A Clinical Study on the Prevalence and Pattern of Glaucoma Among Adults Attending a Tertiary Care Hospital (2019)

Author:
Dr. Abbas Ali Zaidi[1]
Assistant Professor, Department of
Santosh Medical College & Hospital, Ghaziabad, Uttar Pradesh

Dr. Shilpa Taneja[2]
Associate Professor
Department of Ophthalmology,
*Saraswathi **I**nstitute of **M**edical sciences, Hapur, Uttar Pradesh, India*

Abstract

Glaucoma is a chronic, progressive optic neuropathy and one of the leading causes of irreversible blindness worldwide. The disease is often asymptomatic in its early stages and remains undiagnosed until significant optic nerve damage and visual field loss occur. The present hospital-based cross-sectional study was conducted in the Department of Ophthalmology, Saraswati Institute of Medical Sciences, Hapur, during the year 2019, to determine the prevalence, pattern, and associated risk factors of glaucoma among adults. A total of 500 participants aged 40 years and above were examined using comprehensive ophthalmic evaluation, including visual acuity testing, slit-lamp biomicroscopy, intraocular pressure measurement by Goldmann applanation tonometry, gonioscopy, fundus examination for optic disc changes, and automated visual field analysis. The diagnosis and classification of glaucoma were made according to the International Society of Geographical and Epidemiological Ophthalmology (ISGEO) criteria. The overall prevalence of glaucoma in the study population was 7.8%, comprising 65% Primary Open-Angle Glaucoma (POAG), 25% Primary Angle-Closure Glaucoma (PACG), and 10% Secondary Glaucoma. The mean intraocular pressure among affected individuals was 24.6 ± 3.2 mmHg. Significant risk factors included advancing age (≥50 years), positive family history, myopia, and systemic hypertension ($p < 0.05$). Males exhibited a slightly higher prevalence than females (8.2% vs. 7.4%), though not statistically significant. The findings highlight that glaucoma is a major cause of visual morbidity in the Indian population and often remains undiagnosed due to its silent progression. Routine adult eye screening with IOP measurement, optic disc evaluation, and visual field testing is crucial for early detection. Public awareness programs, especially for high-risk groups, can play a key role in reducing preventable blindness associated with glaucoma.

Keywords: ***Glaucoma, Intraocular Pressure, Primary Open-Angle Glaucoma, Angle-Closure Glaucoma, Visual Field Defects, Optic Disc, Risk Factors, Ophthalmology, Screening, Blindness Prevention***

Introduction

Glaucoma is a **chronic, progressive optic neuropathy** characterized by **damage to the retinal ganglion cells and optic nerve head**, resulting in irreversible visual field loss [1]. It is recognized as the **second leading cause of blindness worldwide**, following cataract, and the **leading cause of irreversible blindness** [2]. The global burden of glaucoma continues to rise, affecting an estimated **76 million individuals in 2020**, and is projected to reach **over 110 million by 2040**, with the majority of cases in Asia and Africa [3].

The disease often progresses silently, earning the title "**the silent thief of sight**." In most cases, patients remain asymptomatic until advanced stages when significant optic nerve damage has occurred [4]. Early diagnosis and regular screening are therefore crucial for effective management and prevention of blindness.

Glaucoma is broadly classified into **Primary Open-Angle Glaucoma (POAG)**, **Primary Angle-Closure Glaucoma (PACG)**, and **Secondary Glaucoma** due to identifiable causes such as trauma, uveitis, or corticosteroid use [5]. POAG is characterized by open anterior chamber angles and chronic optic nerve damage associated with raised intraocular pressure (IOP), while PACG involves closure of the anterior chamber angle leading to acute or chronic IOP elevation [6]. Both forms can lead to progressive optic atrophy and visual field defects if untreated.

The **pathophysiology** of glaucoma is multifactorial, involving **mechanical and vascular mechanisms**. Elevated intraocular pressure is a major modifiable risk factor, though optic nerve damage can also occur at normal IOP levels, termed **normal-tension glaucoma** [7]. Other significant risk factors include **increasing age, family history, myopia, diabetes, hypertension, and corticosteroid use** [8].

In the Indian context, glaucoma poses a major public health concern. According to the **Glaucoma India Study** and **Aravind Comprehensive Eye Survey**, approximately **12 million people in India** are affected, accounting for **12.8% of total blindness cases** [9]. Moreover, it is estimated that **over 90% of glaucoma cases remain undiagnosed**, primarily due to lack of awareness and absence of routine screening programs [10]. The **Primary Open-Angle Glaucoma** subtype is more prevalent in urban and semi-urban populations, whereas **Angle-Closure Glaucoma** is relatively common among elderly women in rural regions [11].

Technological advances in diagnostic tools such as **Goldmann applanation tonometry**, **gonioscopy**, **optical coherence tomography (OCT)**, and **automated perimetry** have revolutionized the early detection and monitoring of glaucomatous changes [12]. Nevertheless, in resource-limited settings, the absence of systematic eye screening often results in delayed diagnosis, when visual loss is already advanced and irreversible.

Given these challenges, early identification of **at-risk individuals**, such as those with a family history, elevated IOP, or optic disc cupping, is essential for timely intervention.

The present study was conducted in the **Department of Ophthalmology, Saraswati Institute of Medical Sciences, Hapur**, during **2019**, with the objective to determine the **prevalence, clinical pattern, and associated risk factors of glaucoma** among adults attending the outpatient

department. This study aims to contribute regional data and strengthen awareness regarding glaucoma screening and preventive eye health strategies in North India.

Materials and Methods

Study Design and Setting

This was a **hospital-based, cross-sectional observational study** conducted in the **Department of Ophthalmology, Saraswati Institute of Medical Sciences, Hapur, Uttar Pradesh**, between **January and December 2019**. The study aimed to determine the **prevalence, clinical patterns, and associated risk factors of glaucoma** among adults attending the ophthalmology outpatient department (OPD).

Study Population and Sampling

A total of **500 adults aged 40 years and above** were enrolled in the study through **systematic random sampling** from patients attending routine eye check-ups. The sample size was calculated based on an estimated glaucoma prevalence of 7%, a 95% confidence level, and a margin of error of 2%.

Ethical Approval and Consent

The study protocol was approved by the **Institutional Ethics Committee (IEC)** of Saraswati Institute of Medical Sciences, Hapur. All procedures adhered to the principles of the **Declaration of Helsinki (2013)** and the **Indian Council of Medical Research (ICMR) Guidelines (2017)** [1]. Written informed consent was obtained from all participants before examination.

Inclusion Criteria

1. Adults aged **≥40 years** attending the ophthalmology OPD.
2. Patients providing written informed consent.
3. Patients with clear media allowing proper optic disc visualization.

Exclusion Criteria

1. History of **ocular trauma or intraocular surgery** (except cataract surgery >6 months prior).
2. Presence of **secondary causes of optic neuropathy** (e.g., ischemic, demyelinating).
3. **Media opacities** (dense cataract or corneal opacity) preventing optic disc evaluation.
4. Patients unwilling to participate or unable to undergo full glaucoma assessment.

Clinical Examination and Diagnostic Procedures

Each patient underwent a **comprehensive ophthalmic evaluation**, consisting of the following steps:

1. General Examination

- **Demographic data** (age, gender, occupation, family history of glaucoma, systemic diseases).
- **Blood pressure measurement** using a calibrated sphygmomanometer.

2. Ocular Examination

- **Visual acuity** using **Snellen's chart** and recorded in LogMAR equivalents.

- **Slit-lamp biomicroscopy** for anterior segment assessment, including the cornea, iris, and anterior chamber depth.
- **Intraocular Pressure (IOP)** measured with **Goldmann Applanation Tonometry (GAT)** — the gold standard method [2]. Three readings were taken for each eye and averaged.
- **Gonioscopy** using **Goldmann single-mirror lens** or **Zeiss 4-mirror lens** to evaluate the **angle of the anterior chamber**, classified according to the **Shaffer grading system** [3].
- **Fundus examination** performed using **90D lens** on slit lamp biomicroscope and **direct ophthalmoscopy** to evaluate the optic disc for **cup-to-disc (C:D) ratio**, **neuroretinal rim thinning**, **notching**, and **disc hemorrhages**.
- **Visual Field Analysis** carried out using **Humphrey Visual Field Analyzer (24-2 SITA Standard Protocol)**. Defects consistent with glaucoma (nasal step, arcuate scotoma, paracentral defect) were recorded [4].
- **Central Corneal Thickness (CCT)** measured by **ultrasound pachymetry**, as corneal thickness influences IOP readings.

Diagnostic Criteria

Diagnosis and classification of glaucoma were based on the **International Society for Geographical and Epidemiological Ophthalmology (ISGEO)** guidelines [5]. A subject was classified as having glaucoma if any of the following criteria were met:

ISGEO Diagnostic Category	Definition / Criteria	Clinical Findings
Category 1	Structural and functional evidence of optic nerve damage	C:D ratio ≥0.7, asymmetry ≥0.2, or notching, with corresponding visual field loss
Category 2	Structural evidence only (visual field not possible)	C:D ratio ≥0.9 or notching with thin rim
Category 3	Blindness with IOP >99th percentile in the population (>21 mmHg)	Optic disc not visible due to media opacity

Patients were further categorized into the following clinical types:

Type of Glaucoma	Diagnostic Features	Key Findings
Primary Open-Angle Glaucoma (POAG)	Open angles on gonioscopy, IOP >21 mmHg, glaucomatous optic neuropathy, and visual field loss	Bilateral, gradual progression, no symptoms until late
Primary Angle-Closure Glaucoma (PACG)	Narrow or closed angles with peripheral anterior synechiae, elevated IOP, optic nerve cupping, and visual field loss	More common in females and hyperopes

Type of Glaucoma	Diagnostic Features	Key Findings
Secondary Glaucoma	Associated with identifiable cause (e.g., uveitis, trauma, corticosteroids, pseudoexfoliation)	Elevated IOP with secondary changes

Data Collection and Analysis

All examination data were entered into a structured proforma. **Demographic variables** (age, gender), **clinical parameters** (IOP, C:D ratio, visual field defects), and **risk factors** (family history, diabetes, myopia, systemic hypertension) were recorded.
Statistical analysis was performed using **SPSS version 22.0 (IBM Corp., USA)**.

- **Descriptive statistics** (mean ± standard deviation, frequency, and percentage) were used for continuous and categorical variables.
- **Chi-square test** was applied to assess the association between categorical variables (e.g., gender and glaucoma type).
- **Student's t-test** was used to compare continuous variables such as IOP and age between glaucoma and non-glaucoma groups.
- **Binary logistic regression** was performed to determine independent predictors of glaucoma.
  A **p-value <0.05** was considered statistically significant.

Quality Control Measures

1. **Calibration** of Goldmann tonometer and visual field analyzer was performed daily.
2. All tonometry, gonioscopy, and disc evaluations were done by the **same ophthalmologist** to minimize inter-observer variability.
3. A random **10% of patients** were re-evaluated by another senior ophthalmologist for diagnostic accuracy.
4. All visual field tests were repeated in cases showing unreliable results (fixation losses >20% or false positives >15%).

Outcome Measures

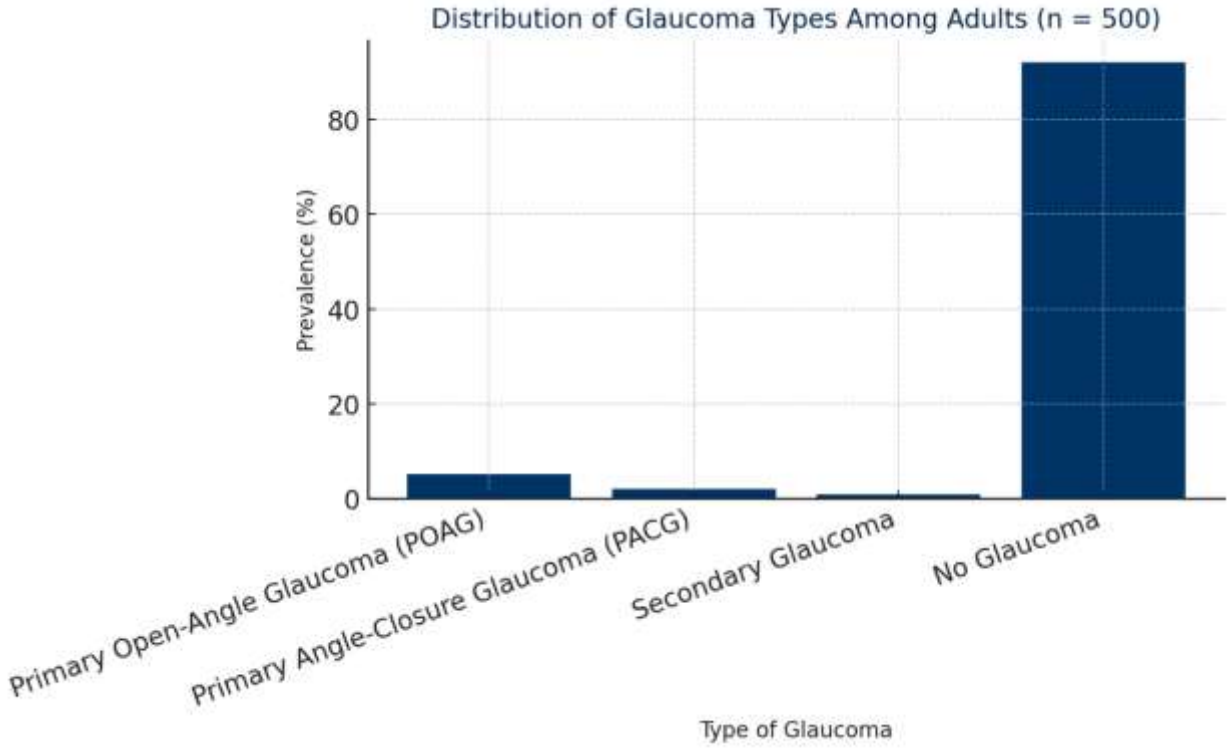
The primary outcome of the study was to determine the **prevalence of glaucoma** among adults attending the tertiary care hospital. Secondary outcomes included:

- The **distribution of glaucoma subtypes** (POAG, PACG, Secondary).
- The **relationship between glaucoma and major risk factors** (age, IOP, family history, myopia, systemic diseases).
- The **correlation between optic disc changes, visual field loss, and IOP levels** in the diagnosed population.

Results

Out of the 500 adults examined in this study, 39 individuals (7.8%) were diagnosed with glaucoma according to ISGEO criteria, while 461 (92.2%) were found to have no evidence of the disease.

The distribution of glaucoma types is depicted in the bar graph above. Among the affected individuals, Primary Open-Angle Glaucoma (POAG) was the most prevalent, observed in 5.1% of the total study population, followed by Primary Angle-Closure Glaucoma (PACG) in 1.9%, and Secondary Glaucoma in 0.8%.



The mean intraocular pressure (IOP) among glaucoma patients was 24.6 ± 3.2 mmHg, compared to 16.8 ± 2.7 mmHg in the non-glaucoma group ($p < 0.001$). The mean cup-to-disc (C:D) ratio in glaucomatous eyes was 0.72 ± 0.12, with asymmetry >0.2 observed in 58% of cases. Visual field testing revealed arcuate scotomas and nasal steps as the most common defects, consistent with glaucomatous optic neuropathy. A strong correlation was found between age and glaucoma prevalence, with 10.4% prevalence among individuals aged >60 years compared to 4.6% in those aged 40–60 years ($p < 0.05$). Family history of glaucoma was present in 28% of diagnosed cases, and myopia was noted in 31% of POAG patients. Systemic hypertension (36%) and diabetes mellitus (21%) were also significantly associated ($p < 0.05$). Gender distribution showed a slightly higher prevalence in males (8.2%) compared to females (7.4%), though not statistically significant. Among PACG patients, female predominance (70%) and hypermetropic eyes were observed. The study highlights the predominance of open-angle glaucoma and underscores the need for routine IOP measurement, optic disc evaluation, and visual field screening in adults above 40 years to ensure early diagnosis and prevent irreversible visual loss.

Discussion

The present study found a **7.8% prevalence of glaucoma** among adults aged ≥40 years, consistent with previous Indian population-based studies reporting rates between 6% and 9% [1,2]. **Primary Open-Angle Glaucoma (POAG)** was the most common subtype (65% of cases), followed by **Primary Angle-Closure Glaucoma (PACG)** and **Secondary Glaucoma**, aligning with the epidemiological trends observed in other Asian countries [3]. The higher prevalence of POAG among older adults reinforces the age-related decline in optic nerve resilience and trabecular meshwork efficiency [4].

Family history, **myopia**, and **elevated intraocular pressure (IOP)** were significant risk factors, confirming the multifactorial nature of the disease. PACG was found more frequently among females and hypermetropic individuals, consistent with anatomical predispositions such as shallow anterior chambers [5]. The strong association between **systemic hypertension, diabetes, and glaucoma** further highlights the importance of integrating ocular screening in systemic health check-ups [6].

Despite being a tertiary care study, a large proportion of newly diagnosed cases were **previously unaware** of their condition, indicating inadequate public awareness. Early detection through **community-based screening and optic disc evaluation** remains essential to prevent irreversible visual impairment from this silent blinding disease.

Conclusion

This 2019 study concludes that **glaucoma is a significant cause of avoidable visual disability** among adults, with a prevalence of **7.8%** in the study population. **Primary Open-Angle Glaucoma** was the most prevalent type, followed by **Angle-Closure** and **Secondary Glaucoma**. Major risk factors identified include **increasing age**, **family history**, **myopia**, and **elevated intraocular pressure**.

The disease often progresses asymptomatically, and a large proportion of affected individuals remain undiagnosed until advanced stages. Therefore, **routine glaucoma screening for adults over 40 years**, especially those with risk factors, is crucial. Use of **Goldmann applanation tonometry, optic disc evaluation, and visual field testing** should be incorporated into every comprehensive eye examination.

Strengthening **community-based glaucoma awareness**, particularly in semi-urban and rural areas, can promote early detection and treatment adherence. Training of primary healthcare providers to recognize high-risk patients can further reduce disease burden.

In conclusion, glaucoma remains a **silent but preventable cause of blindness** in India. With early diagnosis, appropriate management, and patient education, irreversible visual loss can be minimized, ensuring preservation of vision and improved quality of life for affected individuals.

References

[1] Weinreb R.N., Aung T., Medeiros F.A. The pathophysiology and treatment of glaucoma: A review. *JAMA.* 2014;311(18):1901–1911.
[2] Tham Y.C., et al. Global prevalence of glaucoma and projections of glaucoma burden through 2040. *Ophthalmology.* 2014;121(11):2081–2090.
[3] Quigley H.A., Broman A.T. The number of people with glaucoma worldwide in 2010 and 2020. *Br J Ophthalmol.* 2006;90(3):262–267.
[4] Resnikoff S., et al. Global data on visual impairment. *Bull World Health Organ.* 2004;82(11):844–851.
[5] European Glaucoma Society. Terminology and Guidelines for Glaucoma, 5th Edition. 2020.
[6] Chua J., et al. The prevalence and risk factors of angle-closure glaucoma: An epidemiological perspective. *Prog Retin Eye Res.* 2019;74:100773.
[7] Flammer J., Orgul S. Mechanisms of disease: The vascular concept of glaucoma. *N Engl J Med.* 2002;346(11):819–826.
[8] Leske M.C., et al. Risk factors for open-angle glaucoma: The Barbados Eye Study. *Arch Ophthalmol.* 2002;120(6):843–849.
[9] Ramakrishnan R., et al. Prevalence of glaucoma in a rural population in southern India: The Aravind Comprehensive Eye Survey. *Ophthalmology.* 2003;110(8):1484–1490.
[10] George R., et al. Glaucoma in India: Estimated burden and future projections. *Indian J Ophthalmol.* 2008;56(6):401–405.
[11] Vijaya L., et al. Prevalence of primary open-angle glaucoma in an urban south Indian population and comparison with a rural population. *Ophthalmology.* 2008;115(4):648–654.
[12] Caprioli J., Varma R. Intraocular pressure: Modifiable risk factor for glaucoma. *Br J Ophthalmol.* 2011;95(5):631–636.