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Original Research Article

Comparison of body mass index and intraocular pressure

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ABSTRACT

Background: Raised intaocular pressure is considered as a major risk factor for developing optic neuropathy. Intraocular pressure (IOP) depends on various systemic and local factors and it has been postulated that IOP increases proportionately with increase in systolic blood pressure and increase in degree of obesity. The aim of this study was to compare the Body Mass Index (BMI) and Intraocular Pressure (IOP) in adult population.
Methods: Four hundred ninety nine participants (284 male, 215 female) aged between 20 to 70 years were included in the cross-sectional study. On the basis of BMI subjects were divided into four categories i.e. underweight, normal weight, overweight and obese as per revised body type classification for Indian population recommended by Ministry of Health and Diabetes foundation of India. The mean IOP difference was 14.6±1.8 as compared amongst the four categories.
Results: The participants were divided into six categories according to age and the mean IOP of different age groups was calculated. The changes in the mean IOP of males was 15.8±2.5 mm of Hg and the mean IOP of females was 14.7±2.2 mm of Hg. The results of the current study were statistically significant $p<0.01$.
Conclusions: By concluding the current study as well as in the previous published literature, the findings of the current study were statistically significant. IOP was positively correlated with BMI. However, the clinical significance cannot be confirmed by the minor deviation in the IOP as well as BMI of the participants.

Keywords: Body mass index, Glaucoma, Intraocular pressure

INTRODUCTION

Intraocular pressure (IOP) is the pressure exerted over the coat of the eye ball by the intraocular fluids.[1] "The regulation of the intraocular pressure is usually dependent upon certain factors such as rate of aqueous formation (F), rate of outflow(C) and episcleral venous pressure (Pv) and these factors are related to each other by Goldman equation i.e. IOP = F/C + Pv."[2] Apart from the IOP, Body Mass Index (BMI) is a different term that measures the body fat which further depends upon the weight and height of the person.[3] In terms of the ocular diseases, the explanation of the association of these factors such as IOP and BMI is still uncertain.[4] Elevated IOP and BMI are also considered as the key risk factors in causing ocular diseases such as glaucoma.[5]

Glaucoma is the second leading cause of irreversible blindness after cataract.[1] In India, approximately more than 12 million people are affected by the glaucoma alone.[6] This disease is usually classified into several categories with commonest and most epidemic one being primary open angle glaucoma (POAG).[7] Primary open angle glaucoma can be induced due to multiple factors such as changes in IOP, BMI and diabetes etc.[8] The development and progression of open angle glaucoma has

been linked with increase in IOP.[7] Studies done on western population have strongly suggested a positive relation of age with IOP, and moreover some epidemiological studies have examined the relationship between BMI and IOP as well.[3] Also, a lot of studies has shown obesity as a risk factor for inducing the hypertension among the old age group.[9] IOP being a risk factor for glaucoma can be modified by contemporary intervention and if detected early and treated appropriately, its progression and blindness can be prevented.[10]

Hence, by effectively observing the previously published literature concerning this project, this study will help in future to determine the active nature of the factors responsible for the sight threatening glaucoma.

METHODS

The study was conducted at the department of ophthalmology, Maharishi Makandeshwar Institute of Medical Sciences and Research at Maharishi Markandeshwar Deemed to be University, Mullana, Ambala, India, from August 2017 to July 2018. Ethical approval for the research was granted through the M. M. Institute of Medical Sciences and Research. Prior to taking part in the study, participants were issued with a Participant Information Sheet and they were provided with the opportunity to ask questions regarding the study. Written consent was obtained from the willing participants by signing a copy of the Consent Form. The results obtained from the study were explained to the participants following with the anonymity and confidentiality of the results. 499 participants (284 male, 215 female) aged between 20 to 70 years were included in the study. Based on BMI subjects were divided into four categories i.e. underweight, normal weight, overweight and obese.

Classification of BMI according to the body weight

The BMI classification were analyzed by classifying the body weights into various groups using Quetelet's Index as per WHO guidelines. The BMI in the four categories (Table 1) were as follows:

Table 1: Classification of BMI.

Category	Range
Underweight	BMI <18.5 kg/m^2
Normal weight	BMI 18.5-22.9 kg/m^2
Overweight	BMI 23-24.9 kg/m^2
Obese	BMI >25 kg/m^2

Inclusion criteria

- Physical examination of subjects included measurement of height (in meter) and measurement of weight in (kilogram) between the age group of 20-70 years.
- Height and weight were recorded in standing position with light clothes without shoes.
- The ocular examination included visual acuity, slit lamp biomicroscopy and examination of optic disc using direct ophthalmoscope.
- Goldmann Applanation tonometer mounted on a slit lamp was used to check the Intraocular pressure.

Exclusion criteria

- Patients having any chronic systemic or ocular diseases.
- Patients on any chronic systemic or ocular medication.
- Family history of diabetes, hypertension and glaucoma.
- Age >20 years and <70 years.
- Patients who have undergone any ocular surgery.
- Patients having any past ocular trauma history.
- Subjects having any ocular genetic effect e.g. Coloboma.

The patients with inclusion criteria were subjected to detailed history including name, age, sex, occupation and habits. Along with the patient's general history, any past illness and chronic medication history was obtained. Family history of diabetes, hypertension and glaucoma were excluded. A detailed ocular examination with best corrected visual acuity using Snellen's chart, slit lamp bio-microscopy and fundus examination was performed using a +90.00 D Volk lens and direct ophthalmoscopy, and intraocular pressure measurement were done by using applanation tonometer. BMI was calculated by using Quetelet's index i.e. Weight (in Kg)/(Height (in m))^2.

All the tests were performed under strict sterile conditions. The patient was seated comfortable with the chin placed over chinrest. A sterile fluorescein strip was touched at the sclera and the patient was asked to blink in order to uniformly distribute the dye over the ocular surface. Under the cobalt blue light filter of the slit-lamp, the assembly was advanced towards the eye till the bi prisms met the cornea. The mires were observed monocularly by the observer at low power in form of two semicircles. Keeping the prism in same position the tension knob was rotated till the inner borders of the mires just touch each other. The reading obtained in grams was multiplied by 10 to obtain IOP in mm Hg. To avoid the effect of diurnal variation the recordings were done between 9am to 11am. The mean of three successive readings was taken to avoid the observation error.

Results were presented as Mean±SD and range values. T test and one-way ANOVA (Analysis of variances) were used for correlating the both variables. Pearson correlation and regression analysis were performed to assess the co-relationship between different variables. P

value of 0.05 or less was considered statistically significant

RESULTS

Total 499 patients (284 males and 215 females) were included in the study. The participants were divided into six categories according to age i.e. 19-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, and 70-79 years. In the age group of 19-29 years there were 89 females and 91 males. In the age group of 30-39 years there were 31 females and 42 males. In the age group of 40-49 years there were 44 females and 49 males. In the age group of 50-59 years there were 28 females and 54 males. In the age group of 60-69 years there were 20 females and 39 males. In the age group of 60-69 years there were 20 females and 39 males. In the age group of 70-79 there were 3 females and 9 males (Figure 1).

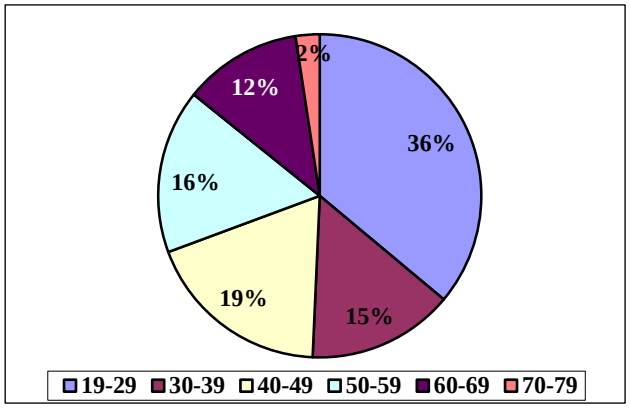

Figure 1: The percentage of participants according to age.

According to BMI the participants were divided into four groups. Underweight with BMI <18.5kg/m^2, Normal weight with BMI 18.5 to 22.9kg/m^2, overweight with BMI 23 to 24.9kg/m^2, and obese with BMI >25 kg/m^2.

Table 2: IOP according to the age groups.

Age Group	No	Mean IOP±SD (mmHg)	Minimum IOP (mmHg)	Maximum IOP (mmHg)
19-29	180	14.6±1.8	10	19
30-39	73	15.8±2.5	11	22
40-49	93	15.5±2.2	11	21
50-59	82	15.9±2.6	10	22
60-69	59	16.1±3.2	11	26
70-79	12	15.9±3.2	10	21

The mean IOP of age group 19-29 year was 14.6±1.8mm of Hg. The mean IOP for age group 30-39 years was 15.8±2.5mm of Hg. The mean IOP of the age group 40-49 years was 15.5±2.2mm of Hg. The mean IOP for the age group 50-59 years was 15.9±2.6mm of Hg. The mean IOP for the age group 60-69 years was 16.1±3.2mm of Hg. The mean IOP for the age group 70-79 years was 15.9±3.2mm of Hg (Table 2). The mean IOP of males was 15.8±2.5mm of Hg and the mean IOP of females was 14.7±2.2mm of Hg.

Relationship of IOP with BMI

The mean IOP of underweight group was 14.1±2.4mm of Hg. The mean IOP of normal weight group was 14.6±2.1mm of Hg. The mean IOP of overweight group was 15.3±2.2mm of Hg. The mean IOP of obese group was 16.6±2.6mm of Hg (Figure 2).

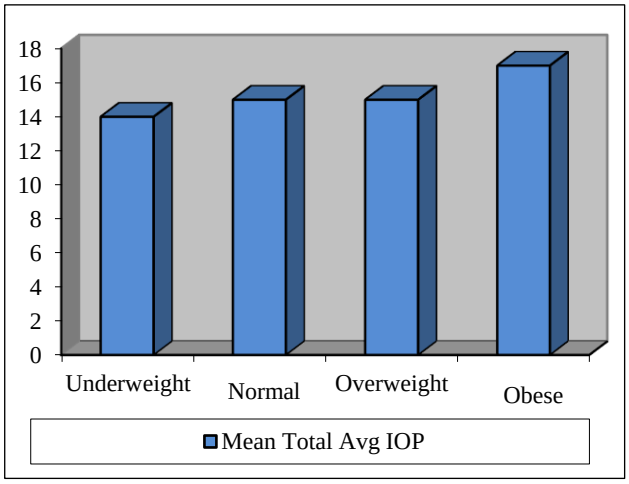

Figure 2: Mean IOP and BMI.

Statistical comparison of IOP in groups according to BMI

The IOP increased with BMI among the four groups i.e. IOP was positively corelated with BMI. The IOP was compared between the groups and within the groups applying ANOVA (Table 3) and the change was found to be significant p<0.01.

Table 3: Statistical comparison using analysis of variance (ANOVA).

	Sum of squares	Df	Mean square	F	Sig.
Between groups	457.164	50	9.143	1.783	0.01
Within groups	2296.719	448	5.127		
Total	2753.883	498			

Table 4: Correlation between total average IOP and BMI using Pearson's correlation coefficient.

		Total average IOP
BMI	Pearson's correlation	0.31
	significance	0.001

The correlation between total average IOP and BMI was calculated using Pearson's correlation coefficient (Table 4). A positive correlation of .31 was found which was statistically significant p<0.001.

DISCUSSION

The previous literature has shown lack of strong evidences regarding the effect of age, sex, weight and body mass index over IOP.[11,12] The relationship of IOP with the systemic parameters need a special concern as raised IOP is the only modifiable risk factor for glaucoma.[13] The development of optic nerve damage and visual field defects are more likely associated with the raised IOP.[14] Most of the available data about prevalence of glaucoma in India is from the south and the north India.[15] However limited data is available from north India.[15] The high rate of blindness due to glaucoma in the Indian population is due to the high proportion of undiagnosed associated risk factors in the Indian community.[16] Therefore, according to this study factors which affect IOP are of great importance in understanding the pathogenesis of the disease and reducing the burden of blindness.[8]

Relationship of IOP with BMI

Results has shown the significant hike in IOP with increasing BMI. Several diseases such as diabetes, hypertension and age-related macular degeneration are directly linked with the obesity and BMI.[17] Some eye diseases like cataract, glaucoma, diabetic retinopathy, and age related macular degeneration were reported to have potential relation to obesity along with a considerable number of patients with glaucoma, progressive damage continues despite intraocular pressure (IOP) reduction with treatment.[16] Besides the increased IOP, there are several other factors associated with glaucoma progression such as neurotoxicity, reduced ocular blood flow, ocular vascular dysregulation and changes in systemic blood pressure.[9] Obesity possesses an increased risk for both elevated IOP and systemic vascular abnormalities such as hypertension and arteriosclerosis.[9] Therefore, obesity may play a role in glaucoma progression through elevated IOP and vascular dysregulation.[3] Body mass index (BMI) is one of the most specific and objective measurement to define obesity.[1]

CONCLUSION

Thus, in conclusion, by observing every single parameter in the current study as well as in the previous published literature the findings of the current study were statistically significant. However, the clinical significance cannot be confirmed by the minor deviation in the IOP as well as BMI of the participants. Further effective and extendable research is necessary to conclude the clinical significance of the IOP and BMI in glaucoma.

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Ethical approval: The study was approved by the Institutional Ethics Committee of M. M. Institute of Medical Sciences and Research, Mullana, Haryana, India

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