

*Dr. P. Sivasubramaniam Oration – 2021*

## **Glaucoma demography in Sri Lanka – A 10 year analysis**

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### **Introduction**

Globally, it is estimated that nearly 2.2 billion people have a vision impairment for either near or distance vision. In at least 1 billion of these cases, the impairment of vision could have been prevented or has not yet been identified.

Out of this 1 billion people, glaucoma (7.7 million) ranked third cause of preventable vision loss with approximately 10% being bilaterally blind<sup>1</sup>, after refractive errors and cataract<sup>2</sup>. In addition the estimated number of blind persons increased (by 42.8%) from 34.4 million in 1990 to 49.1 million in 2020<sup>3</sup>. However it is hard to find Sri Lankan data which have a national consensus to contribute to the estimates. National Blindness survey conducted in 2014 indicated cataract blindness as 1.7%. Another Sri Lankan data is from the Central province where among the adults aged more than 40 years, prevalence of cataract blindness, based on best-corrected visual acuity, was recorded as 1.1%<sup>4</sup>. There are no epidemiological data available on glaucoma. This limitation on National data, highlights the need of a National wide study representing the whole island, to assess the Sri Lankan demographic data, which can be used in planning and implementation of future ophthalmological programs, targeting the specific groups of at risk patients.

In addition, Covid outbreaks pose significant risk for the healthcare workers for screening and monitoring of patients with glaucoma<sup>5</sup>. The rapid transmission of SARS-CoV-2 virus necessitated the countries to limit their healthcare only for emergency care for the increasing number of Covid cases. This resulted in, many patients with lifelong diseases like glaucoma having minimal access to ophthalmological care. This had resulted acceleration of vision loss in previously well controlled patients, necessitating a novel method of intraocular pressure monitoring at mass scale.

Hence this study was conducted to descriptively analyze the clinical practice of managing glaucoma patients under the author's care at National Eye Hospital, Colombo, Sri Lanka, during a 10 year period, which enabled me to suggest recommendations which can be implemented at National Level.

### **Study Design and Location**

This study was conducted among 1928 eyes of 964 patients, that were analyzed using available data from clinic files in National Eye Hospital, Colombo from 2010 (1<sup>st</sup> January) to 2019 (31<sup>st</sup> December). All the patients were personally treated and followed up by the author.

### **Methodology**

1928 eyes of 964 patients were recruited in the study who were followed up for a period of 10 years were included in the study.

### **Inclusion criteria**

1. Diagnosed patients with glaucoma or glaucoma suspects
2. All the patients recruited to the clinic from 2010 to 2020

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Any patient who did not have a clinic record file were excluded from the study.

The following clinical profile data were collected for analysis

- Number of patients recruited each year 2010 January – 2019 December
- Age
- Age group
- Gender
- Patients resident district
- Presentation to clinic (self-referral, referred)
- Reason to visit the clinic (related to glaucoma, unrelated to glaucoma)
- Type of Glaucoma (POAG, PACG, chronic narrow angle glaucoma, secondary Glaucoma, OHT, Glaucoma suspect, sub-acute angle closure)
- Method of IOP control – medical treatment, surgical interventions, medical and surgical combination treatment
- Timing of treatment – prompt treatment, follow up without treatment
- Lost to follow up

## Data Analysis

The data obtained from clinic files were fed in to a google form and were analyzed with the Statistical Package for the Social Sciences (SPSS) – 26 version, and presented in charts and graphs.

Survey On Glaucoma									
Clinic No:-		Year of Registration:-							
Age:-		Gender:- M/F							
Primary Open Angle Glaucoma		POAG Suspect							
		OHT							
		POAG							
Primary Angle Closure Glaucoma		PAC Suspect							
		PAC							
		PACG							
Secondary Glaucoma		Pre Trabecular							
		Trabecular							
		Post Trabecular							
AT PRESENTATION									
		IOP		OD		OS			
		C/D							
		OCT							
HVF	24-2	VFI							
	10-2	MD							
OCT	RNFL	Thickness (µm)							
		Vert. C/D							
	GCA	AV Thickness (µm)							
Treatment									
Observation		Follow up with observation up to now							
		Observed initially, Started treatment afterwards							
		If So, Duration of initial Observation							
Medical Treatment	Initial	β Blocker							
		α Agonist							
		G. CA Inhibitor							
		PG							
		O. CA Inhibitor							
	Current	β Blocker							
		α Agonist							
		G. CA Inhibitor							
		PG							
		O. CA Inhibitor							
Surgical Treatment									
		Not Planned				Planned		Done	
If Done or Planned Specify									
		Planned	Done	IOP Controlled		IOP Not Controlled			
				Sx Alone		With Medical			
Trabeculectomy									
Tube									
Other									
Current Status									
		IOP		OD		OS			
		C/D							
HVF	24-2	VFI							
	10-2	MD							
OCT	RNFL	Thickness (µm)							
		Vert. C/D							
	GCA	AV Thickness (µm)							

Figure 1. Google form for data collection.

Accuracy of SPSS data was checked against the cumulative index data (100%). SPSS analysis was used in this study as it is the one of the commonest and most accurate data analytical method used in descriptive analytical studies<sup>6</sup>.

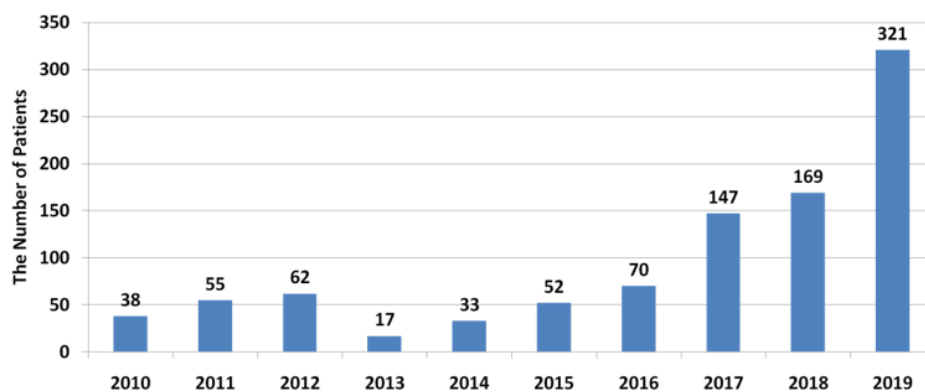
81	3	.3	.3	99.2
82	3	.3	.3	99.5
83	1	.1	.1	99.6
84	1	.1	.1	99.7
85	2	.2	.2	99.9
89	1	.1	.1	100.0
Total	964	100.0	100.0	

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/ORDER=ANALYSIS.

**Figure 2.** Assessing the accuracy of SPSS data.

## Results and Discussion

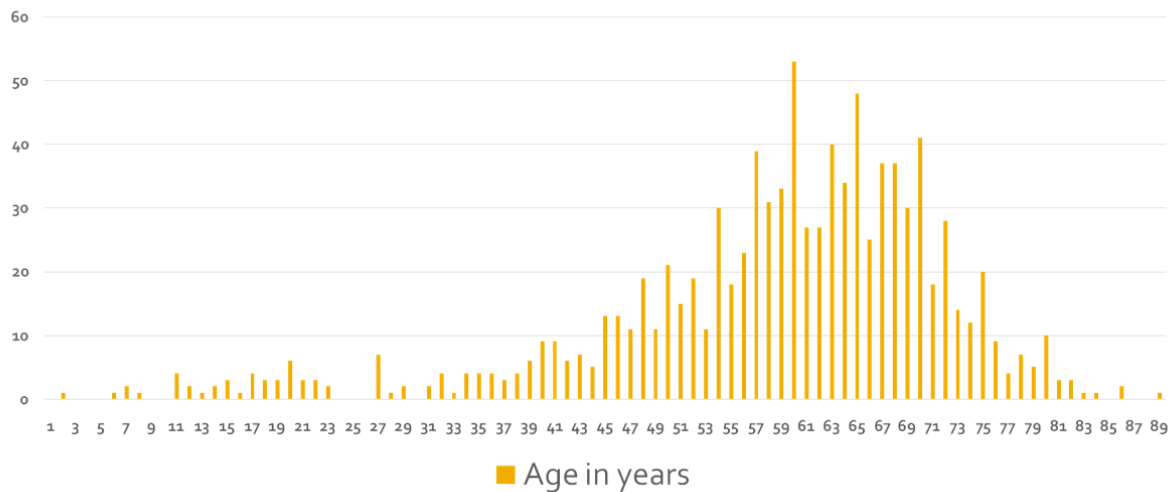
The number of patients recruited each year was analyzed and it was noted that compared to first five years, the total number of newly recruited patients were increased during the next five year period.



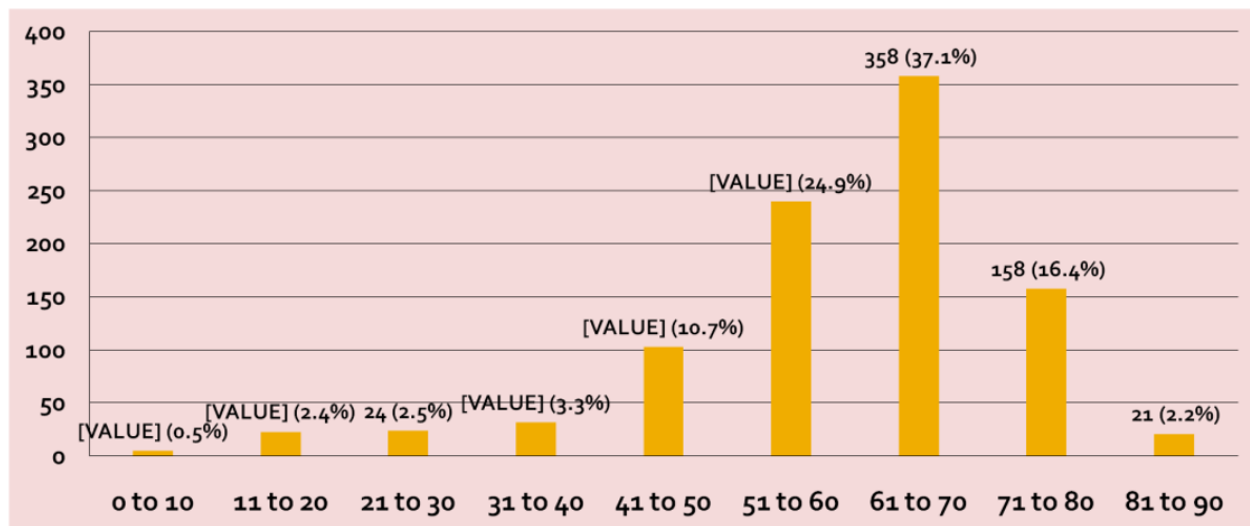
Year	Number Of Patients	Percentage
2010	38	3.9
2011	55	5.7
2012	62	6.4
2013	17	1.8
2014	33	3.4
2015	52	5.4
2016	70	7.3
2017	147	15.2
2018	169	17.5
2019	321	33.3
Total	964	100

**Figure 3.** Number of patients recruited each year.

Clinical profiling of demographic analysis revealed that the age of the patients ranged from 2 years to 89 years while the age groups analysis revealed that the majority (37.1%) were in the age group of 61 to 70. This will be a key issue as the current Sri Lankan population is fast ageing<sup>7</sup>.



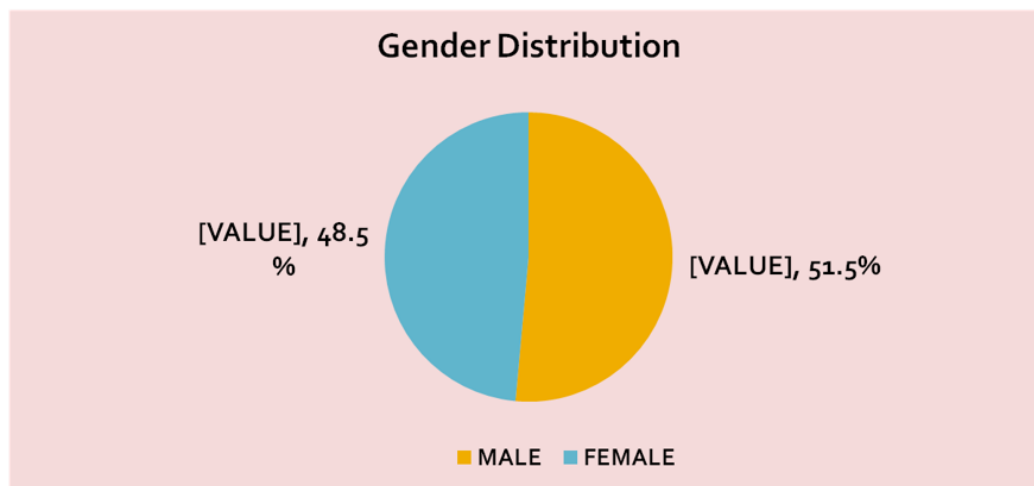
**Figure 4.** Demographic analysis on age distribution.



**Figure 5.** Age groups analysis of the patients.



Gender distribution analysis revealed that there are 51.5% males (n=496) while 48.5% (n=468) were females.



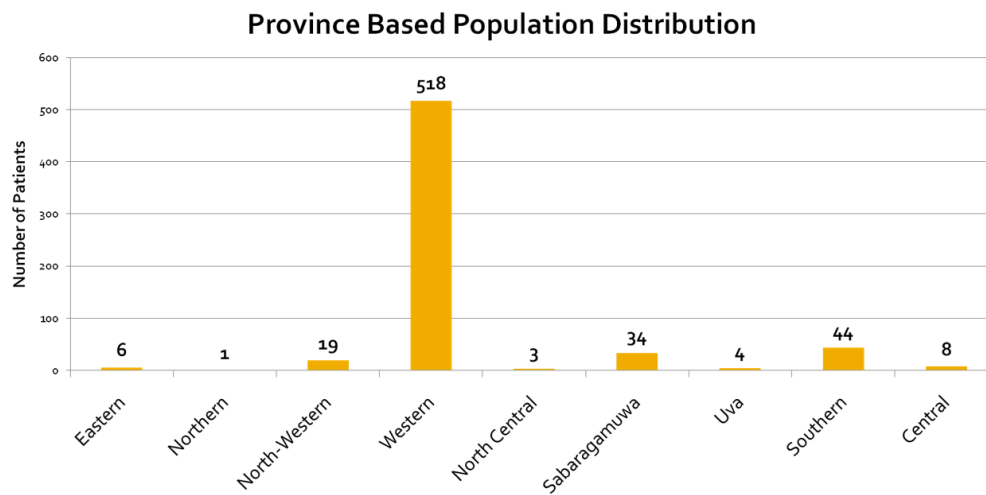
**Figure 6.** Gender distribution analysis of the patients.

Patients' resident areas were analyzed to check the location distribution of the study population. The residency details were recorded only in 637 patients. The district analysis showed that this study represents all the provinces in Sri Lanka.

Province	District	Number of patients	Percentage
Eastern	Ampara	4	0.63
	Trincomalee	2	0.31
Northern	Jaffna	1	0.16
North Central	Anuradhapura	3	0.47
North-Western	Kurunegela	12	1.88
	Puttlam	7	1.10
Western	Colombo	323	50.71
	Gampaha	130	20.41
	Kaluthara	65	10.20
Sabaragamuwa	Kegalle	11	1.73
	Rathnapura	23	3.61
Uva	Monaragala	1	0.16
	Badulla	3	0.47
Southern	Hambanthota	7	1.10
	Mathara	13	2.04
	Galle	24	3.77
Central	Kandy	3	0.47
	Matale	4	0.63
	Nuwara Eliya	1	0.16
		<b>637</b>	<b>100</b>

**Figure 7.** Distribution of residency area of patient.

It was revealed that the highest number of patients were registered from the Western province (81.31%, n=518), and the majority of 50.7% (n=323) were from Colombo district, while Gampaha district recorded 20.4% (n=130) patients and Kalutara district ranked third with 10.2% (n=65). The Northern province recorded the lowest number of patients seen with 0.15% (n=1). However out of the total sample, location details of 327 patients were not available due to incomplete record keeping at the time of registration, which was found as a limitation of the study.



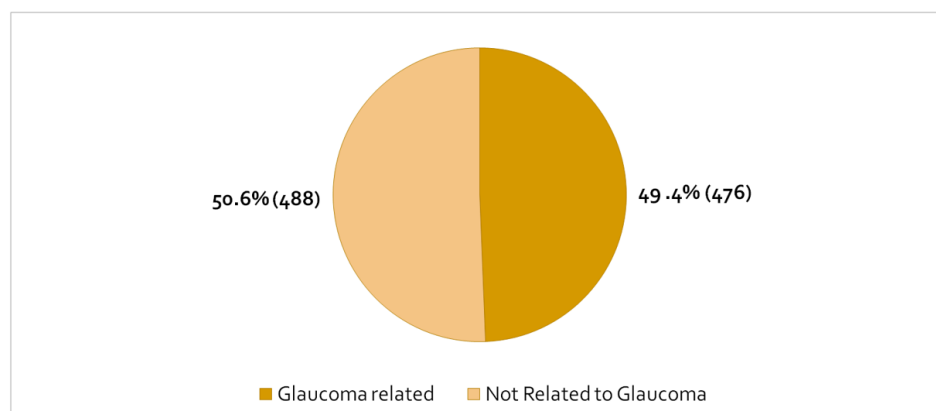
**Figure 8.** Province based population distribution.

Majority of 93.8% patients were presented as self presentation to the clinic while rest were referred by Ophthalmologists and GPs as well as referred from Eye Camps.

	Frequency	Percentage
Self presentation	904	93.8
Referred by Ophthalmologist/GP	40	4.1
Referred from Eye Camps	20	2.1
Total	964	100.0

**Figure 9.** Method of patient referral.

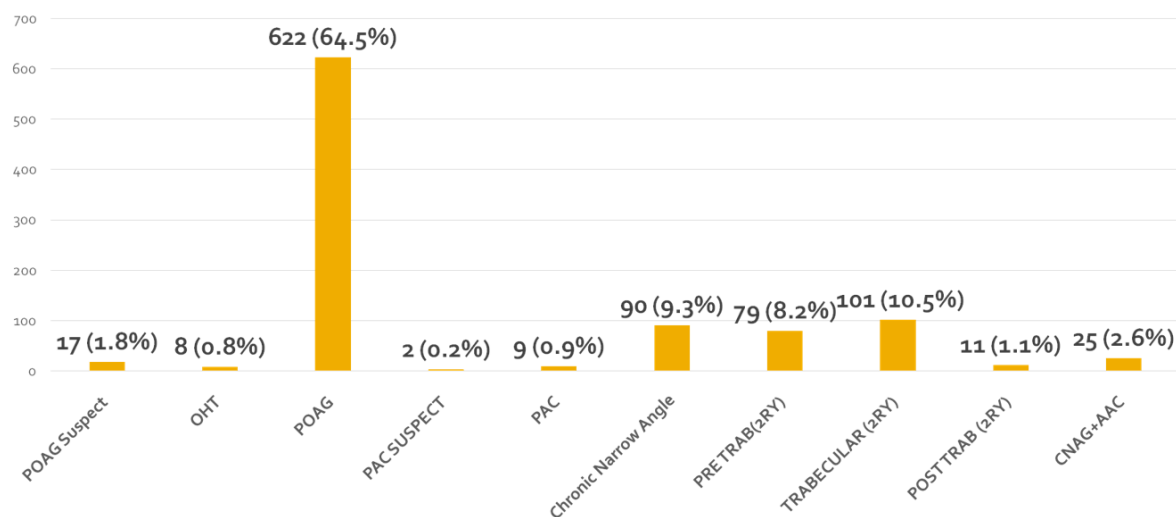
The review of the reason for attending the clinic showed that the 50.6% were unaware that they had glaucoma, while 49.4% came for glaucoma related complaints.



**Figure 10.** Reason for attending the clinic.

This knowledge deficiency was similarly seen in a study done by Abu et al<sup>8</sup> and Leite et al<sup>9</sup> as they demonstrated that 52.4% of participants of their study had a low level of knowledge about glaucoma.

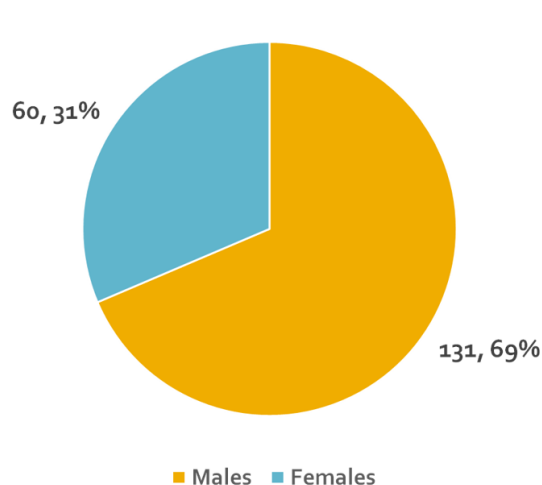
Clinical profiling analysis of the type of glaucoma revealed that the majority of 64.5% (n=622) were diagnosed of having POAG. The published data in Asia highlights that majority of cases were due to POAG<sup>10,11</sup>.



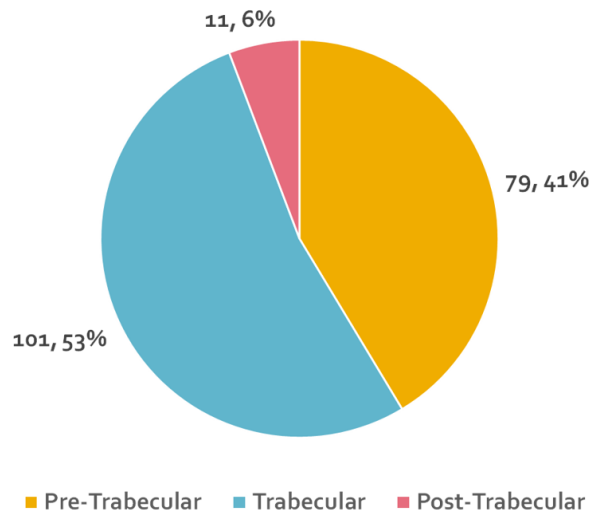
	Frequency	Percent
POAG Suspect	17	1.8
OHT	8	0.8
POAG	622	64.5
PAC SUSPECT	2	0.2
PAC	9	0.9
Chronic Narrow Angle	90	9.3
PRE TRAB(2RY)	79	8.2
TRABECULAR (2RY)	101	10.5
POST TRAB (2RY)	11	1.1
CNAG+AAC	25	2.6
Total	964	100

**Figure 11.** *Type of Glaucoma.*

Analysis of secondary glaucoma showed that most of the secondary glaucoma cases were recorded following globe ruptures, while males (69%) were predominant among the total secondary glaucoma cases, which was similarly documented in published studies<sup>12</sup>.



**Figure 12.** Gender analysis of secondary glaucoma.

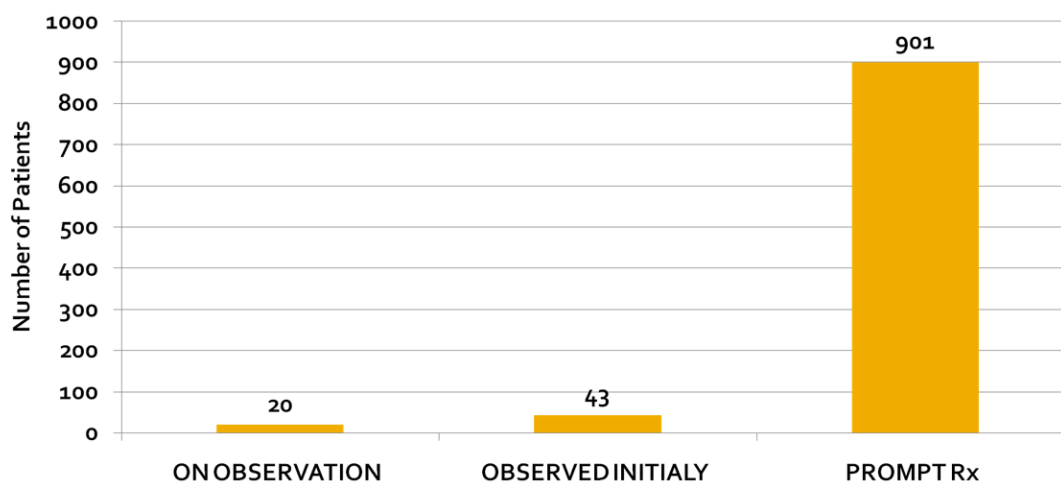


**Figure 13.** Analysis of types of secondary glaucoma.

Literature review on the world glaucoma prevalence on secondary glaucoma showed that the mean prevalence of secondary glaucoma is 0.44 [SD 0.36%] or 18% of the mean prevalence of primary open angle glaucoma in the world<sup>13</sup>. Quigley<sup>1</sup> estimated that 6 million people in the world have secondary glaucoma compared with 67 million with the primary glaucoma (8.95%).

Further analysis of the type of glaucoma recorded that 11.9% (n=115) patients were chronic narrow angle glaucoma, while 0.9% (n=9) patients were diagnosed with primary angle closure glaucoma (PACG). The literature review on world glaucoma prevalence of the acute angle closure glaucoma confirmed that PACG affects 0.17% of individuals younger than 40 years, particularly East Asians<sup>14,15</sup>. The study showed that 2% (n=19) of the patients were glaucoma suspects, while primary angle closure (PAC) suspects were 0.2% (n=2). Ocular hypertension was diagnosed among 8 patients in the study population.

Analysis of the medical management of recruited patients highlighted that 901 patients (93.5%) were started on prompt treatment at the initial visit, while 43 patients (4.5%) were observed initially, but later started on medical management. There were 20 patients (2.1%) who were observed without Rx throughout the study duration.

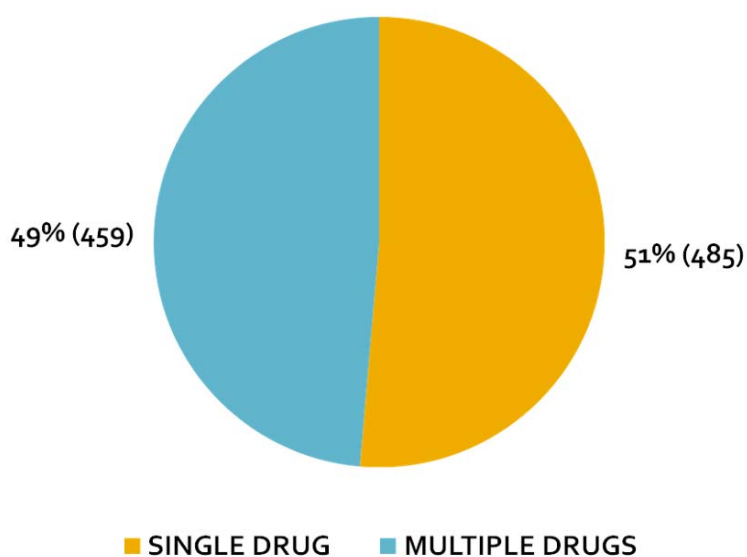


**Figure 14.** Analysis of the medical management of study population.

Out of the 43 patients who were observed initially, were started on treatment as below.

	Frequency	Percent
0 to 6 months	10	23.3
>6months to 1Yr	15	34.9
> 1 Year to 1.5 Years	2	4.7
> 1.5 Years to 2 Years	8	18.6
> 2 Years to 3 Years	3	7
> 3 Years to 4 Years	4	9.3
> 4 Years	1	2.3
Total	43	100

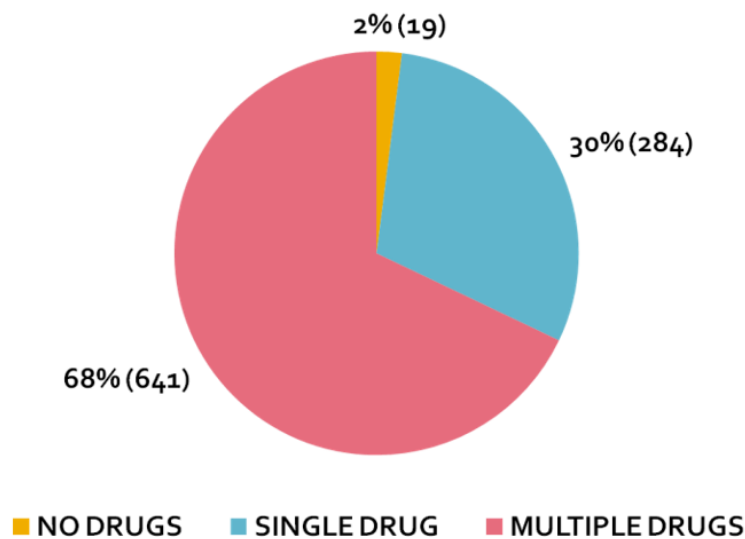
**Figure 15.** Observation time duration of patients who were not started prompt treatment.



**Figure 16.** Initial medical treatment – monotherapy vs polytherapy.

When analyzing the initial medical treatment (n=944), majority of 51% (n=485) were started on monotherapy while 49% (n=459) were started on multiple drugs to control IOP. This was based on the evidence that the reduction of the intraocular pressure is the only form of treatment that has been shown to be efficacious and is generally accepted for the prevention of glaucoma progression<sup>16,17</sup>.

The variation of medical treatment after 10 years, confirmed that the out of the 944 patients, 2% (n=19) were withdrawn from treatment, while 67.9% (n=641) patients were started on multidrug treatment during the follow up period.



**Figure 17.** Variation of medical treatment after 10 years.

The trends analysis of the variation of the medical therapy during 10 years follow up highlighted that the number treated with mono-therapy had decreased from 485 to 284 with time, while the number of patients treated with Multi-therapy had increased from 459 to 641. There were 19 patients who were taken off drugs during the follow up period.

Surgical management of the study was analyzed using existing data. The trends in surgical therapy during 10 years follow up confirmed that out of the 964 patients 8.29% (n=80) required surgical intervention. Out of the patients who required surgical interventions trabeculectomy was performed in 71.25% (n=57), while phaco-trabeculectomy, tube shunt, and repeat trabeculectomy were also performed as below. Schuster et al<sup>18</sup> confirmed that this higher percentage of trabeculectomy, as the reference standard for filtering procedure to reduce intraocular pressure. The literature review confirmed that when performed early, filtration surgery can give excellent IOP control with minimal complications<sup>19</sup>.

Type of Surgery	Frequency
Trabeculectomy	48 (60%)
Phaco-trab	7 (8.75%)
Tube Shunt and Other	6 (7.5%)
Repeat Trabeculectomy	2 (2.5%)
Missing Cases	17 (21.25%)
<b>Total</b>	<b>80</b>

**Figure 18.** Type of surgery that the patients underwent during the follow up periods.

Post Surgical Achievement of IOP control was analyzed and it confirmed that the IOP control was achieved by surgery (Trabeculectomy) alone in 41.26% of patients, while 52.38% of patients needed additional medical treatment for IOP control. However, 6.34% of patients did not have control with medical and surgical treatment<sup>17</sup> patients were lost to follow up following surgery (21.25%).

	Frequency	Percentage
<b>Surgery Alone</b>	<b>26</b>	<b>41.26</b>
<b>Surgery + Medical</b>	<b>33</b>	<b>52.38</b>
<b>Not Controlled</b>	<b>4</b>	<b>6.34</b>
<b>Total</b>	<b>63</b>	<b>100</b>

**Figure 19.** Achievement of IOP control – post surgical.

Pattern of lost to follow up analysis of the study population highlighted that out of the total 964 patients, 89.7% (n=865) patients had come for regular follow up, while 9.6% (n=93) patients were lost to follow up. Additional 0.6% (n=6) were referred to local hospitals.

	Frequency	Percent
<b>Regular</b>	<b>865</b>	<b>89.7</b>
<b>Lost follow up</b>	<b>93</b>	<b>9.6</b>
<b>Ref to local Hosp</b>	<b>5</b>	<b>0.5</b>
<b>Ref to Sub Sp</b>	<b>1</b>	<b>0.1</b>
<b>Total</b>	<b>964</b>	<b>100</b>

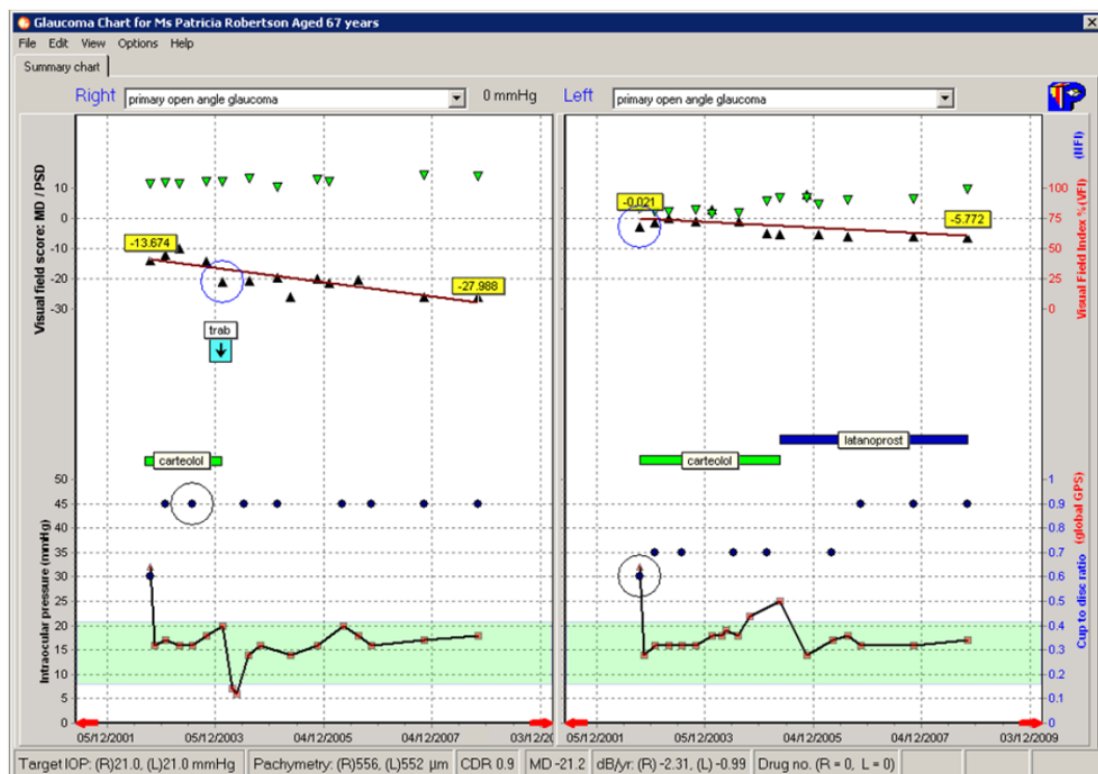
**Figure 20.** Pattern of follow up of patients.

This was a remarkable success when compared with similar studies which highlighted that one-third of glaucoma patients became lost to follow up over a 10-year period<sup>20</sup>.

When analyzing the pattern of lost to follow up patients, confirmed that out of the 93 patients that have failed to come on regular due date, majority of 89.2% (n=83) had come for a review within 1 year.

## Conclusions

The number recruited each year confirmed that higher numbers of patients were registered from year 2017 to 2019. This finding indicates that the clinic attendance reduces after a period of 3 years. To minimize this, patients whose glaucoma is fully controlled can be reviewed annually, and drugs need to be issued with the help of the front desk, where appointments for clinic visits are issued. Computerized system of documenting patients' data need to be installed in outpatient clinics, which is similar to the Electronic Patient Recording System.



**Figure 21.** Medisoft ophthalmology – A platform for electronic patient recording

Age group analysis revealed that the highest number of patients who came to the clinic were in the age group of 61-70 years. These finding indicates the screening of the age group 40 to 80 years is important for our country, highlighting the need to improve the ophthalmic care for the middle age and the elderly. The actual number of patients will increase in future because the current expected growth rate for over 65 population in Sri Lanka is 2.26% per annum.

Secondary glaucoma (19.8%) was the second commonest type of glaucoma, while it had a male preponderance (51.5% – over all and 69% in secondary glaucoma). Majority of the secondary glaucoma was due to work place or other injuries and most often they were the sole breadwinners of the family, which can have a great impact on the economy. This high male preponderance for secondary glaucoma shows the urgent requirement of initiating a “National Awareness Program” regarding importance of wearing protective eye gear.

Location analysis revealed that the majority came from Western province, while study populations represented patients from all the provinces.

The awareness analysis revealed that 50.6% of patients were unaware of having the disease, while 49.4% of patients were aware of the disease. These statistics (49.5% were aware of the disease) is compatible with Western data, and a good indicator of the satisfactory awareness of glaucoma in Sri Lanka. However 50.5% did not know that they have the disease, indicating that the intense programs for awareness needs to be continued. There were several awareness improvement activities conducted at National Eye Hospital, which included organizing glaucoma screening clinics, annual glaucoma walk, arranging eye camps etc.





**Figure 22.** Glaucoma awareness programs at National Eye Hospital.

64.5% cases were POAG, which is compatible with Asian data, highlighting the importance of educating the eye care teams for checking all patients who attend eye clinics for whatever reasons, for IOP measurement. Airpuff tonometry can be used as an effective way to achieve this.



**Figure 23.** Airpuff tonometry at National Eye Hospital.

89.62% were controlled on medical management, out of which initially 51% were on mono-therapy, while later 68% were on multi-drug treatment. This finding is compatible with adding a second drug without switching the drugs, or adding the second drug without due consideration for the adherence and drop instillation technique.

Out of the 964 patients 8.9% required surgical options, while trabeculectomy was the commonest surgery done (71.4%). 41.26% cases were fully controlled after trabeculectomy. This concludes that early safe trabeculectomy need to be done where needed without waiting till glaucoma is very advanced.



**Figure 24.** Early safe trabeculectomy – surgical steps.

52.38% required additional medical treatment after trabeculectomy and 6.1% were not controlled after both surgical interventions and medications. This indicates a close follow up after trabeculectomy is very crucial to prevent progression of glaucoma and further vision loss.

9.6% patients were lost to follow up during the study periods. Low figure of lost to follow up is very likely due to free supply of services, investigations and drugs, which needs to be continued.

### Why this study can be applied to National Data?

Analyzing a large sample (1928 eyes) over 10 years duration makes that the data from this study can be projected to the National Data. It is a descriptive analysis with a narrow confidence interval and the sample represented all 9 provinces. Chi square value for the provincial variation of the sample showed a Chi Square of 17.6099 (P-value is 0.000027), which is significant at  $P < 0.05$ .

	POAG	Non - POAG	Total
Western Province	350	168	518
Other Provinces	56	63	119
Total	406	231	637

**Figure 25.** Chi Square P-values analysis for provincial variation.

Chi square value for the type of glaucoma of the sample showed a Chi Square of 12.7024, which is significant at  $P < 0.05$ .

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	Secondary	Non - Secondary	Total
Western Province	111	407	518
Other Provinces	44	75	119
Total	155	482	637

**Figure 26.** Chi square P-values analysis for type of glaucoma.

### Recommendations

Due to risk of COVID-19 outbreaks, we need to depend on some method that can measure IOP quickly, keeping some distance with the patient. Air puff tonometry mounted on a motorized table and where instillation of breath shield is possible, is a suitable alternative to appplanation of all. In addition, in all eye clinics, the IOP measurements should be done with adherence to all required safety measures.



**Figure 27.** IOP monitoring during Covid outbreak.



Also we need to inform public where to get the IOP checked safely, during the pandemic period. Therefore in eye clinics of all hospitals, tonometry should be available and done. All the private health care institutions where eye surgeons do channeled consultations, tonometry facility should be available and need to be done for all the patients, adopting suitable safety measures.

In addition, emphasis is made regarding the value of disc photos and disc assessments using fundal viewing contact lenses, since direct ophthalmoscopy is not a suitable option even for screening purposes.

When organizing public awareness campaigns, short slogans should be used as a method of effective delivering of messages and intense public awareness campaigns need to be continued.

Drive through IOP measurements will be a timely intervention as it will increase screening of a mass population.



**Figure 28.** Drive through IOP monitoring for mass screening.

### Final conclusion

As lack of data regarding any disease, is a major obstacle for formulating any protocol to improve services, or to gain insight to the disease. This study provides projected Sri Lankan data regarding type of glaucoma, important age group to address and correct management protocols suitable to our country.

### Acknowledgments

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