

# Causes of Blindness and Visual Impairment in a Mediterranean Coast District of Turkey

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## ABSTRACT

We aimed to evaluate the causes of visual impairment and blindness in adults who applied to Alanya Alaaddin Keykubat University Education and Research Hospital health board of disability.

The records of 8924 patients were reviewed retrospectively and 887 adult patients were enrolled as two age-groups: 18-50 and  $\geq 51$  years. Using the United States criteria, three vision-based groups were formed; "blindness", "low vision" and "unilateral visual impairment".

Cataract (36.9%/55.9%), age-related macular degeneration (16.2%/19.4%) and diabetic retinopathy (15.8%/10.1%) were the leading causes of blindness/low vision. Retinal dystrophies (28.1%) and amblyopia (37%) were the main causes of blindness and low vision in the 18-50 age group, respectively. In the  $\geq 51$  age group, cataract was both the most common cause of blindness (42.6%) and low vision (62.3%). While amblyopia (22.2%) was the leading cause of unilateral visual impairment in the 18-50 age group, it was cataract (44.9%) in the  $\geq 51$  age group. The proportion of avoidable causes of blindness was 62.2% and 36.9% of them was treatable. Avoidable causes of low vision was 69.6%, of which 55.9% was treatable.

Early interventions for preventive and educative health policies should be developed at younger ages for aiming to guide the lifestyle trends of individuals in order to reduce the avoidable causes of vision loss and maintain a visual disability-free lifetime.

**Keywords:** Blindness, cataract, disability, ocular disease, visual impairment

## Introduction

Disability is one of the most important reasons limiting the quality of human life in our aging world (1). When the increase in population growth and the gain of about 30 years increase in the mean expected lifespan between the beginning of the 20th and 21st century are evaluated together, the number of people who will have chronic health problems and experience disabilities are predicted to rise (2-4). According to the World Health Organization (WHO) Global Disability Action Plan 2014-2021, more than 1 billion people live with some type of disability and 110-190 million adults encounter significant functional difficulties (2).

Visual impairment and blindness are severe public health issues globally. Lack of productivity due to workforce loss of both the people with blindness and relatives who accompany them, rehabilitation and special education costs, financial support assistance are important economic burdens for

individuals, their families and societies (5). Hence, blindness and visual impairment are not only personal problems restricting lifestyles of individuals also social problems negatively affecting national economies. Whereas, it was reported that 80% of the cases of blindness could be prevented when protective measures were applied or eye disorders were treated appropriately (6).

In this study, we aimed to evaluate the causes of blindness and visual impairment together with the demographic characteristics of patients receiving health board reports of disability.

## Materials and Methods

In this study, the reports of 8924 patients who applied to Alanya Alaaddin Keykubat University Education and Research Hospital health board of disability between January 2016-December 2019 were reviewed retrospectively and 887 patients who were aged  $\geq 18$  years and had a score of

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**Table 1.** Disease Categorization for Visual Impairment

Disease Category	Pathologies
Cataract	All types of cataracts
Diabetic retinopathy	Diabetic macular oedema, proliferative diabetic retinopathy
Amblyopia	Deprivation amblyopia due to delayed congenital cataract surgery, anisometric or isoametric amblyopia
Phthisis bulbi/absent globe	Posttraumatic, postsurgical
Optic atrophy	Ischemic, compressive, toxic, traumatic, autoimmunogenic, uveitic, multiple sclerosis, (excluding optic atrophies secondary to glaucoma and diabetes mellitus)
Corneal opacities	Corneal degenerations, traumatic, postinfectious, iatrogenic, bullous keratopathy, keratoconus, post-keratoplasty, pterygium closing visual axis
Other retinal diseases	Epiretinal membrane, macular hole, retinal detachment (except myopic retinal detachment), all presenile macular scars and atrophies, central serous chorioretinopathy, uveitic macular oedema, retinoblastoma, retinal angioma, choroidal melanoma
Retinal dystrophies	Retinitis pigmentosa, cone dystrophy, Stargardt disease, Best disease
Glaucoma	All primary and secondary glaucomas
Myopic degenerations	Myopic macular degeneration, myopic retinal detachment
Age-related macular degeneration	Senile macular degenerations
Retinal vascular occlusion	Central retinal vein occlusion and branch retinal vein occlusions not associated with uveitic syndromes
Posterior capsular opacification	
Congenital eye anomalies	Microphthalmus, albinism, optic disc and chorioretinal coloboma

visual system impairment rating (VSIR) were included. Of the 887 patients; age, sex, best corrected visual acuity (BCVA) of both eyes, disorders causing visual impairment were analyzed. The study was organized with the approval of Alanya Alaaddin Keykubat University Education and Research Hospital Ethics Committee (date: 14/08/2020, decision no: 2020/22-23) in accordance with the Helsinki Declaration.

All the patients included in the study had loss of visual acuity. Uncooperative patients and patients which had VSIR score only because of visual field loss, disorders like ptosis, eyelid and periorbital tumors, ectropion, entropion were excluded. For better categorization of the pathologies causing visual impairment, we classified all the diseases under 14 main groups (Table 1) (7).

United States (US) criteria was used for the definitions of low vision and blindness (8). "Low vision" was defined as BCVA less than 20/40 but better than 20/200 in better-seeing eye. "Blindness" was defined as BCVA equal to or less than 20/200 in both eyes. Additionally, "unilateral visual impairment" was defined as BCVA less than

20/40 in worse-seeing eye. The term "vision loss" was used for all eyes in the groups with reduced vision to avoid confusion in the text. In eyes with 2 or more disorders, the disorder supposed to have the greatest clinical impact on the visual acuity was considered the main cause. If the main cause of vision loss was different in each eye, the pathology of the better eye was considered the main pathology because low vision and blindness were defined in terms of the better-seeing eye. In contrast, the pathology of the worse-seeing eye was considered the main pathology in the "unilateral visual impairment" group in accordance with the definition above.

Three vision-based groups were formed; "blindness", "low vision" and "unilateral visual impairment". Different from other studies, as in the study of Nowak et al., "unilateral visual impairment" group was defined evaluating the BCVA in worse-seeing eye to show the true magnitude of the vision loss in this study (9). If the BCVA of the better-seeing eye was evaluated in the unilateral visual impairment group, 416 individuals, which is about half of the participants

would have to be excluded, because BCVA of better-seeing eye of these individuals was normal (BCVA  $\geq$  20/40). For exploring the causes at specific age groups, two age-based groups were formed: 18-50 years,  $\geq$  51 years old.

**Statistics Analysis:** The SPSS 22.0 (IBM Corp. released 2013; IBM SPSS Statistics for Windows, version 22.0. Armonk, NY: IBM Corp.) package program was used for all analyses. Continuous data were shown as mean  $\pm$  standard deviation (SD), and categorical data were presented as percentages (%). Descriptive statistics were calculated in the study.

## Results

A total of 887 adult patients with 448 (50.6%) female and 439 (49.4%) male were included in the study. Two-hundred three (22.9%) patients were in the 18-50 age group while 684 (77.1%) were in the  $\geq$  51 age group. The mean age of all patients was  $67.31 \pm 20.46$  years (range: 18-102) (Table 2).

The five most common vision loss were caused by cataract, seen in 353 (39.9%), age-related macular degeneration (AMD) in 99 (11.2%), diabetic retinopathy (DRP) in 83 (9.4%), corneal opacities in 69 (7.8%) and optic atrophy in 68 (7.7%) patients (Table 3).

The most common causes of vision loss in the 18-50 age group were amblyopia seen in 42 (20.7%), phthisis bulbi/absent globe in 31 (15.3%) and optic atrophy in 28 (13.8%) patients, while it was seen as cataract in 340 (49.9%), AMD in 99 (14.5%) and DRP in 66 (9.7%) patients in the  $\geq$  51 age group. Distribution of the common pathologies was different between the age groups 18–50 and  $\geq$  51 years, but similar between sex subgroups (Table 3).

Categories according to age subgroups is shown in Table 4.

Unilateral visual impairment was seen in 416 (46.9%) patients while 471 (53.1%) patients had bilateral visual impairment. Of these 471 patients, 223 was blind and 248 had low vision.

In the blindness group, the leading causes were cataract [82 (36.9%)], AMD [36 (16.2%)] and DRP [35 (15.8%)]. Comparing age groups, retinal dystrophies (RD) [9 (28.1%)] were the main leading cause in the 18-50 age group while cataract [81 (42.6%)] was the main leading cause in the  $\geq$  51 age group.

In the low vision group, the leading causes were cataract [138 (55.9%)], AMD [48 (19.4%)] and

DRP [25 (10.1%)] as in the blindness group. Amblyopia [10 (37%)] was the the main leading cause in the 18-50 age group while cataract [137 (62.3%)] was the main leading cause in the the  $\geq$  51 age group.

In the unilateral visual impairment group, the leading causes were cataract [133 (32%)], phthisis bulbi/absent globe [59 (14.2%)] and corneal opacities [52 (12.5%)]. Amblyopia [32 (22.2%)] was the the main leading cause in the 18-50 age group while cataract [122 (44.9%)] was the main leading cause in the  $\geq$  51 age group.

Of the 416 patients included in the unilateral visual impairment group, 99 (23.8%) had BCVA  $\geq$  20/40 but  $<$  20/20 in the better-seeing eye while 317 patients had BCVA of 20/20. Cataract was the most common cause of reduced vision in the fellow eye followed by DRP and AMD (Table 5).

## Discussion

Epidemiological studies on the prevalence and causes of blindness and visual impairment have become widespread in 1990s and expanded to many countries (10). In our country, "Turkey Disability Survey" was conducted by the State Institute of Statistics in 2002 for the first time. According to the data from this study, it was reported that there were more than 400.000 visually impaired individuals [48.500 (11.8%) people with blindness, 162.000 (39%) people who have visual impairment] (11-12). But, this study didn't provide any data about the main pathologies causing visual impairment. Today, WHO encourages countries and institutions to identify the causes of visual impairment in order to treat and eliminate avoidable causes of blindness (13).

Alanya is a district of Antalya province on the West Mediterranean coast and the total number of individuals is 327.503 according to the latest population census. About 50.9% of this population are individuals aged between 18-50 years and 22.8% are aged over 50 years. The economy is largely based on farming, animal husbandry and tourism. Rural settlements are quite high because of agriculture and there is plenty of sun exposure at every month of the year. The level of economic development is very high, especially in comparison to eastern regions of Turkey.

The causes and prevalence of visual impairment differ in countries and even in different regions of the same country, depending on their levels of economic development (12-14). Globally, of the

**Table 2.** The Mean Age of Patients Based On Age Groups and Sex

	Age Groups		
	18-50	≥ 51	Total
Sex	N=203(22.9%)	N=684(77.1%)	N=887(100%)
Female	36.47±9.87	78.97±10.18	72.52±18.32
Male	35.03±9.72	74.03±11.68	61.98±21.18
Total	35.51±9.77	76.78±11.14	67.31±20.46

**Table 3.** Distribution of The Leading Causes of Vision Loss According to Age and Sex Groups

Disease Category	Age(year)						Total N=887(%)
	18-50			≥ 51			
	Female N=67(%)	Male N=136(%)	Total N=203(%)	Female N=381(%)	Male N=303(%)	Total N=684(%)	
Cataract	5(7.4)	8(5.9)	13(6.4)	210(55.3)	130(43)	340(49.9)	353(39.9)
DRP	4(5.9)	13(9.6)	17(8.4)	30(7.9)	36(11.9)	66(9.7)	83(9.4)
Amblyopia	12(17.6)	30(22.2)	42(20.7)	1(0.3)	5(1.7)	6(0.9)	48(5.4)
Phthisis bulbi/absent globe	11(16.2)	20(14.8)	31(15.3)	9(2.4)	23(7.6)	32(4.7)	63(7.1)
Optic atrophy	8(11.8)	20(14.8)	28(13.8)	14(3.7)	26(8.6)	40(5.9)	68(7.7)
Corneal opacities	9(13.2)	17(12.6)	26(12.8)	25(6.6)	18(6)	43(6.3)	69(7.8)
Other retinal diseases	3(4.4)	13(9.6)	16(7.9)	8(2.1)	8(2.6)	16(2.3)	32(3.6)
Retinal dystrophies	8(11.8)	4(3)	12(5.9)	3(0.8)	5(1.7)	8(1.2)	20(2.3)
Glaucoma	1(1.5)	3(2.2)	4(2)	6(1.6)	14(4.6)	20(2.9)	24(2.7)
Myopic degeneration	5(7.4)	5(3.7)	10(4.9)	2(0.5)	3(1)	5(0.7)	15(1.7)
AMD	-	-	-	66(17.4)	33(10.9)	99(14.5)	99(11.2)
RVO	-	1(0.7)	1(0.5)	4(1.1)	1(0.3)	5(0.7)	6(0.7)
PCO	-	1(0.7)	1(0.5)	1(0.3)	1(0.3)	2(0.3)	3(0.3)
Congenital eye anomalies	1(1.5)	1(0.7)	2(1)	2(0.5)	-	2(0.3)	4(0.5)

DRP, diabetic retinopathy; AMD, Age-related macular degeneration; RVO, retinal vascular occlusion; PCO, posterior capsular opacification

7.33 billion people alive in 2015, it was forecasted that there were 36.0 million (0.48%) people with blindness and 216.6 million (2.95%) people who had moderate to severe visual impairment with the greatest prevalence in low-income regions and lowest in high-income regions (6). Globally in 2015, the leading causes of blindness among all ages were cataract, uncorrected refractive error and glaucoma. The leading causes of moderate to severe visual impairment were uncorrected refractive error, cataract and AMD (15).

In this study, we found that major causes of vision loss were cataract, AMD, DRP, corneal opacities and optic atrophy, in descending order. In Turkey, VSIR is calculated using the BCVA, because of that the proportion of uncorrected refractive errors couldn't be determined from the medical reports. In another study from the east region of Turkey, cataract, glaucoma and AMD were found to be the major causes of blindness and visual impairment (11). The Izmir eye study, conducted in Aegean region of Turkey, reported that RD, AMD and DRP were the main causes of low

**Table 4.** Distribution of The Leading Causes of Blindness, Low Vision and Unilateral Visual Impairment According to Age Subgroups

Disease Category	Blindness			Low vision			Unilateral visual impairment		
	18-50 N=32( %)	≥51 N=191( %)	Total N=223( %)	18-50 N=27( %)	≥51 N=221( %)	Total N=248( %)	18-50 N=14 4( %)	≥51 N=272( %)	Total N=416( %)
Cataract	1(3.1)	81(42.6)	82(36.9)	1(3.7)	137(62.3)	138(55.9)	11(7.6)	122(44.9)	133(32)
DRP	5(15.6)	30(15.8)	35(15.8)	4(14.8)	21(9.5)	25(10.1)	8(5.6)	15(5.5)	23(5.5)
Amblyopia	-	-	-	10(37)	1(0.5)	11(4.5)	32(22.2)	5(1.8)	37(8.9)
Phthisis bulbi/absent globe	1(3.1)	3(1.6)	4(1.8)	-	-	-	30(20.8)	29(10.7)	59(14.2)
Optic atrophy	8(25)	11(5.8)	19(8.6)	1(3.7)	4(1.8)	5(2)	19(13.2)	25(9.2)	44(10.6)
Corneal opacities	1(3.1)	9(4.7)	10(4.5)	4(14.8)	3(1.4)	7(2.8)	21(14.6)	31(11.4)	52(12.5)
Other retinal diseases	-	1(0.5)	1(0.5)	1(3.7)	1(0.5)	2(0.8)	15(10.4)	14(5.1)	29(7)
Retinal dystrophies	9(28.1)	7(3.7)	16(7.2)	2(7.4)	1(0.5)	3(1.2)	1(0.7)	-	1(0.2)
Glaucoma	2(6.3)	9(4.7)	11(5)	-	2(0.9)	2(0.8)	2(1.4)	9(3.3)	11(2.6)
Myopic degeneration	3(9.4)	1(0.5)	4(1.8)	4(14.8)	2(0.9)	6(2.4)	3(2.1)	2(0.7)	5(1.2)
AMD	-	36(18.9)	36(16.2)	-	48(21.8)	48(19.4)	-	15(5.5)	15(3.6)
RVO	-	1(0.5)	1(0.5)	-	-	-	1(0.7)	4(1.5)	5(1.2)
PCO	-	-	-	-	1(0.5)	1(0.4)	1(0.7)	1(0.4)	2(0.5)
Congenital eye anomalies	2(6.3)	2(1.1)	4(1.8)	-	-	-	-	-	-

DRP, diabetic retinopathy; AMD, Age-related macular degeneration; RVO, retinal vascular occlusion; PCO, posterior capsular opacification

vision and blindness (7). In a recent study from central Anatolia region of our country, AMD, cataract and DRP were the main causes of blindness and visual impairment (16). The common features of these 4 studies were that they were conducted in different regions of the same country and the patient population was selected from the health board reports. The difference in the results of these studies may be due to the differences in the socioeconomic, geographical and ethnic characteristics of the regions as well as the differences in their methodologies such as age, vision subgroups and definitions of blindness and visual impairment (WHO criteria or US criteria).

Cataract was the leading cause of vision loss in all 3 blindness, low vision and unilateral visual impairment groups and dominantly higher in the ≥ 51 age groups in this study. Meta-analysis of

population-based studies showed that the prevalence of visual impairment and blindness due to cataract was lowest in high-income countries and greatest in low-income countries (17). Cataract was the leading cause of blindness in low-income countries like Bangladesh (79.6%), India (62.4%); and in middle-income countries like China (48.5%), Guatemala (77.6%), Malaysia (58.6%), Brasil (50%) and Paraguay (43.8%) (18-24). Even in high-income countries, cataract has been reported as the main cause of visual impairment and blindness (25-27). We found that cataract was responsible for 36.9% of blindness, 55.9% of low vision and 32% of unilateral visual impairment. When we look at the whole study results, 39.9% of all patients had vision loss due to cataract. Turkey can be classified among upper

**Table 5.** The Leading Causes of Vision Loss In The Better-Seeing Eye In The Unilateral Visual Impairment Group Consisting of 416 Patients

Disease Category	N(%)
Cataract	61 (14.7)
DRP	13 (3.1)
AMD	6 (1.4)
Amblyopia	5 (1.2)
Other retinal diseases	3 (0.7)
Corneal opacities	3 (0.7)
Myopic degenerations	3 (0.7)
PCO	3 (0.7)
Retinal dystrophies	1 (0.2)
Optic atrophy	1 (0.2)

DRP, diabetic retinopathy; AMD, Age-related macular degeneration; PCO, posterior capsular opacification

middle-income countries and the proportion of blindness and visual impairment due to cataract is expected to be relatively high, but Turkey includes regions with greatly varying socioeconomic, geographic, and ethnic characteristics. The geographical location of Alanya with abundant ultraviolet radiation exposure may play a role in high proportion of cataract. Absence of family support, insufficiency to understand the need for surgery, fear of surgery or poor outcome, difficulties in access to and use of eye-care centers may be important barriers. Also the higher rating of disability support that patients would obtain from the health board due to cataract related vision loss may be another barrier for surgery. In Turkey, cataract surgery is performed free of charge in state hospitals for anyone who has social health insurance. That's why, we don't think surgical cost is a major hurdle.

AMD was the second most common cause of blindness (16.2%) and low vision (19.4%) in this study. It was the fourth most common cause of all global blindness (8.7%) and the proportion of blindness due to AMD has been reported to be higher in developed countries with high-income and older populations (15). In high-income countries like Denmark (42.8%), England-Wales (50%) and US (38%), AMD was the most common cause of blindness (25, 28, 29). Conversely, in most of the low and middle-income countries, AMD has been reported as a less frequent or rare cause of blindness (18, 20, 22, 30). Cataract may be masking AMD in low and middle-income countries. Also in some studies, as we did in this study, cataract might have been noted as the cause of blindness in case of both cataract and AMD existence. The achievement in reducing the quantity of blindness and visual impairment due to cataract and refractive error

has led to an increase in the proportion of blindness due to AMD in high-income countries (31).

Diabetes mellitus is a well known global "epidemic". In 2015, an estimated 415 million people had diabetes globally (32). In 2010, the prevalence of diabetes was 16.5% translating to 6.5 million adults and the increase rate of the prevalence from 1999 to 2010 was 90% in Turkey (33). DRP was the third most common cause of blindness (15.8%) and low vision (10.1%) in this study. Blindness due to DRP was similar between 18-50 and  $\geq 51$  age groups (15.6%-15.8%, respectively), while low vision due to DRP was higher in the 18-50 age group (14.8% versus 9.5%). Blindness due to DRP was comparable in Malaysia (10.4%), Denmark (7.1%), England-Wales (5.4%), US (8%), Barbados (8.7%) and China (7.7%) (22, 25, 28, 29, 34, 35). In Iran, DRP was the leading cause of blindness with a high proportion (50%) (30).

Corneal opacities were estimated to cause 3.5% of all global blindness at all ages (15). Corneal opacities were the fourth most common cause of vision loss (7.8%) in our study and the proportion was higher in the 18-50 age group (12.8% versus 6.3%). Although blindness (4.5%) and low vision (2.8%) due to corneal opacities were relatively low, in the unilateral visual impairment group corneal opacities were the third most common cause (12.5%). Corneal opacities weren't reported among the leading causes of low vision and blindness in high-income countries like Denmark, Barbados and Netherlands (25, 34, 36). Also, in low-income countries like Bangladesh and India, corneal opacities weren't among the major causes of blindness (18,19). In middle-income countries like China (6.1%) and Guatemala (4.5%), the

proportion of blindness due to corneal opacities were comparable to our study (4.5%) (20, 21). Corneal opacities in our study population were especially sequel of trauma and keratitis and agricultural activities had an important role.

Optic atrophy was the fifth most common cause of vision loss (7.7%) in our study. Blindness due to optic atrophy was 8.6% and dominantly higher in the 18-50 age group (25% versus 5.8%). Similarly, in the Izmir eye study, the proportion of vision loss due to optic atrophy was 7.5% and higher in the 18-50 age group (7). The proportion of blindness due to optic atrophy was comparable in England-Wales (4.9%), US (7 %) and Barbados (7.1%) (28, 29, 34). It was a rare cause of blindness in Bangladesh (0.51%) and China (3%) (18, 20). The main causes of optic atrophy in this study were multipl sclerosis, uveitis and anterior ischemic optic neuropathy.

Amblyopia is a common vision disorder among children and young adults and the global prevalence has been reported as 1.44% (37). In our study, the proportion of vision loss due to amblyopia was 5.4% and it was the main leading cause of low vision and unilateral visual impairment in the 18-50 age group (37%-22.2%, respectively). In the meta-analysis study of Fu et al. , the prevalence of amblyopia was higher in high-income countries (2.07%) and lower in low-income countries (0.37%) (37). In Poland, visual impairment due to amblyopia was 15.6%, the second most common cause after AMD (9). In Pakistan, amblyopia was responsible for 4.4% of causes of functional low vision (38). The high prevalence in high-income countries may be explained by the improved detection methods in contrast to the low-income countries.

RD were the most common cause of blindness in the 18-50 age group (28.1%) in this study. RD have been reported as one of the leading causes of blindness and vision loss in England-Wales (8.2%), Jordan (29.7%) and Germany (22%) (28, 39, 40). In the Izmir eye study, RD were the major cause of vision loss (17%); also like in our study, RD were the most common cause of blindness in the 18-50 age group (38.6%) (7). In another study from Central Anatolia of Turkey, RD were reported as the leading cause of blindness and it was attributed to the high rate of consanguineous marriages, which causes an increase in the prevalence of rare recessive diseases (16). Higher proportions of cataract in low and middle-income countries may be masking RD. Additionally, RD that result in low vision at an early age but not

blindness may not be noticed by patients and therefore diagnosis may delay.

Phthisis bulbi/absent globe was the second most common cause of vision loss in the 18-50 age group (15.3%) and the second most common cause of unilateral visual impairment (14.2%) in our study. In the whole study, phthisis bulbi/absent globe was the sixth most common cause of vision loss (7.1%). In a study from China, the third main reason for bilateral blindness was phthisis bulbi/absent globe (7.81%) (13). In Paraguay, the proportion of blindness due to phthisis bulbi/absent globe was 3.1% (24). In the Izmir eye study, phthisis bulbi/absent globe was reported as a very rare cause of vision loss (0.6%) (7). The high frequency of phthisis bulbi in our study was attributed to the high frequency of penetrating ocular trauma.

Glaucoma was the third most common cause of blindness and the fourth most common cause of moderate to severe visual impairment in 2015, globally (15). The proportion of blindness due to glaucoma has been reported to be high in both low to middle and high-income countries like India (9.58%), Malaysia (6.6%), Spain (7%) and England-Wales (11%) (19, 22, 26, 28). In this study, glaucoma didn't rank among the top 5 causes of blindness, low vision or unilateral visual impairment. Vision loss due to glaucoma was 2.7% at all ages, being relatively higher in the  $\geq 51$  age group (2.9% versus 2%). In the Izmir eye study, the proportion of vision loss due to glaucoma was 6.9% (7). However, some of the patients in our study didn't have routine eye examination or follow-up. They had only applied for receiving a health report. Other causes like cataract, AMD, DRP might have been noted as the primary reason causing vision loss, that's why the proportion of vision loss due to glaucoma might have been reported lower.

In this study, different from other studies, we formed the "unilateral visual impairment group", of which the definition was made according to the worse-seeing eye in contrast to blindness and low vision groups. Ninety-nine (23.8%) patients in the unilateral visual impairment group had reduced vision in fellow eyes (better-seeing eyes), which were considered normal (BCVA  $\geq 20/40$  but  $< 20/20$ ), and cataract, DRP and AMD was the leading causes in order of frequency. It is obvious that these people will be involved in the blindness or low vision groups if no precautions are taken.

Globally, 31 million (86%) of 36 million people with blindness, 172.3 million (80%) of 216.6 million people with moderate to severe visual

impairment were within 50 years and older age category which constituted the greatest burden of visual impairment (6). Similarly in our study, 77.1% (684 of 887) of the patients were aged over 50 years. The incidence of cataract, AMD and glaucoma increases after 65 years of age, while amblyopia, degenerative myopia and hereditary retinal diseases are seen more frequently in patients under 65 years. In this study, cataract, AMD, glaucoma, DRP was more prevalent in the  $\geq 51$  age group, while amblyopia, degenerative myopia, RD, optic atrophy, corneal opacities and phthisis bulbi/absent globe was more frequent in the 18-50 age group.

It has been reported that vision loss due to glaucoma and corneal opacity was more common in men, while vision loss due to cataract and DRP was more common in women and no clear sex difference has been reported for AMD (15). In this study, cataract and AMD were more often causes of vision loss in women, while the rate of DRP-related vision loss was higher in men. Longer lifetime of women (81.3 years for females vs. 75.9 for males in Turkey, 2019) may be a reason; women have more time for development of cataract (41). Another reason may be that women's needs or complaints are ignored or underestimated, especially in low and middle-income countries.

Any vision loss due to a preventable or treatable cause like cataract, uncorrected refractive error, glaucoma, DRP or corneal opacity can be defined as avoidable vision loss. According to this definition, of the 252.6 million people with blindness or visual impairment in 2015, 205.1 million (81.2%) had a preventable or treatable cause (15). In Iran, the proportion of avoidable causes of blindness and visual impairment was 92.9% and 76.6%, respectively (30). In Malaysia, 86.3% of the causes of blindness was avoidable and 58.6% was treatable (22). In our study, overall 59.8% of vision loss was avoidable. The proportion of avoidable causes of blindness was 62.2% and 36.9% of them was treatable. Avoidable causes of low vision was 69.6%, of which 55.9% was treatable.

Limitation of our study is that when there were multiple disorders causing vision loss, only the "most readily curable" or the "most easily preventable" was recorded. Therefore, the impact of posterior segment diseases has the potential to be underestimated when the patient presents with cataract. Our hospital is the only institution including a health board committee in Alanya. That's why we assume our patient data are

trustable and may give clues about the proximate distribution of the causes of vision loss in the population. The strength of our study was the relatively large sample size, providing us to determine the specific causes of blindness, low vision and unilateral visual impairment.

In conclusion; cataract, AMD and DRP were found to be the major causes of blindness and low vision. Cataract still remains the most common cause of blindness, low vision and unilateral visual impairment, although increased numbers of cataract surgery. Amblyopia was important for being the leading cause of low vision and unilateral visual impairment in the 18-50 age group. Considering the fact that most of the causes of blindness and visual impairment in our study are preventable or treatable, we think that early interventions for preventive and educational health policies should be developed at younger ages to guide the lifestyle trends of individuals for a visual disability-free lifetime.

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