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A Study Of Ocular Perfusion Pressure Amongst Young Adults In Abia State University, Uturu, Nigeria

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Abstract:
Background: *Ocular perfusion pressure (OPP) represents the pressure difference between arterial blood pressure and intraocular pressure (IOP), playing a critical role in maintaining adequate blood flow to the optic nerve head. While OPP has been extensively studied in older adult populations, data on OPP characteristics and its determinants among young adults remain limited, particularly in sub-Saharan African populations. This study investigated OPP among young adults in Abia State University, Uturu, Nigeria.*
Materials and Methods: *A purposive cross-sectional study was conducted involving 100 young adults aged 18-35 years (45 males, 55 females). Systemic blood pressure was measured using a sphygmomanometer while intraocular pressure was assessed using Goldmann applanation tonometry. Mean arterial pressure (MAP) and ocular perfusion pressure were calculated. Data were analyzed using two-way ANOVA, Pearson correlation, and linear regression at* $p<0.05$.
Results: *The overall mean OPP was 44.0 ± 6.4 mmHg, with mean OPP for the right eye at 44.5 ± 6.3 mmHg and left eye at 43.6 ± 6.7 mmHg. OPP showed a strong positive correlation with MAP* ($r = 0.88$, $p < 0.001$) *and a moderate negative correlation with IOP* ($r = -0.56$, $p < 0.001$). *Variation in OPP across age groups* ($F=1.54$, $p=0.197$) *and gender* ($F=0.42$, $p=0.516$) *was not statistically significant. MAP significantly predicted OPP* ($\beta = 0.70$, $p < 0.001$).
Conclusion: *Ocular perfusion pressure in young adults is significantly influenced by systemic blood pressure and intraocular pressure. These findings support the clinical relevance of OPP as an integrative hemodynamic parameter in young adults. Routine assessment of OPP, particularly in individuals with elevated IOP or systemic vascular abnormalities, may aid in early detection of individuals at risk of ocular perfusion compromise.*

Keywords: *Ocular Perfusion Pressure; Intraocular Pressure; Blood Pressure; Young Adults; Nigerian Population*

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I. Introduction

Ocular perfusion pressure (OPP) is defined as the pressure difference between the arterial blood pressure (BP) and the intraocular pressure (IOP)[1].Ocular perfusion pressure is considered an important determinant of ocular blood flow[1]. The primary role of ocular blood flow is to deliver adequate oxygen and nutrients to the eye, with ocular blood flow regulation adjusting to variations in ocular activity, maintaining a relatively constant ocular temperature and stable retinal perfusion pressure[2]. It is evident that once blood supply to the retina, choroid, or optic nerve head is completely obstructed, severe visual functional damage occurs[3]. Disruption of retinal blood flow has been recognized as a contributing factor in the development of several major causes of blindness[4].

Ocular perfusion pressure can be thought of as the pressure at which blood enters the eye. Mathematically, OPP is defined as the arterial blood pressure minus intraocular pressure. Both of these determinants are dynamic biological parameters. Intraocular pressure varies throughout the day and from day to day. Blood pressure is even more variable, with significant changes throughout each cardiac cycle[5].

OPP refers to the pressure driving blood to the eye; it is the calculated difference between mean arterial blood pressure and IOP. It is an important parameter which determines the perfusion of the optic nerve head. OPP has been linked with glaucoma in many epidemiologic studies. In particular, low OPP has been found to be a risk factor for the development of glaucoma. Both high intraocular pressure and low systemic blood pressure can lead to low OPP[6], which in turn may lead to reduced ocular blood flow and ischemia of the optic nerve head.

A fall in perfusion pressure at the optic disc may be caused by hypotension, vasospasm, or acute blood loss[7]. OPP is an estimate of the local intraocular blood flow, calculated as the difference between the objective values for the diastolic or systolic systemic blood pressure and IOP[7]. A low OPP can impair perfusion of the optic nerve head leading to glaucomatous cupping and visual field loss. As OPP encompasses both systemic BP and IOP, it could be used to evaluate the presence and evolution of open-angle glaucoma better. Understanding the relationship between IOP, systemic hypertension, and OPP can be helpful in assessing the risk factors for the development of open-angle glaucoma[7].

OPP has been suggested as a possible risk factor for the development of primary open-angle glaucoma (POAG)[8]. OPP is an essential factor in maintaining adequate blood flow to the optic nerve and retina. Many epidemiological studies have been done on OPP in relation to older adults. However, limited attention has been given to this study in relation to young adults. Hence the need for this study, to understand the pattern and clinical implication of OPP amongst young adults, which will help in early detection of persons who might be at risk of glaucoma.

The present study aims to determine the ocular perfusion pressure of young adults in Abia State University, Uturu, Nigeria. Specifically, this study seeks to: (1) determine the OPP of young adults;[2] determine the effect of age and gender on OPP;[3] evaluate the relationship between OPP and blood pressure;[4] and determine the association between OPP and intraocular pressure.

II. Materials And Methods

Study Design and Population

This purposive cross-sectional study was carried out at the Optometry Clinic, Abia State University, Uturu, Nigeria, from November 2024 to February 2025. The reference clinic for the research is the Department of Optometry clinic ABSU, where all instruments used for this research purpose were sourced.

Sample Size Determination

A total of 100 participants were recruited for the study using the formula for estimating a single population mean.

Sampling Technique and Procedure

Random sampling was used in which every young adult patient (18-35 years) visiting the clinic had equal chances of being selected. Inclusion criteria were: (1) individuals aged 18-35 years; and[2] individuals who gave their consent. Exclusion criteria were: (1) individuals outside the age bracket; (2) individuals with known cardiovascular diseases; (3) individuals on antihypertensive medications; and (4) individuals with ocular pathologies.

Research Instruments

The following instruments were used: Goldmann applanation tonometer, sphygmomanometer, stethoscope, ophthalmoscope, fluorescein dye, amethocaine 0.5%, and methylated spirit.

Data Collection Procedures

Blood Pressure Measurement: The subject's blood pressure was taken using the sphygmomanometer and stethoscope according to standard protocol [9]. The patient was seated with back support, feet flat on the floor. A properly sized cuff was placed over the patient's arm at heart level. The cuff was inflated 30 mmHg beyond the point where the radial pulse was no longer palpable, then deflated at 2-3 mmHg per second. Korotkoff sounds signified systolic pressure, while cessation indicated diastolic pressure.

Intraocular Pressure Measurement: IOP was measured using the Goldmann applanation tonometer[10]. The patient's eyes were anesthetized using amethocaine 0.5% and fluorescein dye was instilled. The tonometer tip was gently applied to the central cornea and measurements were taken using cobalt blue light. The pressure value was noted in mmHg.

Calculation of Ocular Perfusion Pressure: Mean arterial pressure (MAP) was calculated using the formula: MAP = Diastolic BP + 1/3 (Systolic BP – Diastolic BP). OPP was calculated as: OPP = 2/3 [DBP + 1/3 (SBP – DBP)] – IOP.

Data Analysis Techniques

Data were analyzed using SPSS version 21 at 5% significance level. Descriptive statistics, two-way ANOVA, Pearson correlation, and linear regression were employed.

Ethical Considerations

Ethical approval was obtained from the ethical committee of Abia State University. Informed consent was obtained from all participants. The study followed the Helsinki Declaration principles.

III. Results

Sociodemographic Characteristics

A total of 100 individuals were recruited, with a mean age of 24.0 ± 4.7 years. Participants aged 18–21 years constituted 37.0% (37/100), while those aged 34 and above accounted for 5.0% (5/100). Females represented 55.0% (55/100) and males 45.0% (45/100).

Blood Pressure and Intraocular Pressure Profile

The mean systolic blood pressure was 113.8 ± 9.0 mmHg, mean diastolic blood pressure was 75.3 ± 9.3 mmHg, and mean arterial pressure averaged 88.1 ± 8.0 mmHg. The mean IOP of the right eye was 14.3 ± 3.1 mmHg, while the left eye recorded 15.2 ± 3.5 mmHg.

Ocular Perfusion Pressure

The mean OPP of the right eye was 44.5 ± 6.3 mmHg, left eye 43.6 ± 6.7 mmHg, and overall mean OPP was 44.0 ± 6.4 mmHg.

Table 1: Ocular Perfusion Pressure of Participants

Parameter	Mean	SD	Minimum	Maximum
OPP Right Eye (OD)	44.5	6.3	28	66
OPP Left Eye (OS)	43.6	6.7	29	71
Mean OPP	44.0	6.4	29	68

Effect of Age and Gender

Mean OPP across age groups ranged from 40.0 to 46.1 mmHg. Two-way ANOVA showed no significant effect of age group (F=1.54, p=0.197) or gender (F=0.42, p=0.516).

Table 2: Mean OPP by Age Group and Gender

Variable	Mean OPP (mmHg)	SD	F-value	p-value
Age group			1.54	0.197
18–21	43.4	6.7		
22–25	45.1	5.1		
26–29	46.1	7.8		
30–33	42.0	5.8		
33-35	40.0	5.9		
Gender			0.42	0.516
Female	43.7	6.7		
Male	44.4	6.0		

Correlation Analysis

Mean OPP showed a strong positive correlation with MAP ($r = 0.88$, $p < 0.001$) and a moderate negative correlation with mean IOP ($r = -0.56$, $p < 0.001$).

Table 3: Correlation between OPP and Systemic/Ocular Factors

Variable	Correlation coefficient (r)	p-value
Mean Arterial Pressure	0.88	<0.001
Mean Intraocular Pressure	-0.56	<0.001

Regression Analysis
Mean arterial pressure significantly predicted OPP (β = 0.70, t = 18.10, p < 0.001).

Table 4: Linear Regression Analysis Predicting OPP

Predictor	β	t-value	p-value	95% CI (Lower)	95% CI (Upper)
Mean Arterial Pressure	0.70	18.10	<0.001	0.62	0.77

IV. Discussion

This study investigated ocular perfusion pressure among 100 young adults at Abia State University, Uturu, Nigeria. The participants had a mean age of 24.0 ± 4.7 years, with females constituting 55.0% and males 45.0%. This near equal representation provides a balanced basis for comparing OPP characteristics between sexes.

Ocular Perfusion Pressure of Participants

The overall mean OPP was 44.0 ± 6.4 mmHg. This emphasizes that the population has generally normal OPP values, suggesting adequate ocular blood perfusion in this young adult population. The relatively narrow range of mean OPP values may be attributed to the young age of participants, who are less likely to have systemic vascular compromise.

Similarly, Kim et al. (2020) evaluated ocular perfusion parameters in a cohort of young adults (mean age 23.6 ± 3.8 years) and reported a mean OPP of 44.2 ± 5.5 mmHg[11]. This closely aligns with the present findings. The findings are consistent with Baisakhiya and Verma (2020), who demonstrated that mean OPP in healthy young individuals increases with increasing mean blood pressure and remains within a normal physiological range[12].

Ramya et al. (2018) studied healthy young adults aged 18-21 years and found significant changes in OPP with isometric exercise[13]. Vawda and Munsamy (2021) reported that low OPP may affect retinal thickness and be a risk for optic neuropathy[14].

In contrast, Lee et al. (2022) reported a lower mean OPP of 41.3 ± 7.2 mmHg in adults aged 30-60 years[15], underscoring the relative preservation of ocular perfusion in young adults.

Effect of Age and Gender

The analysis showed no statistically significant effect of age or gender on OPP. This may be attributed to the narrow age range and healthy vascular status expected in young adults. Similar findings were reported by Kim et al. (2020), who noted no statistically significant age effects within young adults[11]. Zhao et al. (2019) documented that in a population with a mean age of 26.8 ± 4.5 years, OPP values clustered tightly with no significant variation by sex[16].

This finding contrasts with Ramya et al. (2018), who reported significantly higher MAP and OPP in males compared to females[13]. The discrepancy may be attributed to differences in body mass index and metabolic profiles.

Relationship with Systemic and Ocular Factors

The strong positive correlation between OPP and MAP (r = 0.88, p < 0.001) is consistent with Baisakhiya and Verma (2020), who reported a strong positive correlation between mean blood pressure and mean OPP[12]. Population-based data from Memarzadeh et al. (2010) showed that low systolic, diastolic, and mean perfusion pressures were associated with a higher prevalence of open-angle glaucoma[17].

The negative correlation between IOP and OPP (r = -0.56, p < 0.001) aligns with existing evidence that elevated IOP compromises ocular perfusion. Raman et al. (2018) demonstrated that lower diastolic OPP was associated with visual field progression in normal-tension glaucoma patients[18]. Liang et al. (2016) reported consistently lower OPP values in primary open-angle glaucoma patients compared with suspects[19].

V. Conclusion

This study demonstrates that OPP in young adults is strongly dependent on systemic blood pressure (r = 0.88, p < 0.001) and moderately associated with IOP (r = -0.56, p < 0.001). Age and gender did not significantly affect OPP in this population. The mean OPP of 44.0 ± 6.4 mmHg indicates that ocular perfusion is generally adequate in young adults.

Recommendations

1. Clinicians should consider measuring OPP in individuals with elevated IOP or systemic vascular abnormalities.
2. Ocular health assessments should be integrated with systemic cardiovascular evaluation.

3. Baseline OPP documentation for young adult patients with family history of glaucoma is recommended.

Limitations

The study was limited by its cross-sectional design, narrow age range, single-point measurements, and sample size which may have limited statistical power to detect age- or gender-related differences.

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