

Prevalence and Associated Risk Factors of Glaucoma in Aligarh, India – A population based study

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Background: Glaucoma is one of the most common causes of blindness. Being irreversible, its early detection and management are utmost important. With increasing life expectancy, the prevalence of glaucoma is expected to rise. We did this study to find the prevalence of glaucoma among middle-aged and elderly population and to find out its associated factors.

Methods: A community based cross-sectional study among rural and peri-urban area of Aligarh was done for a duration of one year. A trained ophthalmologist interviewed and examined 680 patients with a detailed eye examination. Intraocular pressure (IOP) was measured by Keeler pulsair non-contact tonometer, confirm by applanation tonometry. Anderson criteria were used to diagnose glaucomatous visual field defect.

Abstract Results: In our study population, a total of 31 subjects were diagnosed as glaucoma in either one or both eyes. The overall prevalence of glaucoma was found to be 4.6%. About equal distribution of type of glaucoma, i.e. Primary Open Angle Glaucoma (POAG), Primary Angle Closure Glaucoma (PACG) and Normotensive Glaucoma (NTG) was observed in our study participants. The prevalence of glaucoma was found to be significantly associated with increasing age, positive family history as well as a history of angle closure.

Conclusion: The prevalence of glaucoma is higher in the population of Aligarh. Its association with increasing age, positive family history and history of angle-closure may give us clues for early detection. Screening for glaucoma during middle age especially among person with a positive family history or angle-closure would help us early diagnosing and management of this irreversible disease.

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Keywords: Community based study, elderly, Glaucoma, Intraocular pressure

Introduction

Glaucoma is the leading cause of irreversible blindness worldwide and World Health Organization ranks it as second most common cause of blindness worldwide after cataract.¹ It is estimated that the global burden of glaucoma to be 60 million and it would be 79.6 million by 2020, with almost half of them Asian.² In terms of prevalence, the global prevalence of glaucoma is estimated at 3.54%.³ The studies showing the prevalence of glaucoma between 0.94% to 4.73% among them in various part of Asia^{4,5} with angle-closure glaucoma being more frequent among Asian populations. The prevalence is expected to rise.

India with increasing greying of the population, is expected to become the second largest home of glaucoma by 2020. The estimated prevalence of glaucoma cases in India is reported to be 11.9 million.⁶ This prevalence of glaucoma in India is not the same at every place, with varying prevalence among different populations and subgroups having rate of being 2.3 – 4.7%.^{7,8,9} In regards to subtype, Indian population have an equal proportion of Primary open-angle (POAG) and Primary closed-angle glaucoma (PACG).

Glaucoma is a multifactorial condition resulting from progressive optic neuropathy and visual field loss. These

changes are often slow and many glaucoma patients do not know about their underlying glaucomatous eye. Chennai Glaucoma Study as well as Aravind comprehensive eye survey, observed that more than 90% cases of glaucoma were undiagnosed and were identified only at the time of study.^{10,11} They have proposed periodic screening of high-risk population for diagnosing the disease at an early stage. As glaucoma types and risk factors varies from population to population, we did this study to shed a light on its patten in western part of Uttar Pradesh. Considering the paucity of community glaucoma studies, we conducted this study with the objectives of finding out the prevalence of glaucoma and its associated factor among adults aged 40 years and above in the rural and peri-urban area of Aligarh.

Materials and Methods

A community-based cross-sectional study was conducted for a period of one year from July 2015- June 2016 among middle age and elderly population at field practise area of Rural Health Training Centre (RHTC) and Urban Health Training Centre (UHTC), Department of Community Medicine, JN Medical College, AMU, Aligarh. Inclusion criteria were people aged 40 years and above, resident of registered

household (UHTC and RHTC) and who gave consent for interview and examination. Those who were severely ill or who did not give the consent were excluded from the study.

Sample size

We calculated the sample size from the formula given below assuming the prevalence of glaucoma as 3.5% based on prominent prevalence studies in India, and with absolute precision of 2% and 95% confidence interval and a design effect of two. The sample size came out to be 649. Taking non-responses rate into account, the final sample size was increased to 700. Probability proportion to size (PPS) systematic random sampling was done to draw the desired sample from each area with 410 from rural and 290 from peri-urban.

$$N = Z^2 \frac{P(100-P)}{d^2}$$

Study procedure

A predesigned & pretested questionnaire was used to collect data from the study population. It elicits socio-demographic information along with detailed eye examination. Socio-economic status was assessed by Modified BG Prasad classification, 2016.¹² Study instruments included Landolt 'C' chart for visual acuity, +1 D lens, Keeler 'Pulsair easy eye' non-contact tonometer, Appasamy Applanation tonometer, direct ophthalmoscope, slit lamp, gonioscope, and automated perimeter (24-2 SITA standard, Zeiss-Humphrey Visual Field Analyzer). A preliminary eye examination was done at home and those in whom glaucoma was suspected or whose uncorrected visual acuity was <3/60, were referred to ophthalmology OPD at RHTC/UHTC for further evaluation.

Operational definition

1. **High Intraocular pressure:**
 - Pressure > 21mm of Hg in either eye.
 - Difference of more than 6 mm Hg in both eyes.
2. **Significant Disc changes:**
 - Vertical cup disc ratio > 0.6 in either eye.
 - Asymmetry of cup disc ratio > 0.2.
 - Other disc changes like polar notch, hemorrhages on or near the disc, thinning of neuroretinal rim.
3. **Glaucoma diagnosis**
Any two of the three features
 - High Intraocular pressure
 - Significant Disc changes
 - Glaucomatous field defect (Anderson criteria)

Statistical Analysis

Data were tabulated and analysed by using SPSS ver.21.¹³ Descriptive data were presented as frequency, graph, mean and percentage. Categorical data were analysed by chi-

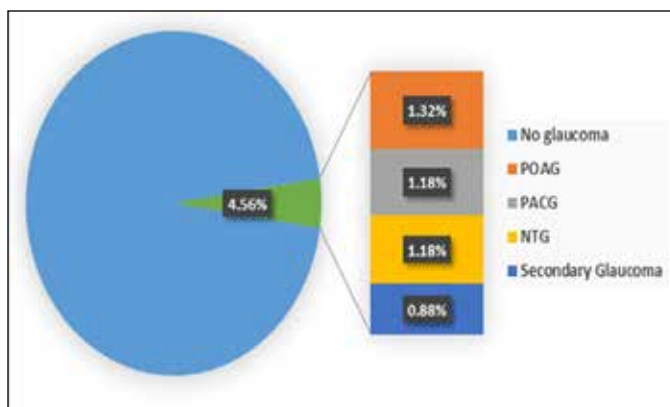


Figure 1: Type of glaucoma among the study population

square test or Fisher exact test, whenever applicable. All tests were two-tailed, and a p-value of ≤ 0.05 was considered significant.

Ethical Considerations

The study was approved from the Institutional Ethics and Research Advisory Committee, Faculty of Medicine, Aligarh Muslim University, Aligarh. Informed consent from all the participant was taken before the study. They were assured that the personal information received would be kept confidential. Proper health education and adequate counselling were provided to all the subjects. Referral for any subject found to have glaucoma or any other ailment was done for further management.

Results

Among the total 700 patients selected, only 680 patients completed the whole questionnaire and were finally analyzed as 20 participants refused or dropout before the complete examination and were excluded from the study. The final analysis was done on 281 urban and 399 rural participants.

Socio-demographic and clinical characteristics

Among the total of 680 study participants, 267 (38.3%) were males and 413 (60.7%) were females. The mean age of the participants was 55.0 ± 11.56 years ranged from 40 – 102 years. The majority of participants were in the age group 40-50 years. Majority of them were married (80.0%) and Hindu (54.0%) by religion. The educational status of the study population was very poor, with more than half of them (63.8%) being illiterate. The study population consisted mostly of housewives 392 (57.6%) and only 237 (34.8%) were employed leaving 51 (7.5%) unemployed or retired. Majority of the participants belonged to lower socio-economic classes with 329 (48.4%) and 277 (33.4%) in class V and class IV respectively. (Table 1)

Mean IOP observed among individual 1360 eyes was found to be 13.61 ± 4.17 mm Hg, with glaucomatous and non-glaucomatous population was 20.24 ± 10.75 and 13.23

Table 1: Socio demographic profile of study participa

Variables		Frequency	Percentage
Residence	Urban	281	41.3
	Rural	399	58.7
Age	40-49	244	35.9
	50-59	172	25.3
	60-69	162	23.8
	>70	102	15.0
Sex	Male	267	39.3
	Female	413	60.7
Religion	Hindu	367	54.0
	Muslim	313	46.0
Marital Status	Married	544	80.0
	Devoiced/Separated	1	0.1
	Widowed	135	19.9
Education	Illiterate	434	63.8
	Primary	90	13.2
	Secondary	128	18.8
	Graduation and above	28	4.1
Occupation	Unemployed/retired	51	7.5
	Unskilled & semi-skilled	130	19.1
	Skilled/clerical/shop/farm	107	15.7
	House wife	392	57.6
Social status	I	8	1.2
	II	38	5.6
	III	78	11.5
	IV	227	33.4
	V	329	48.4

± 3.03 mm Hg respectively. Majority of eyes have normal anterior chamber depth while 29% of them had a shallow angle with two subjects classified as isolated Primary Angle Closer without glaucomatous changes. The mean CD ratio observed in study eyes was 0.335± 0.095, the glaucomatous and non-glaucomatous population was 0.577±0.16 and 0.321 ± 0.07 respectively.

Prevalence of glaucoma

We observed a prevalence of 4.6% (31/680) of glaucoma in our study participants. About equal distribution of type of glaucoma, i.e. Primary Open Angle Glaucoma (POAG), Primary Angle Closure Glaucoma (PACG) and Normotensive Glaucoma (NTG) was observed in our study participants. The prevalence of POAG and PACG was 1.3% and 1.2 % respectively while NTG and secondary glaucoma was found in 1.2% and 0.9 % of the patients. The prevalence of glaucoma among our study participant was found to be significantly associated with increasing age, positive family history as well as the history of angle closure. We did not observe it be associated with other demographic factors like gender, religion, education as well as clinical factors like history of other chronic diseases (Table 2).

Table 2: Associations of glaucoma with various factors

Variables		Glaucoma		P value
		Present	Absent	
Residence	Urban	21 (5.3%)	378 (94.7%)	X2= 0.74, p= 0.39
	Rural	10 (3.6%)	271 (96.4%)	
Age	40-49	4(1.6%)	240(98.4%)	X2 =10.42, p=0.0153
	50-59	7(4.1%)	165 (95.9%)	
	60-69	12(7.4%)	150(92.6%)	
	>70	8(7.8%)	94 (92.2%)	
Gender	Male	11 (4.1%)	256 (95.9%)	X2= 0.06, p= 0.8065
	Female	20 (4.8%)	393 (95.2%)	
Religion	Hindu	18 (4.9%)	349 (95.1%)	X2= 0.08, p= 0.78
	Muslim	13 (4.2%)	300 (95.8%)	
Education	Illiterate	15 (3.8%)	378 (96.2%)	X2= 2.50, p= 0.29
	Primary	10 (7.0%)	133 (93.0%)	
	Secondary	6 (4.2%)	138 (95.8%)	
Social status class*	Higher (I,II,III)	5 (4.0%)	119 (96.0%)	X2= 0.01, p= 0.92
	Lower (IV,V)	26 (4.7%)	530 (95.3%)	
Family history	Present	5 (45.5%)	6 (54.6%)	X2= 42.98, p <0.001
	Absent	26 (3.9%)	643 (96.1%)	
H/o angle closure	Present	7 (70.0%)	3 (30.0%)	p <0.001
	Absent	24(3.6%)	646(96.4%)	
History of HTN	Yes	8(7.7%)	95(92.3%)	X2= 2.07, p= 0.150
	No	23(4.0%)	554(96.0%)	
History of DM	Yes	1(2.9%)	34(97.1%)	p = 1.00
	No	30(4.7%)	615(95.3%)	
	Total	31(4.6%)	649(95.4%)	

Discussion

We did a study among middle age to elderly population to find out the prevalence of glaucoma as well as to observed any associated factors. We observed an overall prevalence of glaucoma to be 4.6%. The various type of glaucoma, with POAG, PACG and NTG in 1.3%, 1.2% and 1.2% of population respectively while secondary glaucoma was the found in 0.9% of the patients. The prevalence of glaucoma among our study participant was found to be significantly associated with increasing age, positive family history as well as the history of angle closure. The prevalence of glaucoma from previous studies has varied results. It was observed to be 2.3 – 4.7% in India, with a prevalence of 4.2% researchers from Agra, near to our study area⁹. Some Central and Southern studies have reported a lower prevalence of glaucoma in compare to North India.¹⁴

International studies have a wide range of rates of glaucoma, varied from 0.94% in Nepal to 13.8% among US citizen.¹⁵ It was reported to be 1.95% among the ethnic Indian living in Singapore.¹⁶ A meta-analysis estimated the global prevalence of glaucoma as 3.54%.¹⁶ Although comparing this prevalence is difficult because of differences in definition, methodology, diagnostic equipment, genetic and environmental predisposition of glaucoma,¹⁷ we concluded the prevalence of glaucoma we observed on the higher side. Among subtypes of glaucoma, in India the POAG is a predominant subtype, with a prevalence of POAG varying from 1.26 – 4.32% and PACG in 0.15 – 1.11% among various Indian subpopulation.¹⁸ We observed an equal distribution of PACG and POAG subtypes in our study.

Among the associated factors, the presence of glaucoma increased with advancing age of the patients. As the development of glaucoma is associated with progressive optic neuropathy and visual field loss, which is expected to worsen with increasing age. Although we did our study among middle age to elderly population, the prevalence of glaucoma in elderly patients was very high in comparison to the middle age group (7.4% vs 1.6%). Similar increase in the prevalence of glaucoma with advancing age has been reported in several studies. Indian studies like Andhra Pradesh Eye Disease Study, Aravind comprehensive eye survey and Central India Eye and Medical Study found a significant association with age and glaucoma, so did others in, Barbados Eye Study, and European Glaucoma Prevention Study.¹⁹ With increasing age, due to the higher risk of ocular hypertension and gradual distraction of optical nerve, the risk of glaucoma also increases. Early detection and treatment would be highly beneficial to a country like India, where these patients often present very late stage.²⁰ Among all the socio-demographic factors, apart from the age of the patients, higher prevalence of glaucoma was observed in urban population, females, and lower socio-economic class, but it was not found to be statistically significant. These findings support the observations of previous studies done across various part of India and other countries.^{21,22}

Among other factors, we also observed a strong relation of positive history of angle closure in patients as well as family history with the presence of glaucoma. A positive family history of glaucoma is a known risk factor for future glaucoma.²⁴ Genetic predisposition of glaucoma also documented in researches.²³ The same study observed positive family history to carry a relative risk of 3.69 times for being diagnosed with Open Angle glaucoma in siblings.²⁴ While another study documented that about half of all POAG having a positive family history, with first degree relatives having 9 times increased risk of developing glaucoma.²⁵ Further, a study from Germany found those having positive family history not only diagnosed but they were also significantly younger at diagnosis than without it.²⁶ Although a recent study from Saudi found no variation of prevalence of glaucoma with age group.²⁷ Several researchers also found a significant association between the attack of angle-closure and development of primary angle closure glaucoma (PACG).²⁸ The smaller limbal and axial anterior chamber depth are highly associated with angle

closure and angle closure glaucoma.²⁹ Being more common among Asians than Caucasians or African population, PACG patients often land up in glaucoma blindness more than any other subtype of glaucoma. Among Caucasian too, PACG development is considered as long-term outcomes after acute primary angle closure. As the majority of PACG sufferers are asymptomatic, presenting late, patients with angle closure should be regularly screened.³⁰ Although, we found glaucoma to be higher among patients with a history of hypertension, it was not found to be statistically significant. Similarly, no significant association was found with a history of diabetes mellitus too. These findings support studies had reported hypertension or diabetes not being a risk factor for glaucoma. An international study had contrasting findings.²⁴ Similarly, another study reported systemic hypertension to be a risk factor for glaucoma development.³¹ This may be because of their clinic-based studies, which may not give real a picture in the community. In regards to diabetes mellitus too, its association with glaucoma is controversial.³²

Conclusion

Our study highlights a higher prevalence of glaucoma in our field study. Apart from this, its association with increasing age and positive family history and angle-closure, screening for glaucoma especially among person with high risk should be introduced a part of general screening during middle age. Being the most common irreversible cause of blindness, early diagnosis and management of glaucoma would yield better prognosis.

References

1. Resnikoff S, Pascolini D, Etya' D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Global data on visual impairment in the year 2002. Vol. 82, Bulletin of the World Health Organization. 2004.
2. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. The British journal of ophthalmology. 2006 Mar 1;90(3):262–7.
3. Tham Y-C, Li X, Wong TY, Quigley HA, Aung T, Cheng C-Y. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. Ophthalmology. 2014 Nov 1;121(11):2081–90.
4. Sah R, Badhu B, Pokharel P, Thakur S, Das H, Panda A. Prevalence of glaucoma in Sunsari district of eastern Nepal. Kathmandu University medical journal (KUMJ). 2007;5(3):343–8.
5. Jacob A, Thomas R, Koshi SP, Braganza A, Muliylil J. Prevalence of primary glaucoma in an urban south Indian population. Indian journal of ophthalmology. 1998 Jun;46(2):81–6.
6. George R, Ve RS, Vijaya L. Glaucoma in India: Estimated Burden of Disease. Journal of Glaucoma. 2010 Aug;19(6):391–7.
7. Dandona L, Dandona R, Mandal P, Srinivas M, John RK, McCarty CA, et al. Angle-closure glaucoma in an urban population in southern india: The andhra pradesh eye disease study. Ophthalmology. 2000 Sep 1;107(9):1710–6.
8. Dandona L, Dandona R, Srinivas M, Mandal P, John RK, McCarty CA, et al. Open-angle glaucoma in an urban population in southern India: the Andhra Pradesh eye disease study. Ophthalmology. 2000 Sep;107(9):1702–9.
9. Awasthi P, Sarbhai KP, Banerjee SC, Maheshwari BB. Prevalence study of glaucoma in rural areas. Indian Journal of Ophthalmology. 1975 Apr;23(1):1–5.
10. Vijaya L, George R, Paul PG, Baskaran M, Arvind H, Raju P, et al. Prevalence of Open-Angle Glaucoma in a Rural South Indian Population. Investigative Ophthalmology & Visual Science. 2005

- Dec 1;46(12):4461.
11. Ramakrishnan R, Nirmalan PK, Krishnadas R, Thulasiraj R., Tielsch JM, Katz J, et al. Glaucoma in a rural population of southern India: The Aravind comprehensive eye survey. *Ophthalmology*. 2003 Aug 1;110(8):1484-90.
 12. Vasudevan J, Mishra AK, Singh Z. An update on B. G. Prasad's socioeconomic scale: May 2016. *International Journal of Research in Medical Sciences*. 2016;44(9):4183-6.
 13. IBM SPSS Statistics for Windows [Internet]. Armonk, NY: IBM Corp.; 2011 [cited 2019 May 21]. Available from: <https://www.ibm.com/products/spss-statistics>
 14. Palimkar A, Khandekar R, Venkataraman V. Prevalence and distribution of glaucoma in central India (Glaucoma Survey 2001). *Indian journal of ophthalmology*. 2008;56(1):57-62.
 15. Lee PP, Feldman ZW, Ostermann J, Brown DS, Sloan FA. Longitudinal Prevalence of Major Eye Diseases. *Archives of Ophthalmology*. 2003 Sep 1;121(9):1303.
 16. Narayanaswamy A, Baskaran M, Zheng Y, Lavanya R, Wu R, Wong W-L, et al. The Prevalence and Types of Glaucoma in an Urban Indian Population: The Singapore Indian Eye Study. *Investigative Ophthalmology & Visual Science*. 2013 Jul 10;54(7):4621.
 17. Paul C, Sengupta S, Choudhury S, Banerjee S, Sleath B. Prevalence of glaucoma in Eastern India: The Hooghly River Glaucoma Study. *Indian Journal of Ophthalmology*. 2016 Aug;64(8):578.
 18. Raychaudhuri A, Lahiri SK, Bandyopadhyay M, Foster PJ, Reeves BC, Johnson GJ. A population based survey of the prevalence and types of glaucoma in rural West Bengal: the West Bengal Glaucoma Study. *The British journal of ophthalmology*. 2005 Dec 1;89(12):1559-64.
 19. Nangia V, Jonas JB, Gupta R, Khare A, Sinha A. Visual impairment and blindness in rural central India: The Central India Eye and Medical Study. *Acta Ophthalmologica*. 2013 Aug;91(5):483-6.
 20. Garudadri C, Senthil S, Khanna RC, Sannapaneni K, Rao HBL. Prevalence and risk factors for primary glaucomas in adult urban and rural populations in the Andhra Pradesh eye disease study. *Ophthalmology*. 2010 Jul;117(7):1352-9.
 21. Leske MC, Connell AMS, Schachat AP. The Barbados Eye Study: Prevalence of Open Angle Glaucoma. *Archives of Ophthalmology*. 1994;112(6):821-9.
 22. EGPS Group, Miglior S, Pfeiffer N, Torri V, Zeyen T, Cunha-Vaz J, et al. Predictive Factors for Open-Angle Glaucoma among Patients with Ocular Hypertension in the European Glaucoma Prevention Study. *Ophthalmology*. 2007 Jan;114(1):3-9.
 23. Tielsch JM, Katz J, Sommer A, Quigley HA, Javitt JC. Family History and Risk of Primary Open Angle Glaucoma: The Baltimore Eye Survey. *Archives of Ophthalmology*. 1994;112(1):69-73.
 24. McMonnies CW. Glaucoma history and risk factors. *Journal of Optometry*. 2017 Apr 1;10(2):71-8.
 25. Awadalla MS, Fingert JH, Roos BE, Chen S, Holmes R, Graham SL, et al. Copy number variations of TBK1 in Australian patients with primary open-angle glaucoma. *American Journal of Ophthalmology*. 2015 Jan 1;159(1):124-130.e1.
 26. Gramer G, Weber BHF, Gramer E. Results of a patient-directed survey on frequency of family history of glaucoma in 2170 patients. *Investigative Ophthalmology and Visual Science*. 2014 Jan 13;55(1):259-64.
 27. Khandekar R, Chauhan D, Yasir ZH, Al-Zobidi M, Judaibi R, Edward DP. The prevalence and determinants of glaucoma among 40 years and older Saudi residents in the Riyadh Governorate (except the Capital) – A community based survey. *Saudi Journal of Ophthalmology*. 2019;
 28. Tan AM, Loon SC, Chew PTK. Outcomes following acute primary angle closure in an Asian population. *Clinical and Experimental Ophthalmology*. 2009;37(5):467-72.
 29. Foster P, He M, Liebmann J. Epidemiology, classification and mechanism. In: Weinreb RN, Friedman DS, eds. *Angle Closure and Angle Closure Glaucoma*. Hague: The Kugler; 2006. 1-2 p.
 30. Ahmad SZ, Ahmad A, Khalique N, Alvi Y.A Community based study of senario of glaucoma in Aligarh, India. *Int J.Community Med Public Helth* 2019;6:4098-104 .
 31. Topouzis F, Coleman AL, Harris A, Jonescu-Cuypers C, Yu F, Mavroudis L, et al. Association of Blood Pressure Status With the Optic Disk Structure in Non-glaucoma Subjects: The Thessaloniki Eye Study. *American Journal of Ophthalmology*. 2006;142(1).
 32. Doucette LP, Rasnitsyn A, Seifi M, Walter MA. The interactions of genes, age, and environment in glaucoma pathogenesis. Vol. 60, *Survey of Ophthalmology*. Elsevier USA; 2015. p. 310-26.

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