

## Prevalence of Glaucoma in India and The World

Dr. R. Krishnadas  
Dr. George V Puthuran



Glaucoma is the most common cause of irreversible blindness in the world. The World Health Organization estimates (2002) for the number of people blind from glaucoma were 4.4 million (12.3% of the blind worldwide). The majority of those with glaucoma remain undetected and one has to rely on the data from epidemiological studies to estimate the number of people afflicted by glaucoma and related blindness. With accumulation of a wealth of data from epidemiological surveys, it is understood that glaucoma affects all populations, though some regions and racial groups are more affected either due to higher prevalence and racial predilection or due to large populations in these regions resulting in absolute number of persons with glaucoma being larger<sup>1</sup>.

### Regional Variations in Glaucoma Prevalence

#### Europe & North America

Primary Open angle glaucoma (POAG) is the predominant glaucoma in North America and Europe and European derived populations of Australia. The highest prevalence of glaucoma in these regions is observed in the African and Caribbean origin population in the USA and the Caribbean. Primary angle closure glaucoma (PACG) is relatively uncommon in Blacks and Caucasians living in these geographic areas.

#### Latin America

There are as yet no published data on the prevalence of glaucoma in populations of Central or South America, but the Los Angeles Latin American Study (LALES) demonstrated a relatively high prevalence of 4.74% amongst Latin Americans in USA. A study by Quigley et al amongst Latin Americans revealed prevalence of glaucoma to be intermediate between those of Caucasians and blacks.

#### Asia

Nearly half the population with glaucoma resides in Asia, owing to this region containing the two most populated nations in the world (India and China with

of 2.4 billion people account for a third of the global population). Prevalence surveys in Mongolia, Singapore, China and India have observed prevalence of primary angle closure glaucoma to be equal to that of POAG and the prevalence of POAG is similar to that of Caucasians. A greater proportion of people in Asia are bilaterally blind from angle closure disease—25% of those with PACG are blind as compared to 10% of those with POAG. Projection of these prevalence data to the predicted population growth in the Asian regions suggest that blindness from glaucoma is likely to be a major public health issue.

#### Africa

The prevalence of combined glaucomas (primary and secondary) in the Tanzanian and South African studies was reported to be 5%. The predominant form of glaucoma was POAG, although exfoliation, aphakic and angle closure composed the remainder. Glaucoma prevalence amongst the blacks in the USA is stated to be four times that of Caucasians. Since the African Americans and Caribbeans are of West African ancestry, the prevalence of glaucoma in West Africa is believed to be similar to that of the black population in North America and no cross sectional studies are currently available. In general, glaucoma affects a higher proportion of people of African ancestry, has a younger age of onset and results in greater visual morbidity as compared to most other populations.

#### Prevalence of Glaucoma in India

Population based studies have estimated the prevalence of glaucoma in India to be about 11.9 million in India and 60.5 million in the world by the year 2010. Most data on prevalence of glaucoma has been in South India and West Bengal, though one is currently underway in Nagpur, Central India, and the data are yet to be made available. There is no data available from North India as of now. There have been four prevalence studies from South India: The Andhra Pradesh Eye Disease Study (APEDS), the Aravind Comprehensive Eye Survey (ACES), the Chennai Glaucoma Study (CGS) and the Vellore Eye Study (VES). Though the methodology employed in

*Glaucoma Services*  
Aravind Eye Care System, Madurai.  
E-mail : krishnadas@aravind.org

each of these population based studies differ widely, all the studies based diagnosis of glaucoma on the appearance of optic discs and matching visual field defects on automated perimetry. No study relied on measurement of intraocular pressure for diagnosis of glaucoma except in situations where optic disc or visual field criteria were unavailable owing to lack of media clarity.

### Primary Open Angle Glaucoma (POAG)

Wide variation in the prevalence of glaucoma were reported between the different studies. The Vellore eye study (VES) reported lowest prevalence rates, since, unlike other prevalence studies, this study included patients in the 30-60 years age group. The prevalence of POAG increased with age in all the reported studies. There was also a low rate of performance of visual fields in the VES probably underestimating the prevalence of glaucoma in this population as both the optic disc and visual field defect criteria were required to detect glaucoma. The VES also had a high rate of non responders (51.5%) in a marked contrast to other prevalence studies, affecting case detection and possible underestimation of the prevalence. The reported prevalence rates of glaucoma in an urban population were significantly higher as revealed in the Chennai Glaucoma Study (CGS)<sup>2</sup> and the Andhra Pradesh Eye Study (APEDS)<sup>4</sup>, with the exception of VES<sup>3</sup>. Diabetes and cardiovascular diseases also have reported to have a higher prevalence in rural India. It is speculated that life style changes and cardio vascular disease patterns in urban India may indirectly influence the prevalence of POAG. The proportion persons with glaucoma who presented with a normal IOP ( defined as within two standard deviation from the population mean) were relatively higher in all the studies: 65% of persons with POAG in APEDS, 45% in ACES (Aravind Comprehensive Eye Survey), 67% in CGS (rural) and 82% in CGS (urban) had normal IOP at

the time of diagnosis, This emphasizes the unreliability of IOP measurement alone in screening for glaucoma, and reinforces careful optic nerve evaluation for accurate diagnosis of glaucoma. Increasing age and higher IOP was a consistent risk factor for glaucoma in all the prevalence studies. ACES reported male gender and myopia to be risk factors for POAG although no other studies observed gender or refractive errors to be associated with increased risk of POAG. Increased incidence of glaucoma with age is a cause for concern since India's population is ageing and the prevalence is expected to increase exponentially in the decades to come. A significant proportion of individuals with glaucoma will reside in the Indian subcontinent by 2030.

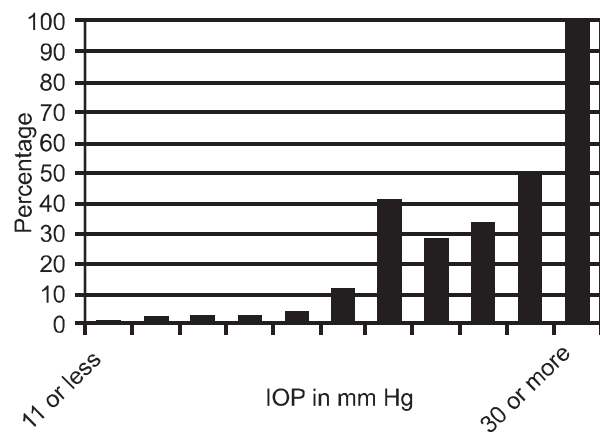


Figure- Prevalence of POAG at each level of IOP - IOP is a significant risk factor for POAG.

(Vijaya et al, IOVS 2005)

### Primary Angle Closure Glaucoma (PACG)

Owing to differing methodology and diagnostic criteria used in the definition of angle closure disease by the investigators, the prevalence of angle closure glaucoma reveals wide variation between the prevalence studies. VES reported PACG to constitute a significant proportion of glaucoma in the population

Table 1-Prevalence of POAG in India

	APEDS	ACES	CGS (Rural)	ACGS (urban)	WBGS
40-49	1.27	0.34	0.63	2.26	-
50-59	2.31	1.57	1.62	3.57	2.55
60-69	4.89	1.83	2.58	4.08	2.69
>70	6.32	2.88	3.25	6.42	4.76
Reported prevalence % (95% CI)	2.56 (1.22, 3.91)	1.7 (1.3, 2.1)	1.62 (1.42, 1.82)	3.51 (3.04, 4.0)	2.99

(4.32%). The stringent criteria used by VES investigators included primary angle closure (PAC) and occludable angles (PACS) also in the diagnosis of PACG thereby overestimating the prevalence of angle closure disease with glaucoma in the study population (urban, 30-60 years). 0.51% in the VES had angle closure disease with disc and visual field changes consistent with the diagnosis of primary angle closure glaucoma. This is similar to the prevalence of PACG reported in the other population studies. APEDS reported a lower prevalence of angle closure glaucoma, and the study especially highlighted a lower prevalence of PACS, partly accounted by a stricter criterion used to define occludability (non visibility of the pigmented trabecular meshwork for  $270^\circ$  or more of the filtering angle). The CGS used similar criteria as the VES to define occludable angles (180 of the filtering angle closed) and reported similar prevalence of angle closure disease. The urban cohort of the CGS had a higher prevalence of angle closure disease than the rural population studied. A vast majority of persons with PACG had chronic, asymptomatic disease in the prevalence studies. Moreover, the CGS reported that in those diagnosed with glaucoma earlier, close to 40% were misclassified as POAG. Gonioscopy is essential tool for appropriately classifying and treating glaucomas.

#### Risk Factors for Angle Closure Disease & Glaucoma

Increasing age has been identified as a significant risk factor for PACG in all studies. CGS established female gender as a definite risk factor for PACG and PAC. The APEDS also reported more women with PACG

though the association was not statistically significant. Both these studies also identified increased risk of PACG with hyperopia. Eyes with angle closure disease are also reported to have shorter axial length, shallower anterior chambers and thicker crystalline lenses than normals in the population (CGS).

#### Exfoliation & Glaucoma

Exfoliation has been recognized to be the most common identifiable risk factor for ocular hypertension and glaucoma the world over. The prevalence of exfoliation glaucoma from hospital based data in India have been reported to be between 1.87 and 13.5%. Recently, population based data on exfoliation are available from the epidemiologic studies on glaucoma. The prevalence of exfoliation in South India has been estimated to be 3-6% in persons aged over 40. Amongst those with exfoliation, glaucoma has been reported to vary between 3% (APEDS), 7.5% (ACES) and 13% (CGS, rural cohort). Increasing age and occupation outdoor as against indoor activity were identified to be significant risk factors. There was no gender predilection for glaucoma and an insignificant association of exfoliation and glaucoma were reported with lower socio economic status in the APEDS.

#### Secondary glaucomas

The prevalence of secondary glaucomas in the population has also been reported to be highly variable in the studies. The West Bengal Glaucoma Study (WBGS) reported 0.08%, the APEDS reported 0.21% in persons aged over 30 and ACES 0.3% in

Age	APEDS		CGS Rural			CGS Urban		
	PACG	PAC	PACG	PAC	PACS	PACG	PAC	PACS
40-49	0.00	0.76	0.44	0.38	4.29	0.07	1.27	4.86
50-59	1.54	3.08	1.02	0.81	7.31	0.63	3.30	7.77
60-69	2.17	3.80	1.01	0.01	7.96	2.21	4.19	9.27
>70	3.16	5.26	1.73	1.08	7.58	1.48	3.21	9.38
Reported Prevalence 95% CI	1.08 (0.36, 1.80)	2.21 (1.15, 3.27)	0.87 (0.58, 1.16)	0.71 (0.45, 0.98)	6.27 (5.51, 7.03)	0.8 (0.6, 1.16)	2.75 (2.01, 3.49)	7.24 (6.58, 8.02)
VES reported prevalence of PACG 4.3 G 4.3 (2,3.01-5.63) (30-60 years) ACES (40 years or more) : 0.5% (0.3-0.7 95% CI)								

persons aged over 40years. The Chennai Glaucoma Study, however found a high prevalence of glaucoma (11.2%) among persons with aphakia/pseudophakia. Cataract surgery and intraocular lens implantation are the most common ophthalmic procedures performed and cataract continues to be the most common cause of preventable blindness in India. Such high rates of prevalence of glaucoma in eyes that have undergone cataract surgery calls for extreme caution in prevention of complications of cataract surgery and careful follow up of individuals post cataract surgery.

### **Glaucoma Blindness in India**

Glaucoma has been declared to be the second common cause of blindness in adult population in India. The proportion of persons bilaterally blind from POAG has been variably reported to be 11% (APEDS), 1.6% (ACES), 3.2% and 1.5% (CGS rural and urban population respectively) and 5.2% (WBGs). In most of these studies, PACG was observed to cause one to four times the proportion of blindness as POAG: 16.6% (APEDS), 2.9 and 5.9% (CGS rural and urban). The high rates of blindness in the Indian population is due to high proportion of undiagnosed glaucoma in the community. Glaucoma was undetected in more than 90% of individuals identified in the population studies. The ACES also reported that 50% of persons detected with glaucoma had undergone an ophthalmic evaluation in the previous year and yet glaucoma was

undetected in 80% of individuals identified by the study. Inadequate identification of glaucoma even in population undergoing ophthalmic evaluation continues to be a major determinant of preventable blindness due to glaucoma in India. Case detection needs to exponentially increase to address an important cause of preventable blindness in the country. Awareness of glaucoma, which is especially low in the rural community needs to be increased by public education and counseling and dissemination of relevant information on glaucoma through electronic and mass media.

### **References**

1. Quigley HA. Number of people with glaucoma worldwide. *Br J Ophthalmol* 1996; 80:389
2. Lingam Vijaya, Ronnie George, Pradeep Paul, et al. Prevalence of glaucoma in a rural population in South India. *The Chennai Glaucoma Study. IOVS* 2005; 46: 4461.
3. Jacob A, Thomas R, Koshy SP. Prevalence of primary open angle glaucoma in an urban population in South India. *Indian Journal of Ophthalmology* 1996;46:81
4. Dandona L, Dandona R, Srinivas M, et al. Open angle Glaucoma in an urban population in south India. *ophthalmology* 2000;107: 1702.
5. Ramakrishnan R, Praveen NK, Krishnadas R. Glaucoma in a rural population in South India. *The Aravind Comprehensive eye survey. Ophthalmology* 2003;110: 1484.