Original Article

Correlation Between Body Mass Index and Intraocular Pressure in Adults: A Cross-Sectional Study

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ABSTRACT

Objective: To evaluate the correlation between BMI and IOP in adults at a tertiary care Hospital in Peshawar.
Study Design: A cross-sectional study.
Place and Duration of Study: This study was conducted at the Ophthalmology Unit Hayatabad Medical Complex Peshawar, from 1st February 2024 to 31st January 2025.
Methods: This was a cross-sectional study, performed over 12 months, involving 79 adult patients attending the Ophthalmology Outpatient Department. Subjects with ocular disease, systemic conditions that may affect IOP, and those taking medications that might affect BMI or IOP were excluded. BMI was classified based on WHO norms and IOP was assessed using Goldmann applanation tonometry. Pearson correlation and linear regression were performed to analyze the relationship between BMI and IOP.
Results: Mean height of the participants was 1.64 ± 0.08 m, mean weight was 65.18 ± 11.5 kg, mean BMI was 26.1 kg/m², and the mean IOP was 15.8 mmHg. There was a statistically significant positive correlation between BMI and IOP ($r = 0.58$, $p < 0.001$). The overweight (43%) and obese (48.1%) participants had higher IOP values than the participants with normal BMI (8.9%).
Conclusion: This study shows a strong correlation between BMI and IOP, indicating that there is a higher risk of having higher IOP in individuals with higher BMI. With the association of obesity and glaucoma, obesity should be incorporated into ophthalmological care. Ocular hypertension and glaucoma may be detected and prevented at an early age in overweight and obese people through regular IOP screening.

Key Words: Body Mass Index, Intraocular Pressure, Obesity, Glaucoma Risk, Ophthalmic Health, Epidemiology, Goldmann Applanation Tonometry, Ocular Hypertension

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INTRODUCTION

Intraocular pressure (IOP) is a physiological parameter of major importance to maintain the integrity of the eye. It is primarily regulated by the aqueous humor production/drainage ratio via the uveoscleral outflow pathways and trabecular meshwork. Increased intraocular pressure (IOP) has been linked to glaucoma, the primary cause of permanent blindness[1]. Variation in IOP can lead to changes in eye health, and may need to be monitored in persons without glaucoma. Underweight, normal weight, overweight and obesity are typically described in terms of body mass index (BMI), which is a measure based on an individual's weight and height. Since 1975, the prevalence of obesity around the world has more than tripled, making it a significant public health concern[2]. The systemic effects of obesity have come into the spotlight, including cardiovascular disease, metabolic syndrome, and now eye health.

There are a number of studies reporting different results regarding the relationship between BMI and IOP. There is some evidence of a positive relationship, higher BMI associated with higher IOP. This correlation can be explained by several mechanisms, including increased episcleral venous pressure, systemic inflammation, and hormonal changes such as increased cortisol (2015). Other studies, however, have failed to find any association, suggesting that this relationship is complex and needs to be explored more extensively (2018).

Given the increasing load of obesity and aging population in Pakistan, the correlation between BMI and IOP is of special clinical relevance. The presence of modifiable risk factors for higher levels of IOP can help in early intervention strategies and help prevent the development of glaucoma. This topic is of growing

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interest but little local information is available to review this correlation within the Pakistani population.[3-5]

In Pakistan, there are limited studies that have investigated the association between BMI and IOP in adults, particularly in Peshawar. Genetic, environmental and lifestyle factors vary significantly and so there is a need for region-specific data. This study aims to address this gap and investigate the association between BMI and IOP in the adult population of Hayatabad Medical Complex, Peshawar. The outcome will contribute to the existing knowledge base and contribute to clinical practice in the region.

METHODS

This cross-sectional study was conducted at Ophthalmology Unit Hayatabad Medical Complex Peshawar, from 1st February 2024 to 31st January 2025. The study included 79 adult patients (18 years and above) attending the Out Patient Department (OPD) for routine eye examination or for any eye complaint other than IOP or BMI. Patients with any known ocular disease (including glaucoma or uveitis), systemic disease (including diabetes or hypertension) or on any medication that might affect the IOP or weight were excluded to ensure validity of findings.

Sample size of 79 participants was determined by convenience sampling based on the feasibility of data collection within the study period and availability of eligible patients. The inclusion criteria were: adults (18 years or older), and the ability to provide informed consent, with no previous history of eye surgery, trauma, or systemic disease that might affect IOP or BMI. Patients with a history of refractive surgery or eye trauma, pregnant or lactating women, and patients on drugs known to affect IOP or weight were excluded.

Data were collected using a structured proforma, which included anthropometric data such as height and weight, and demographics such as age and gender of participants. The height was taken in cm using a stadiometer, and weight in kg by a calibrated weighing scale. BMI was calculated by dividing height (measured in square meters) by weight (measured in kilograms). The World Health Organization (WHO) database defines underweight as BMI < 18.5 kg/m2, normal weight as BMI 18.5–24.9 kg/m2, overweight as BMI 25–29.9 kg/m2, and obese as BMI > 30 kg/m2. IOP was determined by trained ophthalmologist using Goldmann applanation tonometer. Both eyes were recorded and the average IOP was analyzed for both eyes. To minimize the diurnal variation, IOPs were obtained in the early morning (9:00 AM) and late morning (12:00 PM).

The study was approved by the Institutional Review Board (IRB). All participants were provided their consent in written before study initiation. Confidentiality was always maintained when working with patient information. Data analysis was done using the SPSS 25.0. Demographic and clinical characteristics were summarized using descriptive statistics (Means ± SD), frequencies, and percentages. Correlation between BMI and IOP was analyzed by Pearson correlation test. P values were considered statistically significant if they were ≤ 0.05. After controlling for other relevant variables (age and sex), the association between BMI and IOP was assessed using linear regression analysis.

RESULTS

Mean age was 41.6 ± 12.3 years (ranged 18–65 years). There were 42(53.2%) males and 37 (46.8%) females. According to BMI classification 9 (11.4%) were underweight, 26 (32.9%) normal, 24 (30.4%) overweight, and 20 (25.3%) were obese. The average BMI of the subjects was 26.1 ± 4.8 kg/m². Table-1

Table No. 1: Demographic and Clinical Characteristics

Variable	Mean ± SD / n(%)
Age (years)	41.6 ± 12.3
Male	42 (53.2%)
Female	37 (46.8%)
BMI (kg/m²)	26.1 ± 4.8
<18.5 kg/m²	9 (11.4%)
18.5–24.9 kg/m²	26 (32.9%)
25–29.9 kg/m²	24 (30.4%)
≥30 kg/m²	20 (25.3%)

The mean IOP across all participants was 15.8 ± 2.6 mmHg (range: 11–22 mmHg). The mean IOP in the underweight group was 13.9 ± 2.1 mmHg, in the normal weight group was 14.8 ± 2.3 mmHg, in the overweight group was 16.2 ± 2.5 mmHg, and in the obese group was 17.6 ± 2.4 mmHg. Table-2

Table No. 2: Mean IOP Across BMI Categories

BMI Category	Mean IOP (± SD)
Underweight	13.9 ± 2.1 mmHg
Normal weight	14.8 ± 2.3 mmHg
Overweight	16.2 ± 2.5 mmHg
Obese	17.6 ± 2.4 mmHg
Overall Mean IOP	15.8 ± 2.6 mmHg

Statistically significant positive correlation between BMI and IOP were recorded ($r = 0.58$, $p < 0.001$), indicating that higher BMI was associated with increased IOP levels. Table-3

Table No. 3: Correlation Between BMI and IOP

Variable	Mean ± SD	Pearson's Coefficient (r)	P-value
BMI (kg/m²)	26.1 ± 4.8	0.58	<0.001
Intraocular Pressure (mmHg)	15.8 ± 2.6		

The regression model demonstrated that BMI was an independent predictor of IOP ($\beta = 0.47$, $p < 0.001$), while age ($\beta = 0.12$, $p = 0.29$) and gender ($\beta = -0.08$, $p = 0.41$) were not significantly associated with IOP. Table-4

Table No. 4: Multivariate Linear Regression Analysis Predicting IOP

Predictor Variable	Beta Coefficient (β)	p-value
BMI	0.47	<0.001
Age	0.12	0.29
Gender (Male)	-0.08	0.41

DISCUSSION

The present study revealed that there was a positive significant correlation between the I.O.P and B.M.I among the adult population who visited Ophthalmology Department of Hayatabad Medical Complex Peshawar. The mean IOP values of the participants gradually increased with their categories of BMI, with the highest mean IOP among the obese participants compared to underweight and normal weight participants. As well, Pearson correlation and regression indicated that BMI was an independent predictor of IOP when adjusted for age and gender.[6-10]

Our results corroborate those of several recent reports showing a positive association between obesity and increased IOP. Our results were comparable to those of Tham et al and Chan et al who reported increased IOP in overweight/obese adults in Korea and China, respectively[11,12]. These findings further support the link between higher BMI and elevated IOP in different populations. This consistency further supports the link between raised IOP and overweight or obesity in other population studies.

This association can be understood in a number of ways. The association of excess orbital and abdominal fat with increased episcleral venous pressure, sympathetic overactivity, elevated cortisol level, insulin resistance, and systemic inflammation with reduced aqueous humor outflow by the trabecular meshwork may account for the higher IOP in overweight and obese individuals we studied.[13-15]

In the present study, no significant relationship was observed between age and gender with IOP after adjustment in regression model. Other studies have shown higher IOPs with age while BMI had a greater effect in some recent studies, perhaps because they included different populations, different numbers of subjects, different ethnic groups and/or excluded subjects based on different criteria[16,17]. The exclusion of patients with diabetes and/or hypertension, glaucoma, and medication effect on IOP may have minimized confounding and allowed for the effect of BMI to become more apparent.

Our study showed a moderate positive correlation ($r = 0.58$), which was slightly higher than some previous studies[18]. This could be due to local lifestyle, dietary patterns, low levels of physical activity or increase in obesity prevalence over our population. In addition, the steady increase in mean IOP by BMI category bolsters the notion of a dose-response relationship between BMI and ocular hypertension. This has also been found in Indian and Japanese studies.[19,20]

The results of this study have clinical implications. Other occupational risk factors for glaucoma include high intraocular pressure and obesity can potentially play a role in the development of glaucoma indirectly through this risk factor. The routine eye examination in overweight and obese patients might assist in early detection and prevention of glaucoma-related visual loss. Weight loss and dietary changes might also have a beneficial effect on eye health.

Although these important findings were identified, the study has a number of limitations. The sample size was relatively small, and the sampling method was convenience sampling which made it difficult to generalize the findings. The cross-sectional design also does not allow for causality to be drawn. Furthermore, variables like central corneal thickness, lipid profile and exercise were not evaluated. Further studies are recommended to be conducted in the future with multi-centre, longitudinal follow-up design with larger sample size to assess the relationship between BMI and IOP.

CONCLUSION

BMI and IOP showed a strong positive correlation, suggesting that the two variables had a strong positive association. Because there is a well-documented association between high IOP and an increased risk of glaucoma, treatment of obesity should be a focus in ophthalmologic and primary care. Regular screening for IOP in overweight and obese individuals may aid in early detection and prevention of ocular hypertension and glaucoma. Further studies with larger numbers and longer follow-up is warranted to further clarify this relationship and its clinical implications.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Romaisa Kiran Baloch, Jawad Hamayon
Drafting or Revising Critically:	Rafiq Muhammad, Naz Ullah, Adnan Khan
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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