

## Gender and Glaucoma: Findings from a Hospital-based Study in Upper Egypt

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### ABSTRACT

**Background:** There is an increasing evidence globally on the presence of gender bias either in the prevalence or the uptake of eye care services between men and women.

**Objective:** To detect the difference between men and women in the frequency and both demographic and clinical characteristics of glaucoma patients.

**Patients and methods:** The current study adopts a retrospective study design, a total number of 1000 subjects were recruited in the current study on a multi-center approach. The sample was recruited from Aswan University Hospital, Aswan Ophthalmology Hospital, Aswan Eye Center, and Baladi Foundation Eye Clinic.

**Results:** Among 1000 investigated subjects, the mean ( $\pm$ SD) age was 42.3 ( $\pm$ 22.6) years, 455 (45.5%) were male and 545 (54.5%) female. Disaggregating data per gender showed that there were a statistically significant difference in laterality ( $p=0.038$ ), best corrected affected vision ( $p<0.0001$ ), uncontrolled intraocular pressure (IOP) ( $P<0.0001$ ), and accounting enlarged corneal diameter ( $p=0.044$ ). Moreover, there was a significant difference in the type of primary and secondary glaucoma ( $P<0.0001$ ) and ( $P=0.007$ ), respectively. Multivariate analysis confirmed such findings.

**Conclusion:** Gender bias in glaucoma is a critical issue in terms of both prevalence and service utilization. Women are more affected than men because of gender specific risk factors that may include laterality, severity (as surrogated by surgical uptake) in addition to acquiring some glaucoma subtypes specifically such as congenital, juvenile, pseudo-exfoliation (PXF), uveitic, neovascular and pigmentary glaucoma. Disaggregation of glaucoma data by gender should be applied as a routine in prevention of low vision and blindness research.

**Keywords:** Egypt, Gender, Glaucoma, Ocular Hypertension.

### INTRODUCTION

Glaucoma is a group of diseases that is characterized by increase in the ocular tension that yields a damage in the optic nerve and eventually ends up by either partial or total vision loss. Globally, it is one of the major causes for low vision and blindness contributing around 8.5% of total blindness worldwide, and around 6.9% in the Middle East and North African region among the population of 50 years and above<sup>(1)</sup>. The estimated number of people affected with glaucoma globally in the year 2020 was 76 million inhabitant, that number is subjected to a rapid increase to reach up to 112 million inhabitant by the year 2040<sup>(2)</sup>. Although glaucoma is a multifactorial disease that comprises a number of risk factors, gender bias was detected as a serious risk factor for glaucoma; shortly after, gender and blindness studies started to be of international interest. The explanations are not quite clear yet for why females are more affected in general than males by glaucoma. However, the literature refers to a number of potential explanations such as difference in hormonal profile, difference in life expectancy at birth as well as exposure to potential risk factors in addition to less utilization of eye care services by women, especially in developing countries<sup>(3, 4)</sup>.

Studies from Egypt as well as the eastern Mediterranean region show that the prevalence of glaucoma increases more towards the southern

governorates for community and ophthalmology reasons that implies the availability and quality of services and the pattern of eye care service utilization. That matter is more affecting women than men<sup>(4)</sup>. This fact is also true for similar studies in Saudi Arabia where the number of females much exceeded males in terms of encountering glaucoma (59% and 41% for females and males, respectively)<sup>(5)</sup>. Aswan is a southern Egyptian governorate that is around 900 kilometers far from the capital Cairo. The available eye care services that provide tertiary eye care are four main facilities, where one of them is following the ministry of health and population, one university hospital, one non-governmental organization (NGO) hospital and one private sector hospital. Thus, it is anticipated that the prevalence of glaucoma in Aswan is estimated to be much exceeding the corresponding numbers in other Egyptian governorates.

There is a need to investigate the status of gender bias in terms of glaucoma and hence utilize this information in guiding the policy makers and health authorities to adopt gender sensitive interventions to decrease the prevalence of low vision and blindness due to glaucoma in this governorate as well as the neighboring governorates with similar demographic and health profile structures. The current study is aiming at detection of whether or not there is a gender



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bias profile of glaucoma in southern Egypt and detect the characteristics of glaucoma patients as well.

## PATIENTS AND METHODS

The current study adopts a retrospective study design. On a multi-center approach, the sample was recruited from Aswan University Hospital, Aswan Ophthalmology Hospital, Aswan Eye Center (private sector), and Baladi Foundation eye clinic (NGO) based on the following inclusion criteria; patients with confirmed diagnoses as glaucoma, where such confirmed diagnosis was based on; structural and functional evidence, presence of advanced structural damage with unproved field loss, either the optic disc not seen, or the field test is impossible. Cases with glaucoma or ocular hypertension suspect were excluded from the current study. The confirmed diagnosis criteria have followed the international society for Geographical and Epidemiological Ophthalmology classification. Moreover, the diagnosis included all cases with primary open angle glaucoma (POAG), primary angle closure glaucoma (PACG), primary angle closure suspect (PACS), primary angle closure (PAC), secondary glaucoma (SG), congenital glaucoma, developmental glaucoma, and juvenile glaucoma.

### Ethical approval:

**An approval of the study was obtained from Aswan University academic and ethical committee.** Every patient signed an informed written consent for acceptance of the operation.

Clinical examination included assessment of the best corrected visual acuity, visual field evaluation, a threshold examination of the central 24° of Humphrey visual field (24-2 program) showing a glaucoma hemi-field test (GHT) “outside normal limits” and a cluster of four contiguous points on the pattern deviation plot ( $p < 5\%$  of occurring in age-matched normal subjects) not crossing the horizontal meridian was considered compatible with glaucoma, for both eyes of all subjects in whom visual acuity (VA) better than 0.2, anterior chamber examination with slit lamp, was specifically directed at detection of signs of pigment dispersion syndrome, pseudo-exfoliation, and other secondary causes of glaucoma.

The intraocular pressure (IOP) was measured via Goldmann applanation tonometry and I care for young and uncooperative patients. Gonioscopy [using 4-mirror Zeiss gonioscopes and direct gonioscopy lenses for children under general anesthesia (using in adults a small, thin and low illuminated slit in a dimly illuminated room). Cases of primary angle closure suspects and primary angle closure were lumped under one category, “PAC”.

A specifically designed data collection sheet was developed to collect and store patient’s information including the necessary demographic and clinical indices. Collected data included: age, sex,

laterality, both major and differential diagnosis, intraocular pressure (IOP), cup/disc ratio (CDR), and visual acuity at presentation as expressed by the LogMAR transformation of Snellen chart reading. All cases were reviewed in terms of the method of assessment of glaucoma indices to classify them with the standardized definitions described above. Only cases with a clear and confirmed diagnosis were included in the current study.

All cases were examined by the glaucoma unit team members and confirmed by a senior glaucoma consultant. Data were then stored into a constructed database using Microsoft Access 2010®.

Statistical analysis was done using the Statistical Package for the Social Sciences (SPSS), version 26.0 (IBM Inc., Chicago, Illinois, USA). Categorical data were presented as number and percentages, while continuous variables were presented as mean ( $\pm$ SD). Chi squared test was used to detect potential associations between gender and different glaucoma indices. Meanwhile, Student’s t-test was used to detect mean differences in case of continuous variables. Confidence intervals were set as 95%, while *P*-value less than 0.05 was considered statistically significant. Analysis was done based on disaggregation of gender into male and female for comparison purposes.

## RESULTS

A total number of 1000 subjects were recruited in the current study where subjects were in the mean ( $\pm$ SD) age of 42.3 ( $\pm$ 22.6) years. Among the recruited subjects, 455 (45.5%) were male while 545 (54.5%) were female. Among the recruited sample, 355 (35.5%) had a family history of glaucoma, while glaucoma was bilateral in 580 (58.0%) of them.

As regards the impact of glaucoma on visual acuity and other anatomic structure characteristics, the best corrected visual acuity (BCVA) was affected in 435 (43.5%), while corneal diameter was enlarged in 80 (8.0%) of cases. In terms of glaucoma specific indices, the intraocular pressure (IOP) was uncontrolled in 160 (16.0%) of cases, the angle was closed in 205 (20.5%), the cup/disc ratio was glaucomatous in the majority of cases 715 (71.5%), and so was the visual field assessment in 600 (60.0%) of them. Findings from optical coherence tomography (OCT) showed that 595 (59.5%) of the investigated sample were characterized by glaucomatous characteristics.

Moreover, the major glaucoma subtype was found to be primary open angle glaucoma followed by secondary open angle glaucoma, congenital glaucoma and primary angle closure glaucoma. On the other hand, the major subtype of secondary glaucoma was found to be pigmentary and pseudo-exfoliation glaucoma, followed by uveitic and neovascular glaucoma. Details of both primary and secondary glaucoma are demonstrated in [Table 1].

**Table (1): Subtypes of primary and secondary glaucoma per total sample**

Variable	Category	No. (%)
<b>Type</b>	Primary open angle glaucoma	315 (31.5)
	Primary angle closure glaucoma	80 (8.0)
	Secondary angle closure glaucoma	40 (4.0)
	Secondary open angle glaucoma	130 (13.0)
	Congenital	100 (10.0)
	Juvenile	60 (6.0)
	Normal-tension glaucoma	10 (1.0)
	Ocular hypertension	10 (1.0)
	Normal	255 (25.5)
<b>Total</b>		<b>1000</b>
<b>Secondary glaucoma Cause</b>	Angle recession	20 (12.5)
	Pseudo-exfoliation glaucoma	30 (18.8)
	Uveitic	25 (15.6)
	Neovascular	25 (15.6)
	Pigmentary	30 (18.8)
	Steroid induced	20 (12.5)
	Post retinal surgery	10 (6.3)
<b>Total</b>		<b>160</b>

On disaggregating data per gender, there was a statistically significant difference in laterality, best corrected affected vision, uncontrolled IOP, and accounting enlarged corneal diameter. Moreover, there was a significant difference in the type of primary and secondary glaucoma ( $P < 0.0001$ ) and ( $P = 0.007$ ), respectively. Table 2 demonstrates the disaggregated characteristics per gender and the corresponding p values.

**Table (2): Disaggregated demographic and clinical indices per gender**

Variable	Category	Male N: 455	Female N: 545	P value	Total
<b>Age</b>	Mean (SD)	42.4 (23.4)	42.2 (21.9)	???	1000
		<b>No. (%)</b>	<b>No. (%)</b>		
<b>Family History</b>	Positive	170 (37.4%)	185 (33.9%)	0.261	355
	Negative	285 (62.6)	360 (66.1)		645
<b>Laterality</b>	Unilateral	175 (38.5)	245 (45.0)	0.038	420
	Bilateral	280 (61.5)	300 (55.0)		580
<b>Best corrected visual acuity</b>	Affected	240 (52.7)	195 (35.8)	<0.0001	435
	Unaffected	215 (47.3)	350 (64.2)		565
<b>Intraocular pressure</b>	Uncontrolled	110 (24.2)	50 (9.2%)	<0.0001	160
	Controlled	345 (75.8)	495 (90.8)		840
<b>Anterior chamber</b>	Closed	105 (23.1)	100 (18.3)	0.065	205
	Open	350 (76.9)	445 (81.7)		795
<b>Corneal diameter</b>	Large	45 (9.9)	35 (6.4)	0.044	80
	Normal	410 (90.1)	510 (93.6)		920
<b>Intervention</b>	Surgical	170 (37.4)	190 (34.9)	0.412	360
	Medical	285 (62.6)	355 (65.1)		640
<b>Cup/disc ratio</b>	Glaucomatous	335 (73.6)	380 (69.7)	0.174	715
	Normal	120 (26.4)	165 (30.3)		285
<b>Visual field</b>	Glaucomatous	280 (61.5)	320 (58.7)	0.364	600
	Normal	175 (38.5)	225 (41.3)		400
<b>Optical coherence tomography</b>	Glaucomatous	275 (60.4)	320 (58.7)	0.580	595
	Normal	180 (39.6)	225 (41.3)		405

Additionally, multivariate analysis was used to investigate if there is still a statistically significant difference between both genders adjusting for other variables. Conduct of binary logistic regression showed that male were more affected than female in decreased BCVA [Odd Ratio (OR): 6.4 (Confidence interval (CI): 2.026 – 19.909),  $p = 0.006$ ], uncontrolled IOP [OR: 49.2 (CI: 12.2 – 198.7),  $p < 0.0001$ ], and glaucoma subtype [OR: 0.06 (0.012 – 0.288),  $p < 0.0001$ ], while female were more affected than male in terms of having surgical intervention [OR: 12.4 (CI: 3.605 – 42.843),  $p < 0.0001$ ], and having bilateral glaucoma [OR: 3.5 (CI: 1.241 – 9.658),  $p = 0.018$ ].

## DISCUSSION

Gender and glaucoma is one of the fast growing research topics nowadays due to the impact of reducing glaucoma related blindness on the overall prevalence of low vision and blindness. There is a debate on the core hypothesis that identifies women as more affected than men with glaucoma. Such debate is still in need for more evidence from different WHO regions to accept or reject this hypothesis, given the variation in prevalence, pattern and severity of glaucoma per each region as well as the associated risk factors and service uptake pattern. Studies from Egypt supported gender and blindness concepts in general as well as in terms of specific blinding eye diseases such as trachoma and its complications. The current study focused on gender and glaucoma aspects in southern Egypt where glaucoma is well known to be more prevalent due to consanguinity, underutilization of service, lack of quality service and many other factors.

The main findings of the current study shows that family history is present in around one third of cases (35.5%), while surgical intervention is covering only (36.0%) of cases where (16.0%) of them suffer uncontrolled IOP.

Gender differences in family history, being bilateral, getting more damage in the eye as assessed by glaucoma specific indices such as CDR, baseline visual field (VF), and OCT findings are all showing that females are more affected than males. However, it did not reach up to the significance level. Nevertheless, indices such as having affected vision, uncontrolled IOP, and having closed angle, show either statistically significant difference or critically close to significance; which suggests that males are suffering from more affected vision and less compliance to anti-glaucoma medications. This variation is quite common in similar globally published studies.

Findings from our series suggest that age is a confounding variable that turned into significant when included in the multivariate analysis. Variables that showed significant difference between male and female persisted to be significant in the multivariate analysis as well with adjusted odds ratio except for type of intervention that suggested a difference between female and male in terms of surgical services uptake. Male were more affected than female as regards BCVA, IOP, and glaucoma subtype while females were more affected in terms of having bilateral glaucoma and in getting better surgical uptake. In terms of glaucoma subtype, it is clear that female are more affected than male with secondary and juvenile glaucoma whereas in subtype of secondary glaucoma they are more affected with PXF, uveitic, and pigmentary glaucoma.

These findings may reflect a region-specific pattern. Findings from this study goes with findings

from North Africa studies rather than the Asian model that includes studies from Asian-Arabic countries such as Saudi Arabia, Qatar and Oman that are different than studies from sub-Saharan Africa<sup>(5-7)</sup>, for example, studies report primary open angle glaucoma (POAG) as far more common than primary angle-closure glaucoma (PACG) worldwide<sup>(8)</sup>.

Although the current study is not a prevalence study, given that it is a hospital based study, it was clear that the females are more frequently represented than males constituting 54.5% of the total sample. A study in Ghana, showed a more male affection (54%) which represents a different gender pattern than ours. Nevertheless, the frequency of glaucoma among those females (9.5%) was found to be exceeding that in males (8.8%) which agrees with our hypothesis<sup>(9)</sup>. Within the same context, findings from a Nigerian study showed a gender difference towards female prevalence of glaucoma versus male prevalence where the Nigerian study adopted a community-based design<sup>(10, 11)</sup>. Specifically, females accounted for 70.4%, but this was not so in the urban area, where the males had glaucoma more than the females, as males, expectedly, are the ones that vend for the family, does the running around, which in the process exposes them to quite a number of risk factors including ocular trauma<sup>(11)</sup>. One of the plausible interpretations of such findings is that males may be at higher risk of acquiring secondary glaucoma than females such as traumatic glaucoma<sup>(12)</sup>. Another viewpoint that may only affect hospital-based studies is the knowledge, attitude and practice gap (KAP-gap) that is biased towards men, who can more easily seek eye care services due to scarcity of resources and that men are the responsible subjects for the main source of income to the family. Additionally, it was found that there is another type of bias related to difference in compliance to glaucoma treatment modality and barriers to receive eye care services between men and women<sup>(13-14)</sup>.

Overall, it is well known that gender-bias in eye diseases is quite common. However, findings from different regions and even from the same region across different time durations may significantly vary. Understanding community specifications is a critical issue in planning for interventions to reduce its effect. Meanwhile, targeting the groups that at higher risk may have a great impact on reducing the overall blindness.

The current study faced a number of limitations that includes being a hospital based and a retrospective study as well. There may be a need for planning for gender sensitive analysis of the disaggregated data.

## CONCLUSION

Gender bias in glaucoma is a critical issue in terms of both prevalence and service utilization.

Women are more affected than men because of gender specific risk factors that may include laterality, severity (as surrogated by surgical uptake) in addition to acquiring some glaucoma subtypes specifically such as congenital, juvenile, PXF, uveitic, neovascular and pigmentary glaucoma. Disaggregation of glaucoma data by gender should be applied as a routine in prevention of low vision and blindness research.

**Financial Declaration:** The authors did not receive any grant to fulfill the study.

**Conflict of Interest:** The authors declare no conflict of interest in this study.

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