Original Article

Etiological spectrum of irreversible blindness in Kashmir in North India

Madhurima Kaushik, Shah Nawaz, Haniyaa Mufti, Tariq Syed Qureshi

Purpose: To determine the etiological spectrum of irreversible blindness in Kashmir Valley in India. **Methods:** Patients presenting to a tertiary care hospital in Kashmir, India, with unilateral or bilateral blindness from April 2019 to March 2020 were included in this cross-sectional study. Blindness was defined using the World Health Organization (WHO) criteria. All subjects had a complete ophthalmologic examination and information was gathered regarding their demographic profile, nature of ocular disorder whether primary or secondary and laterality, if the ocular involvement was unilateral. **Results:** 248 patients were enrolled in the study. The mean age of the patients was 57.17 years. The male: female ratio was 2.17:1. The commonest cause of unilateral or bilateral blindness was glaucoma (22.58%) followed by diabetic retinopathy (DR) (17.74%). Unilateral blindness was seen in 78.62% of the patients. Unilateral blindness occurred mainly due to glaucoma (16.41%), DR (14.87%), age-related macular degeneration (13.33%), and trauma (pellet injury: 10.76%, non-pellet injury: 10.25%). The major causes of bilateral blindness were glaucoma (45.28%), DR (28.30%), and hereditary/congenital retinal diseases (16.98%). Socioeconomic status and educational status were significantly associated ($P < 0.05$ each) while age, gender, place of residence, and occupation were not significantly associated ($P > 0.05$ each) with the number of eyes affected by blindness. **Conclusion:** Glaucoma and DR are the foremost causes of irreversible blindness in Kashmir. Public health plans aimed at encouraging good health education of patients should be developed in this region. Moreover, patients should be screened effectively for glaucoma and diabetes at the level of primary health care facilities.

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Globally, at least 2.2 billion people have some form of visual impairment. Uncorrected refractive errors, cataracts, age-related macular degeneration (ARMD), glaucoma, diabetic retinopathy (DR), corneal opacity, and trachoma are the leading causes of vision impairment and blindness.[1,2] Thirty-six million people out of these are considered blind with regard to distance vision.[3] Glaucoma, DR, and ARMD are the leading causes of irreversible blindness worldwide.[4-13] Additionally, there is variation in the causes of visual loss between countries.[14]

Blindness in India is an important public health issue[15-17] as well as a social and economic problem. In India, the major causes of visual loss are cataract, refractive errors, glaucoma, corneal opacities, DR, ARMD, trachoma, and childhood blindness.[18]

The allocation of resources for proper delivery of health care resources needs urgent attention in developing countries.[14] Regional data concerning the causes of blindness would be helpful in allocating the resources appropriately and planning public health care aptly. Furthermore, regional studies on irreversible blindness in subjects of all ages will help in assessing the impact of ocular and systemic disease on blindness besides yielding a reasonably correct estimation of the magnitude of blindness in a particular region.

In the present study, we evaluated the etiological spectrum of irreversible unilateral and bilateral blindness in Kashmir Valley in North India.

Methods

This cross-sectional study was performed from April 2019 to March 2020 at a tertiary care hospital in Srinagar, Jammu and Kashmir, India, to ascertain the causes of irreversible unilateral and bilateral blindness in Kashmir Valley. Ethical clearance for this study was taken from the institutional ethical clearance committee. Patients were enrolled in the study after obtaining written informed consent.

Blindness was defined according to the World Health Organization (WHO) criteria as "visual acuity of less than 3/60, or a corresponding visual field loss to less than 10°, in the better eye with the best possible correction."[19]

Patients of any age, having unilateral or bilateral blindness were included in the study. Patients with treatable causes of blindness like corneal opacity, keratoconus, refractive error, cataract, recent vitreous hemorrhage, recent diabetic maculopathy, and operable retinal disease were excluded.

Department of Ophthalmology, Govt. Medical College, Srinagar, Jammu and Kashmir, India

Correspondence to: Dr. Madhurima Kaushik, Postgraduate Student, Department of Ophthalmology, Govt. Medical College, Karan Nagar, Srinagar - 190 010, Jammu and Kashmir, India. E-mail: madhurima0105@gmail.com

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Patients who underwent screening were either referred, new, or follow-up cases or presented in the emergency department. Of the 49,953 patients examined for vision disturbance, 1,135 patients were found to be having blindness in one or both eyes. Eight hundred eighty-two patients had reversible blindness and were excluded while only 253 patients had irreversible blindness and were eligible for inclusion in the study. Five patients with irreversible blindness did not give their consent for inclusion in the study and the remaining 248 patients were enrolled in the study.

Data were obtained regarding the demographic characteristics of patients and nature of ocular disease either primary or secondary to systemic disorders. Only the disease with the greatest effect on vision was documented in patients having more than one ocular disease. If vision loss was primarily due to the co-existing systemic disease, it was recorded. Laterality was recorded in case of unilateral ocular involvement.

All patients underwent full clinical ophthalmologic evaluations at the ophthalmology outpatient clinic. These ophthalmologic evaluations included testing for visual acuity, refractive error, and intraocular pressure (IOP) with Goldmann applanation tonometry, as well as slit lamp and fundus examinations. B-scan ultrasonography was performed to rule out retinal detachment (RD) or vitreous hemorrhage in patients with advanced cataract. Standard automated perimetry was performed with the Humphrey field analyzer for patients with glaucoma. Fundus photos were taken and evaluated wherever possible.

Retinopathy of prematurity (ROP)-related blindness was included in the hereditary/congenital causes as data suggest that genetic risk factors contribute to the development of ROP.[20] Pellet trauma-related blindness and non-pellet trauma-related blindness were considered separate entities. Primary open-angle glaucoma (POAG) was defined as the presence of typical optic nerve head changes and glaucomatous field damage in the presence of an open, normal-appearing angle on gonioscopy and IOP more than 21 mmHg without any apparent ocular or systemic cause that could cause the raised IOP.[21]

Statistical analysis of the data was done using the SPSS software version 20. Continuous variables were expressed as mean and standard deviation. Chi-square test and Fisher's exact test were used for testing the significance of differences between proportions and association between various variables. A '*P*' value of less than 0.05 was taken as statistically significant.

Results

Epidemiological characteristics of the patients with blindness are shown in Table 1. The mean age of the study sample was 57.17 ± 19.36 years (age range 1–87 years). The male-to-female ratio was 2.17:1. Both bilateral blindness and unilateral blindness were equally common in all age groups. Both were more common among rural patients than urban patients but no significant difference was seen between the prevalence of unilateral blindness and bilateral blindness in rural as well as urban patients. No significant differences were present regarding age, gender, and occupation between patients with unilateral blindness and those with bilateral blindness. Blindness was seen exclusively in patients from low and middle socioeconomic status. Bilateral blindness was more common in patients from low socioeconomic status while unilateral blindness was more common in patients having middle socioeconomic status. In the entire study group, the male: female ratio for patients having blindness due to diabetes mellitus was 1:1.42.

Glaucoma was the commonest cause of blindness in one or both eyes per person (56 cases, 22.58%). POAG was the commonest type of glaucoma (47 cases, 18.95%) followed by secondary glaucoma (6 cases, 2.41%), and primary angle-closure glaucoma (PACG) (3 cases, 1.20%). DR was the second commonest cause of blindness and was seen in 44 (17.74%) patients. Various DR changes like proliferative diabetic retinopathy (PDR) leading to tractional retinal detachment involving the macula, rubeosis, intractable macular edema, and ischemic maculopathy were responsible for blindness due to DR in our study. ARMD and pellet trauma jointly ranked third among the causes of blindness and were seen in 26 (10.48%) patients each. Pellet trauma caused unilateral blindness in 21 patients (new cases: 11 [52.38%], follow-up cases: 10 [47.61%]) and bilateral blindness in 5 patients (new cases: 4 [80%], follow-up case: 1 [20%]). Non-pellet trauma ranked fourth as a cause of blindness and occurred in 20 (8.06%) patients. There were 42 (16.93%) patients with blindness due to retinal disease due to various causes, excluding DR. POAG, DR, and congenital retinal causes accounted for a significantly higher number of patients with bilateral blindness than those with unilateral blindness. ARMD, non-pellet trauma, RD, and retinal vascular occlusion (RVO) accounted for a significantly higher number of patients with unilateral blindness than those with bilateral blindness [Table 2].

Laterality of the main causes of unilateral blindness is shown in Table 3. Unilateral blindness was present in 195 (78.62%) patients. Right eye involvement was seen in 109 (55.89%) patients and left eye involvement in 86 (44.10%) patients. Unilateral blindness occurred most commonly due to glaucoma (32 cases; 16.41%), DR (29 cases; 14.87%), and ARMD (26 cases; 13.33%). Blindness in the right eye (total recorded 109) was most commonly due to DR (22 cases; 20.18%), followed by RVO (12 cases; 11.00%), non-pellet trauma (11 cases; 10.09%), pellet trauma (10 cases; 9.17%), ARMD (10 cases; 9.17%), and POAG (8 cases; 7.33%). Blindness in the left eye (total recorded 86) occurred most frequently due to POAG (18 cases; 20.93%), ARMD (16 cases; 18.60%), pellet trauma (11 cases; 12.79%), non-pellet trauma (9 cases; 10.46%), RD (9 cases; 10.46%), and DR (7 cases; 8.13%).

Socioeconomic status and educational status were significantly associated while age, gender, place of residence, and occupation were not significantly associated with the number of eyes affected by blindness [Table 4].

Discussion

Many studies in India have focused on blindness, but none in Kashmir.[15-17] Our study is the first study on etiological spectrum of irreversible blindness in Kashmir and helped in comparing data on blindness from the Kashmir Valley, other parts of India, and the rest of the world and looking for differences in causes if any.

Age is a well-recognized risk factor for blindness as evidenced by previous studies.[15-17,22-25] In our study also, 49.19% of the subjects were aged above 60 years. The mean age of patients with irreversible blindness was 57.17 years. This is in accordance with the mean age of 58 ± 2.28 years observed in patients with

Table 1: Epidemiological characteristics of the patients with irreversible blindness

	No. of total cases with unilateral or bilateral blindness (%) (*n*=248)	No. of cases with unilateral blindness (%) (*n*=195)	No. of cases with bilateral blindness due to single cause (%) (*n*=53)	*P* unilateral blindness vs. bilateral blindness
Age group				
≤20 years	16 (6.45)	11 (5.64)	5 (9.43)	0.345
21-40 years	32 (12.90)	23 (11.79)	9 (16.98)	0.442
41-60 years	78 (31.45)	66 (33.84)	12 (22.64)	0.135
>60 years	122 (49.19)	95 (48.71)	27 (50.94)	0.887
Gender				
Male	170 (68.54)	132 (67.69)	38 (71.69)	0.698
Female	78 (31.45)	63 (32.30)	15 (28.30)	0.698
Residence[a]				
Urban	45 (18.14)	39 (20.00)	6 (11.32)	0.210
Rural	203 (81.85)	156 (80.00)	47 (88.67)	0.210
Socioeconomic status[b]				
Low	152 (61.29)	110 (56.41)	42 (79.24)	0.004
Middle	96 (38.70)	85 (43.58)	11 (20.75)	0.004
High	0 (0.00)	0 (0.00)	0 (0.00)	1
Educational status[c]				
Literate	84 (33.87)	66 (33.84)	18 (33.96)	0.887
Matriculate	66 (26.61)	48 (24.61)	18 (33.96)	0.233
Graduate	18 (7.25)	18 (9.23)	0 (0.00)	0.030
Postgraduate	0 (0.00)	0 (0.00)	0 (0.00)	1
Illiterate	164 (66.12)	129 (66.15)	35 (66.03)	0.887
Occupation				
Laborer/Farmer	18 (7.25)	12 (6.15)	6 (11.32)	0.231
Skilled work/Office	75 (30.24)	57 (29.23)	18 (33.96)	0.617
Housework	72 (29.03)	60 (30.76)	12 (22.64)	0.324
Student	12 (4.83)	9 (4.61)	3 (5.66)	0.999
Unemployed	71 (28.62)	57 (29.23)	14 (26.41)	0.823

[a]Residence was defined as urban for all places with a municipality, corporation, cantonment board or notified town area committee, and all other places meeting the criteria of a minimum population of 5,000, at least 75% of the male main workers engaged in non-agricultural pursuits and a density of population of at least 400 per sq km. All areas not categorized as urban were considered as rural areas; [b]Socioeconomic status: High (annual income >Rs. 8,50,000), middle (annual income Rs. 50,000-8,50,000) and low (annual income <Rs. 50,000; 1 US dollar equals 72.43 Indian rupees); [c]Literate: A person was deemed as literate if he/she could read and write with understanding in any language. A literate person was further subclassified as per the level of education as matriculate (who had passed the 10th standard examination), graduate (who had earned a bachelor's degree) and postgraduate (who had earned a master's degree). A person who could read but could not write was not considered literate[19]

irreversible blindness in a study performed in Saudi Arabia.[14] However, in a study from South India, examining 3,850 subjects for causes of low vision and blindness, the mean age of the blind persons was slightly higher (68.6 ± 13.1 years).[26] Blindness was predominantly seen in males (male: female ratio 2.17:1). Our findings are in conformity with the findings of another study showing the male to female ratio as 3:2.[14] However, some studies have shown a higher prevalence of blindness in females while others have shown no difference in gender.[17,22] More attention toward the health of males as they are generally the earning members in the family may be a reason for their seeking health care which may explain the dominance of males among patients with blindness in our study. Pellet trauma seen almost exclusively in young males was also a factor for male dominance in our study.

A majority (81.85%) of our subjects belonged to rural areas. Previous studies have shown similar results with regard to residence.[16,17] Both bilateral and unilateral blindness were more frequent among rural patients than urban patients. This difference in urban and rural populations suggests that rural dwellers need better access to eye care. As life expectancy has increased now due to better medical facilities, the elderly population is on the rise. Detecting the disease process at an early stage is crucial for ensuring a decrease in visual disorders and enabling patients to retain functional eyesight during their entire lifetime. Consequently, regular eye check-ups of people residing in rural areas may be fruitful in this regard as lack of good health care facilities in the rural area may lead to progression and delay in diagnosis of conditions resulting in blindness.

The etiology of blindness varies across the world. In 2015, cataract was the most common cause for blindness, followed by ARMD, glaucoma, uncorrected refractive error, DR, and cornea-related disorders in high-income countries and in Eastern and Central Europe.[27] Sight loss and blindness from ARMD, cataract, DR, glaucoma, and under-corrected refractive error are

Table 2: Causes of irreversible unilateral or bilateral blindness

Cause of blindness	No. of total cases with unilateral or bilateral blindness (%) (*n*=248)	No. of cases with unilateral blindness (%) (*n*=195)	No. of cases with bilateral blindness due to single cause (%) *n*=53)	*P* Unilateral blindness vs. bilateral blindness
POAG	47 (18.95)	26 (13.33)	21 (39.62)	<0.0001
Diabetic retinopathy	44 (17.74)	29 (14.87)	15 (28.30)	0.038
ARMD	26 (10.48)	26 (13.33)	0 (0.00)	0.003
Pellet trauma	26 (10.48)	21 (10.76)	5 (9.43)	1
Non-pellet trauma	20 (8.06)	20 (10.25)	0 (0.00)	0.018
Retinal detachment	15 (6.04)	15 (7.69)	0 (0.00)	0.045
RVO	15 (6.04)	15 (7.69)	0 (0.00)	0.045
Hereditary/Congenital retinal causes like RP, ROP, colobomas	12 (4.83)	3 (1.53)	9 (16.98)	<0.0001
Uveitides	10 (4.03)	10 (5.12)	0 (0.00)	0.125
Auto-evisceration after perforated corneal ulcer	9 (3.62)	9 (4.61)	0 (0.00)	0.211
Myopic macular degeneration	6 (2.41)	6 (3.07)	0 (0.00)	0.346
Endophthalmitis	6 (2.41)	6 (3.07)	0 (0.00)	0.346
Secondary glaucoma	6 (2.41)	3 (1.53)	3 (5.66)	0.113
PACG	3 (1.20)	3 (1.53)	0 (0.00)	0.600
Deep amblyopia	3 (1.20)	3 (1.53)	0 (0.00)	0.600

POAG, primary open-angle glaucoma; ARMD, age-related macular degeneration; RVO, retinal vascular occlusion; RP, retinitis pigmentosa; ROP, retinopathy of prematurity; PACG, primary angle-closure glaucoma

Table 3: Laterality of major causes of unilateral blindness*

Pathology	Right eye No. of patients (%) (*n*=109)	Pathology	Left eye No. of patients (%) (*n*=86)
Diabetic retinopathy	22 (20.18)	POAG	18 (20.93)
RVO	12 (11.00)	ARMD	16 (18.60)
Non-pellet trauma	11 (10.09)	Pellet trauma	11 (12.79)
Pellet trauma	10 (9.17)	Non-pellet trauma	9 (10.46)
ARMD	10 (9.17)	RD	9 (10.46)
RD	6 (5.50)	Diabetic retinopathy	7 (8.13)
POAG	8 (7.33)	Uveitides	6 (6.97)
Uveitides	4 (3.66)	RVO	3 (3.48)

*The table shows only the major causes of unilateral blindness. RVO, retinal vascular occlusion; ARMD, age-related macular degeneration; RD, retinal detachment; POAG, primary open-angle glaucoma; ROP, retinopathy of prematurity

estimated to affect 1.93 (1.58 to 2.31) million people in the UK.[28] ARMD is a complex multifactorial disease and the primary cause of legal and irreversible blindness among individuals aged ≥ 65 years in developed countries.[9] Glaucoma ranks second among the foremost causes of blindness worldwide accounting for up to 8% of total blindness[18] but is the most frequent cause of irreversible blindness.[8] In developing countries, cataract seems to be the most important cause of blindness.[15-17,22-26,29] In India, glaucoma ranks third among the major causes of blindness after cataract and refractive errors[17] but it is the leading cause of irreversible blindness, affecting at least 12 million people and causing blindness in nearly 1.2 million people. Glaucoma remains undetected in more than 90% of the cases in the community.[18] Our findings support this as glaucoma accounted for a significant number of cases with irreversible blindness. In our series, POAG, DR, ARMD, and pellet trauma accounted for the maximum cases. Pellet trauma was a peculiar cause of irreversible blindness and was not clubbed with trauma due to other causes to avoid false projection of the causes of irreversible blindness in the region as pellet trauma cases have virtually disappeared now in Kashmir Valley. Non-pellet trauma, RD, RVO, hereditary/congenital retinal conditions, uveitides, and auto-evisceration after corneal ulcers were also responsible for a sizable number of cases with blindness.

POAG, DR, hereditary/congenital retinal conditions, and pellet trauma were the major causes for bilateral blindness. POAG emerged as the commonest cause of bilateral blindness in our study. This was in accordance with the findings of POAG being the commonest cause of irreversible blindness in the western countries[10] but contrary to the findings of PACG as the commonest cause of irreversible blindness in the Asian population.[5] This finding is similar to the estimates of this disease in other parts of India.[30] Being a painless condition, patients are unaware of the disease which may lead to progressive optic atrophy and ultimate blindness. As such the importance of periodic comprehensive eye check-ups needs to be emphasized at all levels so that preventive action can be taken in time.

Table 4: Factors associated with the number of eyes affected by irreversible blindness

Characteristics	No. of cases with unilateral blindness (%) (*n*=195)	No. of cases with bilateral blindness (%) (*n*=53)	*P*
Age			
≤40 years	34 (17.43)	14 (26.41)	
41-60 years	66 (33.84)	12 (22.64)	0.179
>60 years	95 (48.71)	27 (50.94)	
Gender			
Male: 170	132 (67.69)	38 (71.69)	
Female: 78	63 (32.30)	15 (28.30)	0.698
Place of Residence			
Urban	39 (20.00)	6 (11.32)	
Rural	156 (80.00)	47 (88.67)	0.210
Socioeconomic status			
Low	110 (56.41)	42 (79.24)	
Middle	85 (43.58)	11 (20.75)	0.010
High	0 (0.00)	0 (0.00)	
Educational status			
Matriculate	48 (24.61)	18 (33.96)	
Graduate	18 (9.23)	0 (0.00)	0.043
Illiterate	129 (66.15)	35 (66.03)	
Occupation			
Laborer/Farmer	12 (6.15)	6 (11.32)	
Skilled work/Office	57 (29.23)	18 (33.96)	
Housework	60 (30.76)	12 (22.64)	0.557
Student	9 (4.61)	3 (5.66)	
Unemployed	57 (29.23)	14 (26.41)	

Cases with unilateral blindness were 3.6 times more common than cases with bilateral blindness in our study. Glaucoma, DR, ARMD, pellet trauma, and non-pellet trauma were the major causes of unilateral blindness in Kashmir. Though overall, glaucoma was the commonest cause of unilateral blindness in our patients, DR was more common than POAG, the main type of glaucoma, which is in agreement with the findings of a study in Saudi Arabia that DR was the commonest cause (27%) of irreversible unilateral blindness.[14] The presence of uncontrolled diabetes mellitus (DM) in a majority of patients having blindness due to DR warrants the need for meticulous control of the blood sugar in diabetic patients and regular eye check-ups with the management of DR if present. This may require close liaison with the treating physician who can explain to the patients that proper glycemic control will prevent the development of complications like DR and ensure a normal life expectancy which can motivate the patients to comply with the management. Moreover, the primary physician can refer every patient with diabetes to the ophthalmologist for screening for the presence of DR right at the time of detection of diabetes itself and periodically thereafter. This will help in detecting the DR at an early stage thus ensuring a corrective action and preventing its progression to an advanced state where the patient can develop serious impairment of vision or blindness.

Retinal degenerations and dystrophies are extremely heterogeneous disorders that are associated with irreversible visual loss and blindness early in life.[31,32] Prevalence of bilateral irreversible blindness caused due to hereditary/congenital causes was significantly higher than that of unilateral blindness in our study (16.98% vs. 1.53%). Blindness due to these conditions was seen early in life in our study.

The ocular inflammatory disorders falling under the uveitides are an important cause of blindness worldwide and are responsible for 5–10% of visual impairment globally.[33] In our study, uveitides accounted for 5.12% of cases of irreversible unilateral blindness which is in conformity with the global data.

We also observed unilateral blindness due to myopic macular degeneration (MMD) in 3.07% of the patients which was much less in comparison to a high prevalence of MMD in East Asia where it has become the leading cause of blindness (bilateral: 17.2%; unilateral: 5.9%) in the region.[34]

A nationwide survey in India in 15 populous states showed that age, gender, place of residence, literacy, and working status had a significant association with blindness.[17] Likewise, in our study in Kashmir, patients of more than 60 years of age, male patients, patients from low socioeconomic status, patients from rural areas. and illiterate patients formed a major part of the study group which implies that these factors may have a relationship with blindness. Moreover, socioeconomic status and educational status were significantly associated with the number of eyes affected by blindness implying that impairment of vision may go unchecked and lead to blindness in an illiterate person due to poor health awareness.

In view of a need for an effective strategy to tackle the problem of blindness in this region, the Government is actively promoting the National Programme for Control of Blindness (NPCB). Earlier, this

program focused on cataract but now is funding for management of conditions like DR, glaucoma, ocular trauma, childhood blindness, keratoplasty, low vision, and ROP in addition to other ongoing schemes. Keratoplasty has been started in the region so that blindness due to corneal problems can be handled. Special clinics like retina, glaucoma, and cornea are being run for timely detection and treatment of eye diseases to prevent irreversible loss of vision. Moreover, a committee has been formed by the Central Government to find effective alternatives to the use of pellet guns by the security forces. Now pellet guns are rarely used by security forces, thereby preventing the unnecessary loss of vision.

Every effort is made by the authors to increase awareness and knowledge of people regarding eye diseases in general so that a change can be brought in their approach toward vision-related problems which would help in seeking eye consultation at an early stage of the disease and facilitate a timely action for treating the disorder. Measurement of IOP in general and screening for DR in patients with diabetes are encouraged so that corrective action can be taken at an early stage.

As such, health awareness should be promoted regarding the need for a periodic check-up of eyes so that blindness due to common conditions like glaucoma and DR can be prevented.

Limitations of the study

As our study was a hospital-based study and did not take into account all cases of irreversible blindness present in the community, there is a possibility that the spectrum of illnesses causing irreversible blindness may be slightly biased. Alcohol use was not evaluated as a factor associated with the number of eyes affected by irreversible blindness as alcohol is rarely consumed in the region due to religious reasons.

Conclusion

Glaucoma and DR are the main causes of irreversible blindness in Kashmir Valley. The initiative taken by the Government to curb the problem of blindness in the region is likely to yield results if sustained and coordinated efforts are made at all levels. More screening and awareness programs can be conducted by various eye care providers to enable early detection, treatment, and prevention of irreversible blindness.

Research ethics and patient consent

The study was in accordance with the ethical standards of the responsible committee on human experimentation (institutional) and with the Helsinki Declaration of 1964, as revised in 2013 and was approved by the ethical clearance committee of Govt. Medical College, Srinagar, Jammu and Kashmir, India. A written informed consent was taken from all patients for their participation in the study. A written informed consent for participation in the study was obtained from parent or guardian where participants were children (under 16 years old).

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Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization (WHO). Blindness and vision impairment. 2020. Available from: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment. [Last accessed on 2021 Feb 27].
2. Bourne RRA, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB, *et al.* Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: A systematic review and meta-analysis. Lancet Glob Health 2017;5:e888–97.
3. Auckland P, Resnikoff S, Bourne R. World blindness and visual impairment: Despite many successes, the problem is growing. Community Eye Health 2017;30:71-3.
4. Stone JS, Muir KW, Stinnett SS, Rosdahl JA. Glaucoma blindness at a tertiary eye care center. N C Med J 2015;76:211-8.
5. Wang J, Yusufu M, Khor CC, Aung T, Wang N. The genetics of angle closure glaucoma. Exp Eye Res 2019;189:107835.
6. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: A systematic review and meta-analysis. Ophthalmology 2014;121:2081-90.
7. Gupta D, Chen PP. Glaucoma. Am Fam Physician 2016;93:668-74.
8. Jonas JB, Aung T, Bourne RR, Bron AM, Ritch R, Panda-Jonas S. Glaucoma. Lancet 2017;390:2183-93.
9. Almasieh M, Levin LA. Neuroprotection in glaucoma: Animal models and clinical trials. Annu Rev Vis Sci 2017;3:91-120.
10. He S, Stankowska DL, Ellis DZ, Krishnamoorthy RR, Yorio T. Targets of neuroprotection in glaucoma. J Ocul Pharmacol Ther 2018;34:85-106.
11. Wiggs JL, Pasquale LR. Genetics of glaucoma. Hum Mol Genet 2017;26:R21-7.
12. Rinninella E, Mele MC, Merendino N, Cintoni M, Anselmi G, Caporossi A, *et al*. The role of diet, micronutrients and the gut microbiota in age-related macular degeneration: New perspectives from the gut-retina axis. Nutrients 2018;10:1677.
13. Balyen L, Peto T. Promising artificial intelligence-machine learning-deep learning algorithms in ophthalmology. Asia Pac J Ophthalmol (Phila) 2019;8:264-72.
14. Alghamdi HF. Causes of irreversible unilateral or bilateral blindness in the Al Baha region of the Kingdom of Saudi Arabia. Saudi J Ophthalmol 2016;30:189–93.
15. Vijaya L, George R, Arvind H, Baskaran M, Raju P, Ramesh SV, *et al*. Prevalence and causes of blindness in a rural south Indian population. Br J Ophthalmol 2006;90:407-10.
16. Murthy GV, Vashist P, John N, Pokharel G, Ellwein LB. Prevalence and causes of visual impairment and blindness in older adults in an area of India with a high cataract surgical rate. Ophthalmic Epidemiol 2010;17:185-95.
17. Murthy GV, Gupta SK, Bachani D, Jose R, John N. Current estimates of blindness in India. Br J Ophthalmol 2005;89:257-60.
18. National Health Portal (NHP) India. Blindness. Available from: https://www.nhp.gov.in/disease/eye-ear/blindness. [Last accessed on 2021 Jan 02].
19. World Health Organization (WHO). International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)-WHO Version for Internet. 2016. Available from: http://apps.who.int/classifications/icd10/browse/2016/en#/H54. [Last accessed on 2019 Mar 03].
20. Mohamed S, Schaa K, Cooper ME, Ahrens E, Alvarado A, Colaizy T, *et al*. Genetic contributions to the development of retinopathy of prematurity. Pediatr Res 2009;65:193-7.

21. Allingham RR, Damji KF, Freedman SF, Moroi SE, Rhee DJ. Chronic open angle glaucoma and normal tension glaucoma. Shields Textbook of Glaucoma. 6th ed. New Delhi: Wolters Kluwer; 2011. p. 176-88.
22. Dandona L, Dandona R, Srinivas M, Giridhar P, Vilas K, Prasad MN, *et al*. Blindness in the Indian state of Andhra Pradesh. Invest Ophthalmol Vis Sci 2001;42:908-16.
23. Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Srinivas M, Mandal P, *et al*. Burden of moderate visual impairment in an urban population in southern India. Ophthalmology 1999;106:497-504.
24. Dandona L, Dandona R, Srinivas M, Giridhar P, Prasad MN, Vilas K, *et al*. Moderate visual impairment in India: The Andhra Pradesh eye disease study. Br J Ophthalmol 2002;86:373-7.
25. Thulisiraj RD, Nirmalan PK, Ramakrishnan R, Krishnadas R, Manimekalai TK, Bapurajan NP, *et al*. Blindness and vision impairment in a rural south Indian population: The Aravind comprehensive eye survey. Ophthalmology 2003;110:1491-8.
26. Vijaya L, George R, Asokan R, Velumuri L, Ramesh SV. Prevalence and causes of low vision and blindness in an urban population: The Chennai Glaucoma study. Indian J Ophthalmol 2014;62:477–81.
27. Bourne RRA, Jonas JB, Bron AM, Cicinelli MV, Das A, Flaxman SR, *et al*. Prevalence and causes of vision loss in high-income countries and in Eastern and Central Europe in 2015: Magnitude, temporal trends and projections. Br J Ophthalmol 2018;102:575-85.
28. Pezzullo L, Streatfeild J, Simkiss P, Shickle D. The economic impact of sight loss and blindness in the UK adult population. BMC Health Serv Res 2018;18:63.
29. Abdull MM, Sivasubramaniam S, Murthy GV, Gilbert C, Abubakar T, Ezelum C, *et al*. Causes of blindness and visual impairment in Nigeria: National blindness and visual impairment survey. Invest Ophthalmol Vis Sci 2009;50:4114–20.
30. George R, Ramesh SV, Vijaya L. Glaucoma in India: Estimated burden of disease. J Glaucoma 2010;19:391-7.
31. Kannabiran C, Mariappan I. Therapeutic avenues for hereditary forms of retinal blindness. J Genet 2018;97:341-52.
32. Jabs DA. Immunosuppression for the Uveitides. Ophthalmology 2018;125:193-202.
33. Trivedi A, Katelaris C. The use of biologic agents in the management of uveitis. Intern Med J 2019;49:1352-63.
34. Tang Y, Wang X, Wang J, Huang W, Gao Y, Luo Y, *et al*. Prevalence and causes of visual impairment in a Chinese adult population: The Taizhou Eye Study. Ophthalmology 2015;122:1480-8.