sex | Right Eye | Left Eye |
|---|---|---|
| Male | 13.33 | 13.81 |
| Female | 13.48 | 13.73 |

**Table 2: IOP According To BMI**

| BMI | RE | LE |
|---|---|---|
| Under weight | 14.08 | 14.34 |
| Normal weight | 13.14 | 13.56 |
| Over weight | 13.57 | 13.80 |
| Obese | 15.16 | 15 |

The mean IOP of right eye in underweight patients was 14.08 +/-3.5. The mean IOP of right eye in normal weight patients was 13.14+/-3.18mm Hg. The mean IOP of right eye in overweight patients was 13.57+/-3.86mm Hg. The mean IOP of right eye in obese patients was 15.16+/- 2.04mm Hg. The mean IOP of left eye in underweight patients were 14.34+/-3.97mm Hg . The mean IOP of left eye in normal patients was 13.56+/- 3.44mm Hg. The mean IOP of left eye in overweight patients was 13.80+/-3.48mm Hg. The mean IOP of left eye in obese patients was 15.00+/-2.68mm Hg.

A very high correlation was found between mean IOP of both eyes and BMI with p value being <0.001 .




**Graph 1: Relation between BMI, IOP**

## DISCUSSION:

Intraocular pressure is an important component in maintaining structure and function of the eye and increased intraocular pressure leads to glaucomatous optic neuropathy. There are several factors influencing the IOP, of which BMI seems to be one of the risk factors. The results of our study show that there is a positive correlation between Body mass index and Intraocular pressure.

This was supported by several other studies. In a study conducted by Lee JS et al., where the relationship between intraocular pressure (IOP) and obesity was evaluated in a Korean population including 13212 individuals, concluded that there is a positive correlation between BMI and IOP with $p<0.05$[2].

The other studies showing consistent results with our studies include those conducted by Klein[3] and colleagues over 4926 American subjects, Bulpit[4] and colleagues over 573 British subjects. Both the studies concluded that there is significant correlation between BMI and IOP. However, certain factors like age, hypertension, and diabetes mellitus, which are all known risk factors for increased IOP, were not considered in these studies.

Another study conducted by Gelonick[5] and colleagues studied the relationship between intraocular pressure (IOP) and body mass index (BMI) in the seated and supine positions and concluded that higher BMI is correlated with higher IOP in both the seated and supine positions.

The mechanism of rise of IOP was explained by Mori *et al.*[6] who reported that obesity related to hyperlipidemia might increaseIOP due to excess intraorbital fat tissue, leading to an increase in episcleral venous pressure, and a consequent decrease in outflow facility. A few others have suggested that hyperlipidemia might cause increased blood viscosity and consequently increased outflow-resistanceof episcleral veins may result. Many other studies also showed a positive relation between BMI and IOP[7,8,9,10,11].

Thus a positive correlation can be established between BMI and raised IOP, and it cannot be established whether such rise in IOP lead to glaucomatous optic neuropathy; as only a small rise in IOP was seen with large increases in BMI.

Gasser et al[12] in their study found no correlation between BMI and primary open-angle glaucoma (POAG), and other studies observed lesser incidence of glaucomatous nerve damage in obese women. Lowering of BMI by reducing ones weight may result in IOP reductions of similar magnitudes.

Flammer[13] and colleagues explained how increased BMI can cause increased IOP; where vascular dysregulation was considered as the major risk factor for glaucoma. Vascular dysregulation may lead to local vasospasms and disturbed autoregulation of blood flow in the optic nerve head, choroid, and other ocular tissues. However, BMI is associated with vascular atherosclerosis rather than dysregulation. Obesity is also a risk factor for hypertension and arteriosclerosis. Increased blood pressure increases ultrafiltration and IOP[14,15].

Thus higher BMI may increase IOP but not necessarily increase the risk of glaucoma. It is known that glaucoma may occur in subjects with normal IOP, but it does not necessarily have to develop in subjects with increased IOP. Hence we cannot assume a correlation between BMI and glaucoma.

Our study thus allowed us to conclude that obesity per se may be a risk factor for an increase in IOP. However certain major limitations of our study are that the subjects were taken from a selected population that attends an examination center. Our centre is a private institute and is not in reach to the unemployed general population. Furthermore, our study is cross sectional and hence causality cannot be determined.

## CONCLUSION:

Higher BMI is associated with increased IOP and this study highlights the importance of weight control in reducing IOP.

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