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## Research Article

# A Cross-Sectional Study on Socioeconomic Status of Glaucoma Patients and Prescription Burden of Antiglaucoma Drugs in Pakistan

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## Abstract

**Background and Objective:** Glaucoma management has a very strong impact on society, especially in terms of morbidity, consultations and medical costs because glaucoma patients need to continue using medication throughout their lives. The study aimed to estimate the pattern of socioeconomic status and prescription burden of antiglaucoma drugs in glaucoma patients with comorbidities like hypertension and diabetes mellitus. **Materials and Methods:** This cross-sectional study was conducted in a tertiary care eye hospital, Rawalpindi, Pakistan. Glaucoma patients were interviewed for 6 months and variables like demographics, education level, monthly income, disease distribution, medication history, prescription pattern were noted and monthly cost of all drugs, socioeconomic status and prescription burden were assessed from the data. **Results:** Out of 876 patients, 511 were males and 38.4% were from the 40-60 year's age group. The majority were jobless, dependent upon others with no formal education and 89.1% belonged to lower socioeconomic status. Comorbidities include Hypertension (27%) and Diabetes mellitus (18.8%). The mean monthly cost of ocular drugs was  $599.73 \pm 491$  PKR per patient and a 194% increase was noted by the addition of glaucoma drugs. **Conclusion:** Our findings describe that majority of our patients were poor, elderly, illiterate, dependent, multimorbid and belonged to lower socioeconomic levels with a high prescription burden of antiglaucoma drugs.

**Key words:** Socioeconomic, prescription burden, glaucoma, antiglaucoma drug, cost-of-illness, hypertension, diabetes mellitus

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Glaucoma is one of the leading causes of irreversible visual impairment and blindness and accounts for 13% of global blindness according to the World Health Organization with an addition of 2.4 million new cases every year<sup>1</sup>. The global incidence of glaucoma was 64.3 million patients in 2013, which increased to 76.0 million in 2020 and is expected to reach up to 111.8 million in 2040<sup>2</sup>. According to literature, the development and progression of glaucoma have been attributed to various risk factors like age, gender, family history, body mass index, hypertension, diabetes mellitus, thyroid disease, steroids usage and use of tobacco/alcohol<sup>3</sup>.

The socioeconomic status of patients is mainly dependent upon the combination of the place of living, educational level, monthly or annual income, total wealth and occupation. In many studies, it has been reported that the lower socioeconomic stratum comprised a higher proportion of individuals having glaucoma<sup>4</sup>. These people use facilities for eye care less frequently so presenting to glaucoma very late with low quality of life and advanced visual field loss. Another factor of late presentation of glaucoma is lack of knowledge about eye diseases especially glaucoma. The level of education of a patient also reflects that a higher level of education is linked with more knowledge about glaucoma and higher socioeconomic status<sup>5</sup>.

Glaucoma exerts a significant burden on financial conditions. The cost of treatment incurred from direct or indirect medical costs has indirect relation with the severity of glaucoma and the number of drugs used<sup>6</sup>. According to Cost-of-illness studies, more than 300 million pounds were spent on glaucoma which comprises 45% as direct cost<sup>7</sup>. Systemic medications for diseases other than glaucoma taken by patients may affect adherence due to cost and complex regimen of therapy<sup>8</sup>.

From a public health perspective, the burden of disease and the drugs is more important than just the presence of a disease and its prevalence. Glaucoma management has a very strong and huge impact on society, especially in terms of morbidity and productivity, consultations and medical costs because glaucoma patients need to continue using medication throughout their lives<sup>9</sup>. The glaucoma treatment burden is mainly borne in developed countries by the government or health insurance but in developing countries like Pakistan, the majority of the population has to bear their health expenses on their own. Glaucoma patients often have other major diseases like hypertension and diabetes which

also need to be managed throughout life by using multiple treatments. The burden of antiglaucoma drugs on the budget of patients already taking medication to treat diseases like hypertension and diabetes needs to be addressed.

As there is a lack of such types of studies in Pakistan, so it is important to gather information about the socioeconomic status of glaucoma patients with a special focus on patients having comorbidities and evaluate the prescription burden of antiglaucoma drugs in glaucoma patients visiting tertiary care eye hospitals.

The study aimed to estimate the pattern of socioeconomic status of glaucoma patients and the prescription burden of antiglaucoma drugs with special emphasis on patients having comorbidities like hypertension and diabetes mellitus type 2.

## MATERIALS AND METHODS

**Study area:** A prospective, cross-sectional study was conducted in the outpatient department of glaucoma, Al-Shifa trust eye hospital (A tertiary care eye hospital), Rawalpindi Pakistan from September 2015-March 2016.

**Ethical approval:** Formal permission was taken from the ethical committees of the hospital and the University of Malakand before the commencement of this study. The study was performed in full compliance with the declaration of Helsinki 1964.

**Data collection:** The inclusion criteria comprised of patients visiting glaucoma clinics having ages above 20 years and belonging to either gender. Collection of information (face to face) from the patients directly or through their attendants (by taking prior consent) was performed on a specially designed form.

A comprehensive history including chief complaint, family history of glaucoma or any other eye disease was taken. The socio-demographic variables like age, gender, height and weight, education level, occupation and monthly income were recorded. Addiction history especially tobacco use, any other disease and medication records were also noted. Body Mass Index (BMI) was calculated from body weight and height.

**Cost analysis:** The monthly cost of drugs was calculated by dividing the retail price by the number of drops per bottle and then multiplied by the frequency of use per day as it was originally calculated by Fiscella *et al.*<sup>10</sup>. The result was

then multiplied by 30 to calculate the monthly cost. Assuming that the patients were using eye drops in their both eyes so the results were then multiplied by 2. Monthly costs of antihypertensive, antidiabetic and other drugs were also calculated. The maximum retail prices of all drugs were taken from the government of Pakistan recognized drug index PharmaGuide Pakistan (23rd Edition, 2014-15) and then calculated the prescription burden of antiglaucoma drugs.

**Methodology:** The socioeconomic status of patients was calculated by using a method developed by Kuppaswamy known as the scale of Kuppaswamy urban (1976) and that was further modified by different researchers<sup>11</sup>. The monthly income groups' scale was further modified as per our requirement in PKR as done by Mughal *et al.*<sup>12</sup> in 2010. Basic criteria for evaluating variables like education level and occupation of the patients and monthly income of patients or to whom they were dependent was followed. Then after

calculating the socioeconomic status scale, the classes were presented as lower, lower upper-lower, lower-middle, middle upper-middle and upper class.

**Statistical analysis:** All of the data was evaluated by using SPSS 17 software and descriptive statistics were implemented. Mean, standard deviation, maximum limit and percentage were calculated. Categorical variables like age group, educational status and monthly income in Pakistani Rupees (PKR) were calculated in 3 or more categories and the rest were binary. United States Dollar conversion rate at the time of conduction of study was, 1 USD = 100.90 PKR.

## RESULTS

During the prescribed period 876 patients were interviewed. Total 74% (n = 648) of patients were treated free of cost (Charity/Zakat). Out of them, 511 (58.3%) were males

Table 1: Demographic and socioeconomic factors of our study subjects.

Variables	Responses	Frequency (no. of patients)	Percentage
Patient category	Zakat (charity/free of cost)	648	74
	Subsidized rates	228	26
Gender	Male	511	58.3
	Female	365	41.7
Age group (years)	Less than 40	90	10.3
	40-60	336	38.4
	61-70	293	33.4
	More than 70	157	17.9
Educational status	No formal education	344	39.3
	1-5 years	152	17.4
	6-10 years	273	31.2
	11-14 years	83	9.5
	More than 14 years	24	2.7
Rural and urban distribution	Rural	322	36
	Urban	554	64
Body mass index (BMI)	Underweight	45	5.1
	Normal	457	52.1
	Overweight	239	27.3
	Obese	133	15.2
Addiction status	Using tobacco	219	25
	Not using tobacco	657	75
Economic dependence	Self-dependent	297	33.9
	Dependent on family	579	66.1
Monthly income (PKR)*	Up to 10000 (99.10 USD)	242	31.9
	10001-20000 (99.10-198.20 USD)	335	44.1
	20001-30000 (198.20-297.32 USD)	107	14.1
	30001-50000 (297.32-495.54 USD)	61	8.0
	>50000 (495.54 USD)	14	1.8

Income indicates the monthly income of patients or whom they were dependent (n = 759 as data for income was missing in 117 (13.4%) cases), \*PKR: Pakistani rupee (1 USD = 100.90 PKR), n = 876

while 38.4 and 33.4% belonged to the 40-60 and 61-70 years age group respectively. Total 66.1% (n = 579) were dependent upon their families or society and 64% (n = 554) were from urban areas. The majority of them (n = 344, 39.3%) were found to have no formal education while 31.2% (n = 273) had 6-10 years of formal education (Table 1). Almost half of the patients (n = 412, 47.03%) were jobless. Women serving as housewives were 15.53% (n = 136) and 9.70% (n = 85) of patients were retired citizens (Fig. 1). 238 (27%) were hypertensive and diabetic respectively while 2.8% (n = 194) had other systemic diseases including asthma, CVD, depression, arthritis, gastric problems & tuberculosis etc. (Fig. 2). Monthly income of 44.1% (n = 335) patients or whom they were dependent was 10,001-20,000 PKR (99.10-198.20 USD), followed by up to 10,000 PKR (99.10 USD) of 31.9% (n = 242). In addition, 27.3% (n = 239) were recorded as overweight as per the calculated BMI scale. (Table 1). The majority of patients (n = 780, 89.1%) belonged to the lower or upper lower class on the socioeconomic status scale calculated by the scale of Kuppuswamy urban (1976) (Table 2).

Total 29.3% (n = 257), 27.9% (n = 244) and 20.3% (n = 178) patients were using 1, 2, 3 eye medicines

respectively. Amongst them 35.2% (n = 308), 23.4% (n = 205) and 14.6% (n = 128) were using 1, 2, 3 antiglaucoma drugs respectively (Table 3). About 219 (25%) patients were using no medication for glaucoma.

The mean monthly cost of ophthalmic medicine calculated was 599.73 ± 491 PKR (5.94 ± 4.87 USD) per patient with a maximum of 2776.3 PKR (27.51 USD) per month a maximum of 2400 PKR (23.78 USD) per month and 154.13 ± 625 PKR (1.52 ± 6.19 USD) per patients with a maximum of 6060 PKR (60.06 USD) per month respectively and also for Other systemic drugs calculated was 75.45 ± 343 PKR (0.75 ± 3.39 USD) per patients with a maximum of 3741 PKR (37.07 USD) per month. The mean monthly total cost of all drugs including ophthalmic drugs calculated was 908.61 ± 1003 PKR (9.00 ± 9.94 USD) per patient with a maximum of 9100 PKR (90.19 USD) per month and 194% increase was noted in the mean monthly cost and 33.3% increase in the maximum cost of all other drugs by the addition of glaucoma medication. A highest 794.84% prescription burden was noted in the mean monthly cost of patients using other systemic drugs followed by antihypertensive 756.37% and then antidiabetic 389.10%

Table 2: Socioeconomic status of our subjects

Scale	Socioeconomic status	Number of patients	Percentage
26-29	Upper	8	0.9
16-25	Middle, upper middle	16	1.8
11-15	Lower middle	72	8.2
5-10	Lower, upper lower	345	39.4
<5	Lower	435	49.7

It was calculated based on the Kuppuswamy scale (1976), The majority belonged to the upper-lower or lower class, n = 876

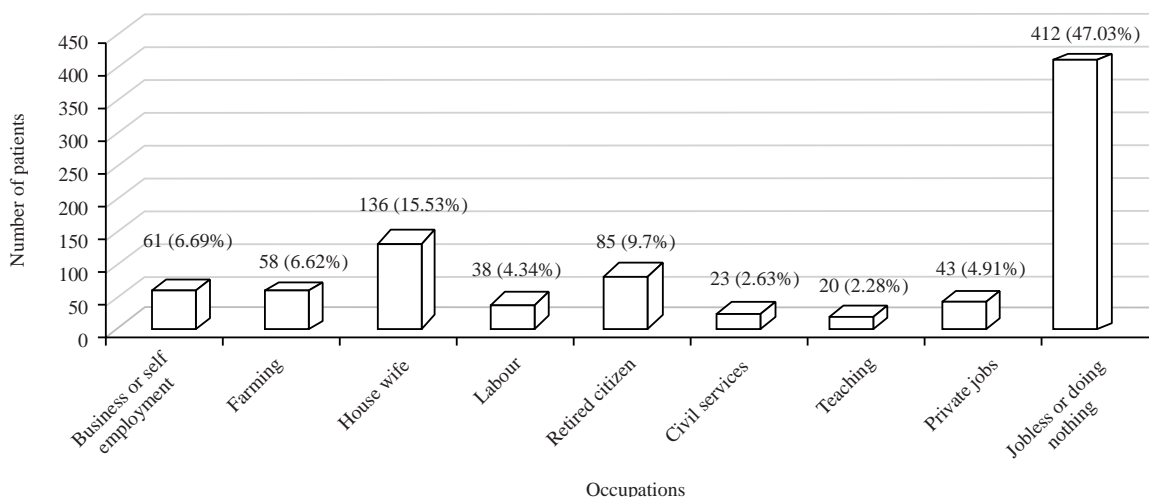


Fig. 1: Occupational status of our studied subjects

Data labels include the number and percent of patients, n = 876

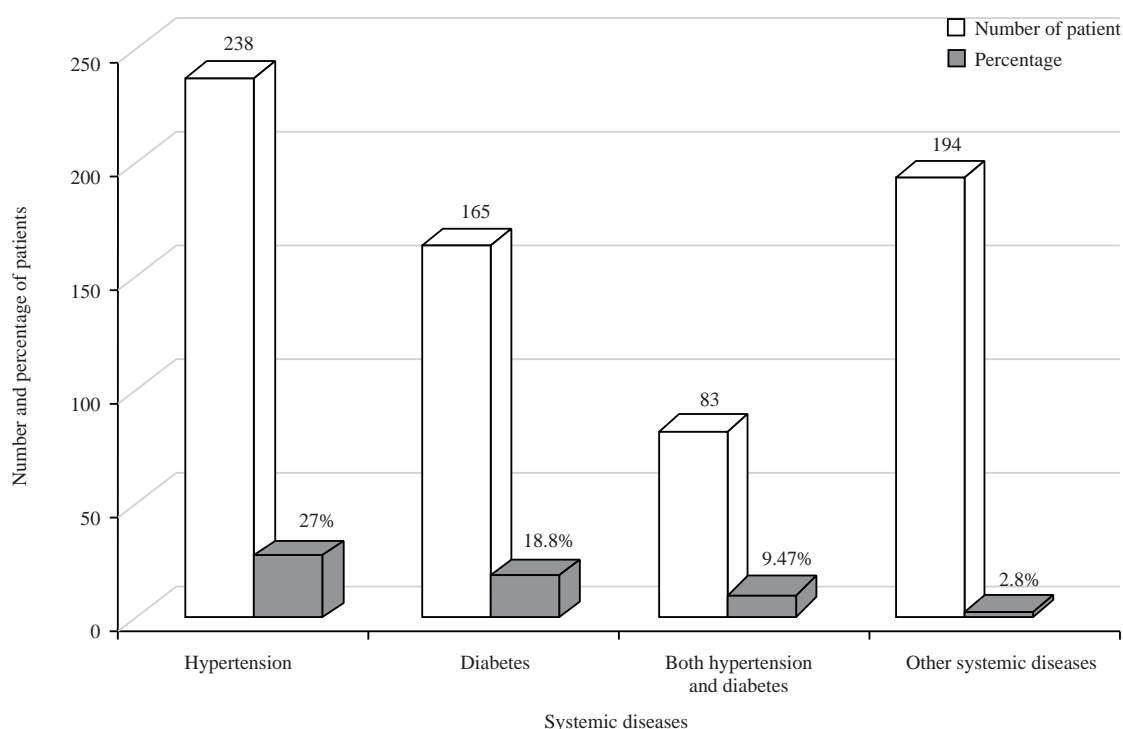


Fig. 2: Status of systemic diseases of our study subjects

Hypertension and diabetes mellitus 2 were the most common systemic diseases while other systemic diseases include asthma, cardiovascular and gastric issues

Table 3: Number of ophthalmic drugs prescribed to our study subjects

Number of drugs	Total ophthalmic drugs* (%)	Total glaucoma drugs** (%)
0	124 (14.2)	219 (25.0)
1	257 (29.3)	308 (35.2)
2	244 (27.9)	205 (23.4)
3	178 (20.3)	128 (14.6)
4	45 (5.1)	6 (0.7)
5	13 (1.5)	2 (0.2)
6	3 (0.3)	0
7	4 (0.5)	0

\*Total ophthalmic drugs prescribed including antiglaucoma drugs. \*\*Only antiglaucoma drugs prescribed, these include both topical and systemic antiglaucoma drugs, eye drops containing more than one active drug (fixed-dose combination) are taken as a single drug in our study, n = 876 (868+8 missing)

Table 4: Mean monthly cost, maximum cost of all drugs and percent burden of antiglaucoma drugs

Type of drugs	Mean monthly cost (PKR)*	Burden of antiglaucoma (%)	Maximum cost (PKR)*	Burden of antiglaucoma (%)
Antiglaucoma drugs	599.73 ± 491		2776.3	
Antihypertensive drugs	79.29 ± 237	756.37	2400	115.68
Antidiabetic drugs	154.13 ± 625	389.10	6060	45.81
Other drugs	75.45 ± 343	794.84	3741	74.21
All drugs (excluding antiglaucoma)	308.88 ± 818	194.16	8337	33.30
All drugs (including antiglaucoma)	908.61 ± 1003		9100	

Other drugs means patients using drugs to treat systemic diseases other than hypertension diabetes and glaucoma, \*PKR: Pakistani rupee (1 USD = 100.90 PKR)

while the highest 115.68% burden was noted in the maximum cost of antihypertensive by addition of antiglaucoma followed by other systemic drugs 74.21 and then 45.81% in the antidiabetic drugs (Table 4).

## DISCUSSION

The findings of our current study demonstrate the lower socioeconomic status of multimorbid glaucoma

patients with a higher prescription burden of antiglaucoma drugs. The majority of patients were dependent upon others, having no formal education and belonged to the older age group.

Glaucoma patients present to ophthalmologists at different stages of the disease and the literature suggests a direct relationship between the increasing severity of the disease with the economic burden<sup>13</sup>. A study by Lui M-H *et al.*<sup>14</sup> has reported that in Europe and United States the economic burden increased up to four-fold in glaucoma patients from mild to severe stage. In the current study majority of patients belonged to the older age group and only 10.3% of patients were less than 40 years of age. About half (47.03%) patients were unemployed, which might be due to the older age or disease severity as indicated in the study conducted in Mexico where 53% of the glaucoma patients were found unemployed and the reason for unemployment was visual disability in 20.8% of subjects<sup>15</sup>. Moreover, 15.53% of patients in the current study were housewives and 9.70% were enjoying the retired life. A case-control study in the United Kingdom revealed that the patients with lower occupational status had an advanced stage of glaucoma<sup>16</sup>. So these patients are usually dependent upon others, family or society as indicated in our study that 66.1% of patients were dependent upon others. Because of this dependency and having no regular source of income, these patients might have faced problems in traveling and visiting their ophthalmologists and this delay led to an increase in severity of glaucoma and ultimately increase in the prescription burden of antiglaucoma drugs. This might also be the reason that in our society, such types of patients frequently visit charity or trust hospitals to get free treatment, as exhibited in our study where 74% of the patients were treated on charity. Various studies have also reported a higher prevalence and more advanced state of glaucoma in people with lower socioeconomic status due to later presentation<sup>17</sup>.

In our study, the monthly income of 44.1 and 31.9% of patients or to whom they were dependent was only 10,000-20,000 PKR (99.10-198.20 USD) and up to 10,000 PKR (99.10 USD) respectively. This reflects in the socioeconomic status calculated by Kuppaswamy urban (1976) as discussed earlier, that a maximum number (88.9%) of patients in this study belonged to the lower or lower upper class. Education is another major factor that can predict the social status of a person. People with low education levels are more dependent upon others and are unable to explain their condition to doctors. They have less awareness about the disease and even they can't understand well the proper usage of medication. In

our study majority of patients (39.3%) were found to have no formal education. Education level, occupation and monthly income of patients or to whom they were dependent were the factors that contributed to calculating the socioeconomic status.

Regarding comorbidities, 27% of glaucoma patients were hypertensive and 18.8% were diabetic. So these patients needed antihypertensive or antidiabetic medication in addition to antiglaucoma drugs. In addition, 22% of patients were also suffering from other systemic diseases like asthma, cardiovascular disorders, depression, arthritis and gastric issues along with glaucoma. It means these patients need to take extra medication to treat or manage other systemic diseases as well.

About 25% of patients in the current study were smokers or using tobacco in some other ways. It could aggravate any of the above diseases and may increase the severity and duration of treatment. On the other hand, it could also increase the economic burden directly or indirectly. According to a study conducted in India, 16.5% of glaucoma patients were suffering from hypertension, 14% from diabetes and 6% patients were found as smokers<sup>18</sup>. In comparison, the current study has reported a higher percentage of glaucoma patients with a history of hypertension, diabetes and tobacco use. It is pertinent to mention here that the current study has considered the use of tobacco in any form including smoking, snuffs etc. According to Blue Mountain Eye Study, the risk of glaucoma increased by more than 50% with hypertension. This relationship between glaucoma and hypertension has been explained by several mechanisms like lower blood flow to the optic nerve by microvascular damage, impairment of posterior ciliary auto regulatory circulation and optic nerve damage by nocturnal episodes of hypotension caused by antihypertensive drugs<sup>3</sup>. This study also revealed the significant, consistent and real relationship between diabetes mellitus and glaucoma which was independent of diabetes effect on IOP. The results of a recently reviewed meta-analysis of prospective cohort study revealed a 36% increased incidence of glaucoma in diabetics as compared to non-diabetics<sup>19</sup>.

A majority of the epidemiological, population-based and cross-sectional studies found no association between glaucoma and smoking either current or previous, however, a meta-analysis of recent studies has shown an association of glaucoma with current smoking but not with the previous<sup>16</sup>. This association may be linked with the mechanism explained in the study that, tobacco use can induce vasoconstriction

leading to increased episcleral venous pressure which results in raised IOP due to inhibition of aqueous outflow<sup>20</sup>.

Several studies have also explained the association of higher BMI or being overweight with the increasing risk of glaucoma by a substantial increase in IOP<sup>21</sup> and this observation is in agreement with our study where about half of the patients (42.5%) were obese or overweight.

According to the current study, 29.3, 27.9 and 20.3% were using one, two and three ophthalmic medicines respectively. On the other hand, 35.2, 23.4 and 14.6% of patients were using 1, 2 and 3 antiglaucoma drugs. Eye drops that have more than one drug (Fixed-dose combination) were considered as a single drug in our study. Our findings are in contrast to a similar study conducted in India reported 30.7, 42.7 and 21.3% of patients were using 1, 2 and 3 glaucoma medicines<sup>22</sup> which indicates a different prescribing pattern of glaucoma medicine in India. One fourth (25%) of our patients were not using any glaucoma medicine. These patients were either glaucoma suspects and were under observation or they had gone through glaucoma surgery and glaucoma medications were stopped by ophthalmologists.

It should be kept in mind that, glaucoma patients with comorbidities using multiple drug therapies, face the problems of increased medication cost, risk of side effects and drug interactions which may lead to poor adherence and low quality of life and ultimately higher morbidity and mortality rates<sup>23</sup>.

In our study, a 194% increase in the mean monthly cost of all drugs was noted by the addition of glaucoma medications. This increase in cost posed an extra burden on glaucoma patient's pocket with comorbidities. Similarly, 756.37, 389 and 794.84% additional burden in the mean monthly cost of hypertensive, diabetic and patients with other systemic diseases were noted respectively. This was only the cost of drugs and did not include any consultation, investigations and transportation costs. As a majority of patients belonged to old age and had multiple diseases, they also needed an attendant to travel with them or to support them during the consultation which will further increase the total cost of treatment. This overall increase may affect the disease management by skipping the doses or by delaying consultations. As advised in a study, the cost and complexity of systemic medications may lead to non-adherence and even a minimum addition of copayments can significantly affect a patient's medication burden. So ophthalmologists should keep in mind the total prescription burden while prescribing for glaucoma patients with co-systemic diseases<sup>8</sup>.

The strength of our study is that, as per our knowledge, it is the first study in Pakistan discussing the socioeconomic

factors related to glaucoma patients and the prescription burden of antiglaucoma drugs especially in glaucoma patients with comorbidities like hypertension and diabetes. This new information will provide the basis for the researchers to work further on the subject and investigate other factors as well. This study will provide useful information about the prescription burden of glaucoma to the ophthalmologists, policymakers and other health regulatory authorities. So we suggest the establishment of glaucoma centres at the district level and availability of antiglaucoma drugs free of cost by the government as trust hospitals or charitable organizations are not available everywhere.

Single centred, descriptive design and shorter duration are the limitations of our study. We recommend multi-centred or community-based research in future to know the actual burden of antiglaucoma drugs in Pakistan.

## **CONCLUSION**

In the light of our current study, we conclude that the majority of our glaucoma patients were poor, old age with low literacy rate, having multiple diseases and were dependent upon others. They were using multiple drugs either for glaucoma, hypertension, diabetes or any other systemic disease. They belonged to lower socioeconomic status with a high prescription burden of antiglaucoma drugs. Because of polypharmacy, high prescription burden and expected increase in the total cost of treatment patients may lead to unaffordability and non-compliance which may result in skipping of doses or delay in consultation and worsening of the disease.

## **SIGNIFICANCE STATEMENT**

This study discovers the socioeconomic status of glaucoma patients and the prescription burden of antiglaucoma drugs in glaucoma patients with comorbidities like hypertension and diabetes mellitus using multiple therapies in a developing country. This study will help the researcher to uncover the critical area of permanent vision loss due to non-compliance in glaucoma patients resulting from the economic burden of treatment that many researchers were not able to explore. Thus, a new theory on pharmacoeconomics and cost-effectiveness may be arrived at.

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