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ASSESSMENT OF COLOR VISION AND STEREOPSIS IN PATIENTS WITH NORMAL TENSION GLAUCOMA PRESENTING AT AL EHSAN WELFARE EYE HOSPITAL

Original Research

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ABSTRACT

Background: Glaucoma is a progressive optic neuropathy and a leading cause of irreversible blindness worldwide, with an estimated 60 million cases in 2010 that rose to nearly 80 million by 2020. It may occur with or without elevated intraocular pressure (IOP) and often remains undetected until late stages. Normal tension glaucoma (NTG), a subtype of open-angle glaucoma, presents unique diagnostic challenges. Early detection through functional assessments such as color vision and stereopsis evaluation is critical for timely intervention and preservation of visual quality.

Objective: This study aimed to determine the impact of NTG on color vision and stereopsis and to identify the type of color vision deficiency most frequently observed in young adults with NTG.

Methods: A cross-sectional study was conducted on 93 NTG patients aged 15–35 years, including 61 males and 32 females, over a period of four months at Al Ehsan Welfare Eye Hospital, Lahore. Patients fulfilling the inclusion criteria underwent visual assessment. Visual acuity was measured with a Snellen chart and recorded in logMAR units. Color vision was analyzed using the Farnsworth D-15 test, while stereopsis was evaluated using the Titmus Fly Test. Intraocular pressure was assessed through applanation tonometry, and cup-to-disc ratio was documented by ophthalmoscopy.

Results: Visual acuity analysis revealed mean values of 0.4153 for the right eye (OD) and 0.4409 for the left eye (OS). Color vision testing of the right eye showed 71 patients (76.3%) normal, 15 (16.1%) deutan deficiency, 5 (5.4%) protan deficiency, and 2 (2.2%) tritan deficiency. In the left eye, 63 patients (67.7%) had normal color vision, 18 (19.4%) deutan deficiency, 11 (11.8%) protan deficiency, and 1 (1.1%) tritan deficiency. Stereopsis ranged between 40 and 200 seconds of arc, with a mean of 91.61 and a standard deviation of ±34.74.

Conclusion: This study demonstrated that NTG impairs functional visual parameters, with deutan deficiency being the most common color vision anomaly and significant stereopsis variability indicating depth perception compromise. Incorporating color vision and stereopsis testing into clinical evaluation may enable earlier diagnosis and enhance targeted management of NTG in young adults.

Keywords: Color Vision Tests, Glaucoma, Intraocular Pressure, Optic Disk, Stereopsis, Visual Acuity, Young Adult.

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INTRODUCTION

Glaucoma is a chronic, progressive optic neuropathy and is recognized as one of the leading causes of irreversible blindness worldwide. It is characterized by optic nerve damage with distinctive cupping of the optic disc, associated visual field abnormalities, and may occur with or without elevated intraocular pressure (IOP) (1). The global prevalence of glaucoma was estimated to affect approximately sixty million people in 2010, with projections suggesting an increase to nearly eighty million by 2020, underscoring its significant public health burden (2). Despite advances in diagnosis and treatment, glaucoma often remains undetected until late in its course, particularly in normal-tension glaucoma (NTG), where IOP remains within the statistically normal range. Delayed recognition of NTG significantly contributes to preventable vision loss, highlighting the necessity for improved screening and early detection strategies (3). Glaucoma manifests in several forms, with primary open-angle glaucoma (POAG) and primary angle-closure glaucoma (PACG) being the most prevalent. Primary glaucoma arises without a known underlying systemic or ocular cause, whereas secondary glaucoma results from identifiable pathological processes such as trauma, systemic disease, or ocular inflammation. Both forms share hallmark features of retinal ganglion cell degeneration, thinning of the retinal nerve fiber layer (RNFL), and progressive optic disc changes that ultimately impair visual function (4,5). Importantly, patients in the early stages of glaucoma may demonstrate discrepancies between preserved central visual acuity and a decline in functional vision, such as difficulty adapting to low-light conditions, impaired depth perception, or early color vision deficits, particularly along the blue-yellow axis (6). NTG, as a subtype of open-angle glaucoma, is distinguished by glaucomatous optic neuropathy and visual field loss occurring despite IOP levels consistently below 21 mmHg, with gonioscopy revealing wide anterior chamber angles (7).

Functional impairment in glaucoma extends beyond visual field constriction and includes alterations in stereopsis and color vision. Patients frequently report visual symptoms such as blurriness, dimness, and difficulty in color differentiation well before overt tunnel vision develops (8,9). Color perception relies on cone photoreceptors sensitive to different wavelengths of light, and its disturbance can be either congenital or acquired. Congenital color vision deficiencies are genetically determined and present from birth, whereas acquired deficits emerge later in life, commonly due to ocular or neurological diseases such as glaucoma (10-12). Acquired dyschromatopsia has been reported in up to one-third of glaucoma patients, with blue-yellow discrimination frequently affected. Stereopsis, the binocular ability to perceive depth from retinal disparities, also deteriorates in glaucomatous patients and has been linked to RNFL thinning and optic nerve damage, impacting daily tasks such as driving, navigation, and reading (13,14). The only proven strategy to slow glaucoma progression remains reduction of IOP, achieved through pharmacological, laser, or surgical interventions (15,16). However, the functional limitations caused by early changes in color vision and stereopsis emphasize that glaucomatous impairment extends beyond IOP alone. A growing body of evidence suggests that incorporating assessments of color discrimination and stereopsis into routine clinical evaluation may enable earlier detection of NTG, thereby preserving visual function and quality of life (17,18). This study was therefore designed to investigate the impact of normal-tension glaucoma on color vision and stereopsis, with a particular focus on identifying which type of color vision deficiency is most frequently associated with NTG in young adults. The objective was to determine whether these functional parameters could serve as sensitive markers for early glaucomatous damage, thereby supporting more timely diagnosis and intervention.

METHODS

This study employed a cross-sectional design to evaluate the impact of normal tension glaucoma (NTG) on visual functions, specifically color vision and stereopsis. Data were collected over a four-month period, from March 15, 2024, to July 15, 2024, at Al Ehsan Welfare Eye Hospital, Lahore. A non-probability convenient sampling strategy was adopted, with a total sample size of 93 participants. The sample size was calculated using a pilot study formula, taking into account an expected frequency of 0.32 obtained from a prior study, a confidence level of 85%, and a precision (d) of 0.07 (1). Participants were selected according to defined inclusion and exclusion criteria. Eligible participants were males and females aged between 15 and 35 years who had been clinically diagnosed with NTG. Exclusion criteria comprised patients with presbyopia, those with any other ocular conditions, systemic diseases such as diabetes, or those on medications known to affect vision. These criteria were strictly applied to ensure that outcomes could be attributed primarily to NTG. Prior to recruitment, all participants were informed about the objectives and procedures of the study in comprehensible

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language, and written informed consent was obtained. Ethical approval for the study was granted by the relevant institutional review board of Al Ehsan Welfare Eye Hospital. Confidentiality of patient information was ensured, and all procedures were performed in accordance with the principles of the Declaration of Helsinki.

Each participant underwent a structured evaluation, beginning with an interview to collect demographic data and medical history. Visual acuity was assessed using the Snellen chart, and results were documented in logMAR units to ensure standardized interpretation. Intraocular pressure (IOP) was measured using an applanation tonometer to confirm the diagnosis of NTG, as only participants with IOP values consistently ≤21 mmHg were included. Fundus examination was performed using an ophthalmoscope to document optic disc appearance. Color vision was evaluated using the Farnsworth D-15 test. Participants were instructed to arrange colored discs in order of similarity, and their performance was assessed for evidence of dyschromatopsia. Stereopsis was measured using the Titmus Fly Test, in which participants, wearing polarized glasses, identified three-dimensional images, including the iconic fly figure and geometric patterns, to determine depth perception. These tools were selected for their reliability and widespread use in clinical ophthalmology. All clinical findings and demographic details were recorded in a pre-designed proforma to ensure systematic data capture. Data analysis was conducted using Microsoft Excel and SPSS version 21. Descriptive statistics, including frequencies and percentages for categorical variables (such as gender) and mean with standard deviation for continuous variables (such as age), were calculated to summarize participant characteristics. Associations between NTG and visual outcomes (color vision deficiencies and stereopsis impairment) were explored using appropriate statistical tests.

RESULTS

A total of 93 patients with normal tension glaucoma were enrolled, comprising 61 males (65.6%) and 32 females (34.4%). The mean age of participants was concentrated in the upper range of the study group. Specifically, 6 participants (6.5%) were aged 15–20 years, 11 (11.8%) were aged 21–25 years, 31 (33.3%) were aged 26–30 years, and 45 (48.4%) were aged 31–35 years, indicating that the majority of patients were in the 26–35 years category. Visual acuity values demonstrated a variable distribution. For the right eye (VAOD), the range was 0 to 1, with a mean of 0.4153 and a standard deviation of 0.34944. Similarly, for the left eye (VAOS), values ranged from 0 to 1, with a mean of 0.4409 and a standard deviation of 0.33207. Color vision analysis revealed that in the right eye, 71 participants (76.3%) exhibited normal color vision, 15 (16.1%) had deutan deficiency, 5 (5.4%) demonstrated protan deficiency, and 2 (2.2%) presented with tritan anomaly. In the left eye, 63 participants (67.7%) had normal color vision, 18 (19.4%) showed deutan deficiency, 11 (11.8%) had protan deficiency, and 1 (1.1%) had tritan anomaly. Stereopsis values ranged between 40 and 200 seconds of arc, with a mean of 91.61 seconds and a standard deviation of ±34.74. The most frequent stereopsis level was 80 seconds of arc, observed in 27 participants (29.0%), followed by 100 seconds in 23 participants (24.7%), 60 seconds in 18 participants (19.3%), and 140 seconds in 15 participants (16.1%). Fewer individuals demonstrated 40 seconds (n=7, 7.5%) and 200 seconds (n=3, 3.2%). The cup-to-disc (C/D) ratio in the right eye ranged from 0.2 to 0.8, with a mean of 0.531 and a standard deviation of 0.1011. In the left eye, the ratio ranged from 0.4 to 0.7, with a mean of 0.613 and a standard deviation of 0.6743.

Intraocular pressure (IOP) values remained within the normal range, consistent with NTG diagnostic criteria. In the right eye, IOP ranged from 12 to 21 mmHg with a mean of 15.305 mmHg (SD 2.5446), while in the left eye, it ranged from 11.4 to 21.3 mmHg with a mean of 15.687 mmHg (SD 2.9338). Comparative analysis of IOP and C/D ratio between individuals with normal color vision and those with color vision deficiencies showed progressive increases in both IOP and C/D ratios across deutan, protan, and tritan subgroups. For example, in the right eye, mean IOP was 14.423 mmHg in participants with normal color vision compared with 17.733 mmHg in deutan, 19.1 mmHg in protan, and 18.95 mmHg in tritan subgroups. Similarly, the C/D ratio increased from 0.506 in normal vision to 0.593 in deutan, 0.64 in protan, and 0.7 in tritan cases. Parallel findings were observed in the left eye, with IOP and C/D ratios higher in participants with color vision deficiencies compared to those with normal color vision. When analyzing the relationship between color vision deficiency, intraocular pressure (IOP), and cup-to-disc (C/D) ratio, a progressive trend was observed across subgroups. Individuals with normal color vision demonstrated a mean IOP of 14.42 mmHg in the right eye and a mean C/D ratio of 0.506. In contrast, participants with deutan deficiency had significantly higher values, with a mean IOP of 17.73 mmHg and a C/D ratio of 0.593. Protan-deficient individuals showed further increases, with a mean IOP of 19.1 mmHg and a C/D ratio of 0.64, while tritan-deficient individuals exhibited the highest values, with a mean IOP of 18.95 mmHg and a C/D ratio of 0.70. This gradient suggests a strong correlation between the severity of color vision impairment and both IOP and optic nerve damage markers, reinforcing the hypothesis that functional vision loss is linked to glaucomatous structural changes.

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Table 1: Age and Gender Distribution of Participants

Age of Patients	Frequency	Percent	Gender	Frequency	Percent
15–20 years	6	6.5	Male	61	65.6
21–25 years	11	11.8	Female	32	34.4
26–30 years	31	33.3			
31–35 years	45	48.4			
Total	93	100	Total	93	100

Table 2: Color Vision Status of Right and Left Eyes in Participants

Color Vision Status	Right Eye Frequency	Right Eye Percent	Left Eye Frequency	Left Eye Percent
Normal	71	76.3	63	67.7
Deutan	15	16.1	18	19.4
Protan	5	5.4	11	11.8
Tritan	2	2.2	1	1.1
Total	93	100	93	100

Table 3: Visual Acuity of participants

Visual Acuity	N	Minimum	Maximum	Mean	Std. Deviation
VAOD	93	1	0	0.4153	0.34944
VAOS	**93**	**1**	**0**	**0.4409**	**0.33207**

Table 4: Stereops is of the participants

Stereopsis Value	N	Minimum (seconds of arc)	Maximum (Seconds of arc)	Mean	Std. Deviation
STVALUE	**93**	**40**	**200**	**91.61**	**34.74**

Table 5: Cup-to-Disc Ratio and Intraocular Pressure of Participants

Parameter	N	Minimum	Maximum	Mean	Std. Deviation
C/D Ratio OD	93	0.2	0.8	0.531	0.1011
C/D Ratio OS	93	0.4	0.7	0.613	0.6743
IOP OD	93	12	21	15.305	2.5446
IOP OS	93	11.4	21.3	15.687	2.9338

Table 6: Comparative Analysis of Cup-to-Disc Ratio and Intraocular Pressure in Right and Left Eyes of Normal and Color Vision Deficient Individuals

Color Vision Status	Eye	N	Parameter	Minimum	Maximum	Mean	Std. Deviation
Normal	OD	71	IOP	12	19.8	14.423	1.8734
	OD	71	C/D Ratio	0.2	0.7	0.506	0.0939
Deutan	OD	15	IOP	12.7	21	17.733	2.6278
	OD	15	C/D Ratio	0.5	0.7	0.593	0.0704
Protan	OD	5	IOP	18	20	19.1	0.8124
	OD	5	C/D Ratio	0.6	0.7	0.64	0.0548
Tritan	OD	2	IOP	16.9	21	18.95	2.8991
	OD	2	C/D Ratio	0.6	0.8	0.7	0.1414
Normal	OS	63	C/D Ratio	0.4	0.6	0.514	0.0564
	OS	63	IOP	11.4	21	14.586	2.3188
Deutan	OS	18	C/D Ratio	0.5	0.7	0.572	0.0826

Color Vision Status	Eye	N	Parameter	Minimum	Maximum	Mean	Std. Deviation
	OS	18	IOP	12	20.4	16.878	2.597
Protan	OS	11	C/D Ratio	0.6	0.7	1.245	1.9096
	OS	11	IOP	13.4	21.3	19.673	2.2419
Tritan	OS	1	C/D Ratio	0.6	0.6	0.6	.
	OS	1	IOP	19.8	19.8	19.8	.

Table 7: Comparative Analysis of Mean Intraocular Pressure and Cup-to-Disc Ratio Across Color Vision Deficiency Subgroups in the Right Eye

Color Vision Status	N	Mean IOP (Right Eye)	Mean C/D Ratio (Right Eye)
Normal	71	14.42 mmHg	0.506
Deutan	15	17.73 mmHg	0.593
Protan	5	19.10 mmHg	0.640
Tritan	2	18.95 mmHg	0.700

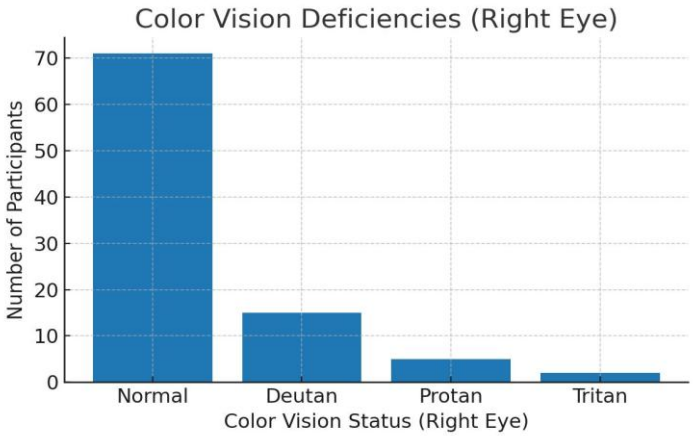

Figure 1Color Vision Deficiencies (Right Eye)

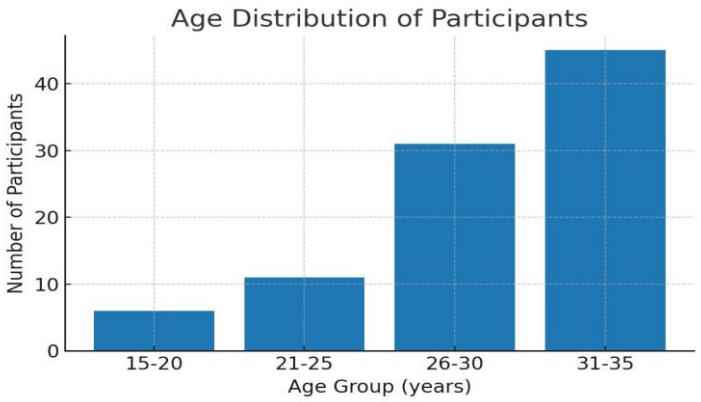

Figure 2 Age Distribution of Participants

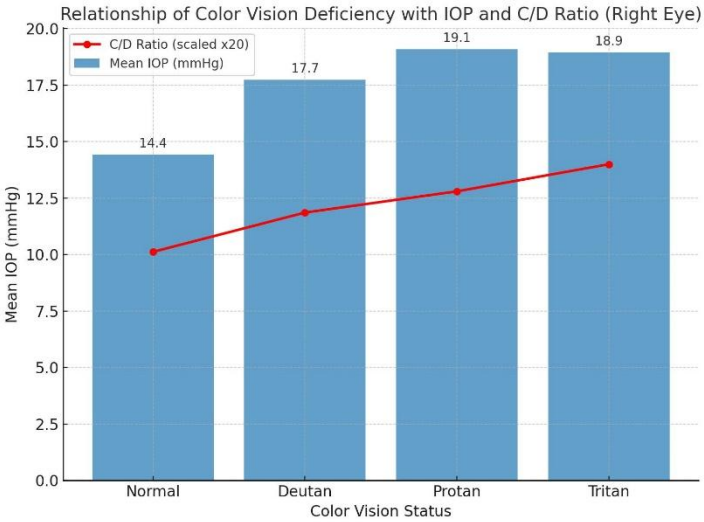

Figure 3 Relationship of Colar Vision Deficiency with IOP and C/D Ratio (Right Eye)

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DISCUSSION

The findings of this study demonstrated that normal tension glaucoma (NTG) significantly affects functional aspects of vision, including color discrimination and stereopsis, even in relatively young adults. The stereopsis range of 40 to 200 seconds of arc with a mean of 91.61 seconds indicated a notable decline in depth perception, reflecting functional compromise despite intraocular pressure values within normal limits. This is consistent with previous research that reported a statistically significant relationship between glaucoma and stereopsis impairment, where most patients exhibited measurable reduction in three-dimensional vision within a defined arc range (1). The present study also observed color vision deficiencies in both eyes, with 23.7% of participants showing defects in the right eye and 32.3% in the left eye. Deutan deficiencies were most frequent, followed by protan defects, while tritan anomalies were least common. These results align with previous evidence that glaucoma, particularly NTG, has a predilection for acquired dyschromatopsia along the red-green axis, although yellow-blue disturbances have also been reported in other studies (19,20). The study corroborates earlier reports that stereopsis declines as retinal nerve fiber layer thickness decreases, even though RNFL thickness was not directly measured here (18). The observed variability in stereopsis may therefore serve as a clinical surrogate for underlying structural damage. Literature has also highlighted that more subtle tests of color discrimination, particularly targeting specific hues, are sensitive in detecting early glaucomatous changes (19). This complements the present study's finding that deutan deficiencies were most prevalent, underscoring the diagnostic utility of detailed color vision assessments in NTG patients.

The comparison with prior research further indicates that NTG patients may not show severe congenital-type color vision loss but are still vulnerable to acquired deficiencies that impact functional vision (20,21). This reinforces the notion that incorporating color vision testing into clinical practice provides valuable insight into early disease processes. The present findings also support previous reports that stereopsis impairment may be a more pronounced and consistent feature of NTG compared to color vision changes, thereby making depth perception assessment a critical component of patient evaluation (22). The observation of stereoacuity within the limits of 40 to 200 seconds, with a central tendency near 91 seconds, complements the wide range of values documented in other studies and confirms that even young patients with NTG experience measurable stereopsis impairment (23,24). The clinical implications of these findings are significant. By demonstrating measurable deficits in color vision and stereopsis, this study emphasizes the need to expand NTG assessment beyond intraocular pressure and visual field testing. Incorporating such functional evaluations into standard practice could enable earlier detection and more tailored management strategies, ultimately preserving visual quality and reducing the burden of irreversible blindness. Furthermore, patient education regarding the potential effects of NTG on daily life activities, such as depth judgment and color-dependent tasks, could enhance adherence to monitoring and treatment.

This study possessed several strengths, including its focus on a younger age group often underrepresented in glaucoma research and its systematic assessment of both stereopsis and color vision. The inclusion of multiple diagnostic tools added robustness to the evaluation of functional impairment. However, limitations must be acknowledged. The use of non-probability sampling reduces generalizability, and the relatively small sample size restricts the power to detect subtle associations. Additionally, the absence of structural measurements such as RNFL thickness and the lack of advanced statistical correlations between stereopsis, visual acuity, and color vision limit the depth of interpretation. Future studies should employ larger, randomized samples and include multimodal imaging alongside functional tests to strengthen the understanding of how NTG compromises visual function. Overall, the study highlights that NTG, despite normal intraocular pressure, contributes to meaningful functional impairment in vision. The consistent finding of stereopsis decline and the prevalence of color vision deficiencies reinforce the importance of incorporating these measures into comprehensive ophthalmic evaluations. Early identification of these changes offers the opportunity to intervene before advanced disease progression, thereby improving long-term visual outcomes and quality of life.

CONCLUSION

This study concluded that normal tension glaucoma in young adults affects critical visual functions, particularly stereopsis and color vision, even when many patients retain near-normal visual acuity. While most individuals preserved normal color perception, notable deficiencies were still observed, emphasizing the importance of monitoring subtle changes. The consistent variability in depth perception highlighted stereopsis as a sensitive functional marker of disease impact. These findings underscore the need for comprehensive ophthalmic evaluations that include both stereopsis and color vision testing, as their integration into routine assessments can enable earlier detection, timely intervention, and more effective preservation of quality of life in patients with normal tension glaucoma.

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AUTHOR CONTRIBUTION

Author	Contribution
Saif Ahsan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Hafiz Muhammad Noman	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Salman Amjad	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Kiran Shakeel Alvi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

REFERENCES

1. Ramamoorthy P, Alexander NL, Frankfort BJ. Abnormal perception of pattern-induced flicker colors in subjects with glaucoma. J Vis. 2022;22(2):5.
2. Michalak KP, Zabel J, Olszewski J, Wojtyła-Buciora P, Przekoracka-Krawczyk A. Application of Blue Filters Increases the Usefulness of Moreland Test in Anomaloscopic Color Vision Assessment for Blue-Green Color Range. Int J Environ Res Public Health. 2021;18(14).
3. Karaconji T, Zagora S, Grigg JR. Approach to childhood glaucoma: A review. Clin Exp Ophthalmol. 2022;50(2):232-46.
4. Kalyani VKS, Dayal A, Chelerkar V, Deshpande M, Chakma A. Assessment of psychosocial impact of primary glaucoma and its effect on quality of life of patients in Western India. Indian J Ophthalmol. 2020;68(11):2435-8.
5. Kato RT, Rolim-de-Moura C, Allemann N. Chromatic vision and structural assessment in primary congenital glaucoma. Sci Rep. 2024;14(1):9551.
6. Azoulay-Sebban L, Zhao Z, Zenouda A, Lombardi M, Gutman E, Brasnu E, et al. Correlations Between Subjective Evaluation of Quality of Life, Visual Field Loss, and Performance in Simulated Activities of Daily Living in Glaucoma Patients. J Glaucoma. 2020;29(10):970-4.
7. Li M, Chen X, Yuan N, Lu Y, Liu Y, Gong H, et al. Effects of acute high intraocular pressure on red-green and blue-yellow cortical color responses in non-human primates. Neuroimage Clin. 2022;35:103092.
8. Sun MT, Tran M, Singh K, Chang R, Wang H, Sun Y. Glaucoma and Myopia: Diagnostic Challenges. Biomolecules. 2023;13(3).
9. Maheshwari D, Ingle I, Tara TD, Ramugade-Shinde S, Pillai MR, Kader MA, et al. Impact of glaucoma on vision-specific quality of life in monocular glaucoma patients using the Indian vision function questionnaire. Indian J Ophthalmol. 2023;71(7):2760-6.
10. Selvan H, Gupta S, Wiggs JL, Gupta V. Juvenile-onset open-angle glaucoma - A clinical and genetic update. Surv Ophthalmol. 2022;67(4):1099-117.
11. Leung DYL, Tham CC. Normal-tension glaucoma: Current concepts and approaches-A review. Clin Exp Ophthalmol. 2022;50(2):247-59.
12. Asrani S, Aggarwal S. Optical Coherence Tomography Findings in Glaucoma With Coexisting Vitamin A Deficiency. J Glaucoma. 2024;33(7):e49-e53.
13. Yüksel N, Yılmaz Tuğan B. Pseudoexfoliation Glaucoma: Clinical Presentation and Therapeutic Options. Turk J Ophthalmol. 2023;53(4):247-56.
14. Kim SW, Go Y, Kang SO, Lee CK. Quantitative visual tests in primary open-angle glaucoma patients according to three different lights with different color-rendering index. BMC Ophthalmol. 2021;21(1):238.
15. Urbonavičiūtė D, Buteikienė D, Janulevičienė I. A Review of Neovascular Glaucoma: Etiology, Pathogenesis, Diagnosis, and Treatment. Medicina (Kaunas). 2022;58(12).
16. Miraftabi A, Coleman AL, Nilforushan N, Parsamanesh M, Nguyen AH, Karimi N, et al. Vision-related quality of life in patients with a history of congenital glaucoma. Eur J Ophthalmol. 2021;31(6):3074-9.

17. Aspberg J, Heijl A, Bengtsson BJAJoO. Screening for open-angle glaucoma and its effect on blindness. 2021;228:106-16.
18. Rehman, S. U., Ullah, R., Imran, M., Iqbal, K., Saleem, Z., & Khattak, S. R. (2021). Intolerance of uncertainty and mental well-being: Important role of loneliness and fear of COVID-19: Evidence from Higher Educational Institutions. Multicult. Educ, 7(1), 147-54.
19. Schuster AK, Erb C, Hoffmann EM, Dietlein T, Pfeiffer N J DÄI. The diagnosis and treatment of glaucoma. 2020;117(13):225.
20. Dhar SK, Raji K, Sandeep S Jmjafi. Study of correlation between stereopsis and retinal nerve fiber layer thickness in cases of glaucoma. 2021;77(1):63-9.
21. Bayer L, Funk J, Töteberg-Harms M JIo. Incidence of dyschromatopsy in glaucoma. 2020;(40):597-605.
22. Rehman, S. U., Ullah, R., Imran, M., Iqbal, K., Saleem, Z., & Khattak, S. R. (2021). Intolerance of uncertainty and mental well-being: Important role of loneliness and fear of COVID-19: Evidence from Higher Educational Institutions. Multicult. Educ, 7(1), 147-54.
23. Khattak, S. R., Saeed, I., Rehman, S. U., & Fayaz, M. (2021). Impact of fear of COVID-19 pandemic on the mental health of nurses in Pakistan. Journal of Loss and Trauma, 26(5), 421.
24. Jang J-U, Choi J-H, Choy Y-J, Lee K-J JTKJoVSV. Binocular Visual Function in Patients with Normal Tension Glaucoma. 2021;23(3):237-45.