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Original Article

The Causes and Frequency of Monocular and Binocular Blindness in Adults Applying to the Health Committee of a University Hospital in Central Anatolia

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Abstract

Objectives: The aim of this study was to investigate the frequency of blindness and the pathologies that cause blindness in the Konya province of Turkey.

Materials and Methods: The records of individuals over 18 years of age who applied to the health committee of Meram School of Medicine Hospital between January 2015 and December 2018 were evaluated retrospectively.

Results: After reviewing the records of 4,268 applicants, a total of 222 applicants were included in the study (159 patients with monocular blindness, 63 patients with binocular blindness). The most common causes of monocular blindness were optic atrophy (13%), amblyopia (11%), and phthisis bulbi (10%). The most common causes of binocular blindness were retinitis pigmentosa (28%), proliferative diabetic retinopathy (13%), and unoperated cataract (11%). The frequency of monocular blindness was 3.7% (95% confidence interval [CI]: 3.2-4.3%) and binocular blindness was 1.5% (95% CI: 1.1-1.9%) in the sample. The frequency of blindness increased with age, with a positive correlation between mean age and blindness (p=0.002). Monocular blind applicants had a significantly lower mean age than binocular blind applicants (48.8±13.3 vs. 55.0±13.1 years, p=0.002) and binocular blind women had a significantly higher mean age than binocular blind men (62.7±16.0 vs. 53.2±11.7 years, p=0.023). The prevalence of monocular and binocular blindness was significantly higher in men than women (p=0.032).

Conclusion: The results of this study show that many of the pathologies that cause blindness are preventable or treatable, and that blindness is associated with age.

Keywords: Blindness, prevalence, retinitis pigmentosa, proliferative diabetic retinopathy, cataract

Introduction

Visual impairment or blindness is a disability that restricts a person's life in many ways. Blindness is not only an individual disability; it is also a major public health problem, because blindness also affects millions of others who assist and care for blind people, such as their relatives. Ultimately, it affects the national economy.[1] According to data from two different studies conducted in Japan and Canada, it was calculated that visual impairment and blindness impose an economic burden of $15-73 million per year.[2,3]

Approximately 33 to 39 million people worldwide are believed to be blind.[4,5,6,7] According to data from the World Health Organization (WHO), the global blind population increases by 1-2 million every year.[8] However, it is known that the majority of pathologies that cause blindness are preventable or treatable.[8] Early diagnosis and proper treatment of the pathologies that cause blindness may help rehabilitate these patients and enable them to rejoin society. Further research will contribute to the development of policies and programs for blindness prevention that could reduce the economic burden of this health problem.

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In addition, according to WHO's more recent 2019 World Report on Vision, eye health problems and visual impairment affect over 2.2 billion people worldwide, 1 billion of whom have visual impairment that was preventable or is unaddressed.[9] This includes people with uncorrected refractive errors (123.7 million) and presbyopia (826 million) as well as those with cataract (65.2 million), glaucoma (6.9 million), corneal opacities (4.2 million), diabetic retinopathy (3 million), and trachoma (2 million). This report reveals once again that many pathologies that cause visual impairment are preventable and treatable.[9]

Turkey is a developing country with a total population of over 80 million and a large young population. However, the worldwide population is increasingly older and as a result, the prevalence of age-related ocular pathologies and blindness is also increasing.[4] Konya is a major city in the Central Anatolia region, capital of the Konya province, and the seventh most populous city in Turkey, with a total metropolitan population of over 2 million. Moreover, the Konya province neighbors several smaller provinces and patients from these areas also come to Konya for diagnosis and treatment. As a result, hospitals in Konya serve a population of approximately 3 million.

In light of this information, we aimed in this study to evaluate the frequency of blindness and determine the pathologies that cause blindness in the Konya province by reviewing the data of people who applied to the health committee of Meram School of Medicine Hospital.

Materials and Methods

In this study, the records of individuals over 18 years of age who applied to the health committee of Necmettin Erbakan University Meram School of Medicine Hospital between January 2015 and December 2018 were examined retrospectively. Necmettin Erbakan University, Meram Medical Faculty Ethics Committee approved with the decision numbered 2019/1722 and the principles of the Declaration of Helsinki were adhered to throughout the study.

Best-corrected visual acuity (BCVA) was evaluated for all applicants according to their education level (Snellen chart for literate applicants, reduced logMAR tumbling-E chart for illiterate applicants). All applicants underwent automated refraction (Topcon KR-8900 Auto Kerato-refractometer). Intraocular pressure (IOP) was measured by air-puff tonometry. If IOP was ≥21 mmHg, Goldmann applanation tonometry was used to confirm the IOP value. Slit-lamp biomicroscopic and dilated funduscopic examinations were performed. If necessary, applicants were examined by spectral-domain optical coherence tomography (Heidelberg Engineering, Heidelberg, Germany), fundus angiography (Heidelberg Engineering, Heidelberg, Germany), corneal topography (Pentacam HR, Oculus Optikgerate, Wetzlar, Germany), and Humphrey Field Analyzer (HFA: Carl Zeiss Meditec, Dublin, CA, USA). Examination and demographic data of the applicants were recorded only once. Using the WHO criteria, blindness was defined as BCVA worse than 20/400 in the better eye or constriction of visual field to <10° from central fixation. Monocular blindness was defined as BCVA less than 20/400 in the worse eye and higher than 20/400 in the better eye.

Statistical Analysis

SPSS version 22.0 package program (IBM Corp, Armonk, NY, USA) was used for statistical analysis of the data. The Kolmogorov-Smirnov test was used to confirm normal distribution of the variables. Categorical variables were expressed as number and percentage, and continuous variables were expressed as mean ± standard deviation. Categorical data were analyzed using chi-square test with 95% confidence intervals (CI). Student's t-test was used to compare normally distributed continuous variables between monocular and binocular blindness groups. Pearson correlation test was used to calculate correlation coefficients and their statistical significance. A p value <0.05 was considered statistically significant.

Results

Of 4,268 records reviewed, 897 (21%) of the applicants wanted to obtain a health report for reasons such as applying for a job or firearms license and 3,371 (79%) wanted to obtain a disability report in order to exercise their legal rights. Of these, a total of 222 applicants who were diagnosed as blind (monocular blindness, n=159 and binocular blindness, n=63) were included in this study. The demographic characteristics of the sample are shown in Table 1.

The frequency of monocular blindness in the sample was 3.7% (95% CI: 3.2%-4.3%). The most common causes of monocular blindness were optic atrophy (13%), amblyopia (11%), and phthisis bulbi (10%). The other causes of monocular blindness are shown in Figure 1. The diagnosis of optic atrophy was generally associated with a primary disease such as neurodegenerative disease, central nervous system tumor (e.g., brain, pituitary), or cranial trauma due to traffic accidents. Subtypes of amblyopia were anisometropic amblyopia (n=17) and deprivation amblyopia (n=1). Moreover, the applicants evaluated under phthisis bulbi diagnosis were those who underwent perforation repair due to penetrating eye injury and subsequently developed blindness due to various ocular pathologies such as ocular trauma, infection, inflammatory diseases, ocular surgery, and chronic retinal detachment (RD). Ocular trauma was the most common of cause of phthisis bulbi and all of these applicants were male (n=15).

The frequency of monocular blindness in women was 2.2% (95% CI: 1.2-3.6%). Optic atrophy (29%), age-related macular degeneration (AMD; 22%), and cataract (14%) were the first three causes of monocular blindness among female applicants. Other reasons are given in Table 2. The causes in the "other" category in Table 2 were retinitis pigmentosa (RP; 1%) and proliferative diabetic retinopathy (PDRP; 1%). Of the applicants with monocular blindness, 91% (n=145) were men.

The frequency of monocular blindness in men was 4% (95% CI: 3.4-4.7%). The first three causes of monocular blindness in male applicants were amblyopia (12%), optic atrophy (11%), and phthisis bulbi (10%). Other reasons are given in Table 2. The "other" category for men included cataract (8%), RD (8%), other corneal diseases (8%), other retinal diseases (7%), PDRP (6%), glaucoma (3%), RP (3%), AMD (2%), keratoconus (1.5%), and myopic macular degeneration (MMD; 1.5%).

The frequency of binocular blindness was 1.5% in the sample (95% CI: 1.1-1.9%). The most common causes of binocular blindness were RP (28%), PDRP (13%), and cataract (11%). The other causes of binocular blindness are shown in Figure 2. Pathologies such as posterior staphyloma, macular scar secondary to angioid streak, previous RD surgery, and retinochoroidal coloboma were classified as "other retinal diseases" and pathologies such as bullous keratopathy, band keratopathy, corneal leukoma/scar, and corneal dystrophy as "other corneal diseases." The general diagnosis of optic atrophy included subgroups of central nervous system tumor (brain, pituitary, etc.), neurodegenerative diseases, cranial trauma due to traffic accidents, and optic neuropathy.

We determined that 81% (n=51) of the binocular blind applicants were male. The frequency of binocular blindness was 1.4% (95% CI: 1.0-1.8%) in men and 1.8% (95% CI: 1.0-3.2%) in women. The first three causes of binocular blindness were cataract (33%), RP (25%), and PDRP (17%) among women and RP (29%), optic atrophy (13%), and PDRP (12%) among men (Table 3). Other causes in men were cataract (6%), MMD (6%), RD (6%), evisceration/enucleation (4%), blunt/perforating trauma (4%), keratoconus (2%), and other corneal diseases (2%).

A remarkable finding was the significant male predominance among both monocular and binocular blind applicants (p=0.032). Moreover, the mean age of monocular blind applicants was significantly lower than that of binocular blind applicants (48.8±13.3 vs. 55.0±13.1 years, p=0.002). When monocular blind female and male applicants were compared, no statistically significant difference was found in terms of mean age (50.6±22.9 vs. 48.7±12.1 years, p=0.605). However, the mean age of binocular blind female applicants was significantly higher than that of binocular blind male applicants (62.7±16.0 vs. 53.2±11.7 years, p=0.023).

Lastly, we observed a positive correlation between mean age and blindness, with the frequency of blindness increasing with age (p=0.002).

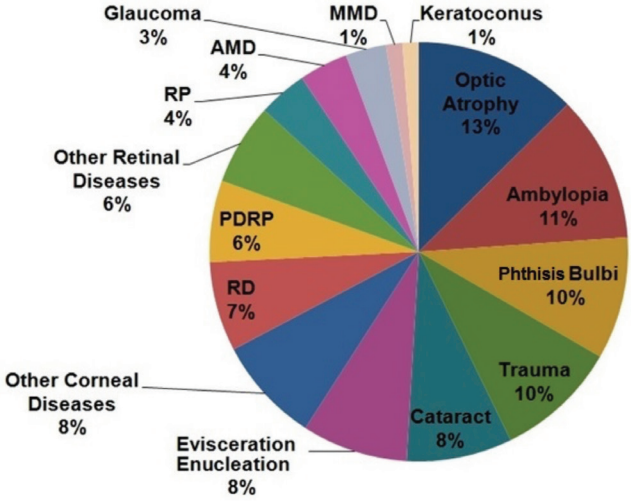

Figure 1. The distribution of the causes of monocular blindness

RD: Retinal detachment, PDRP: Proliferative diabetic retinopathy, RP: Retinitis pigmentosa, MMD: Macular degeneration

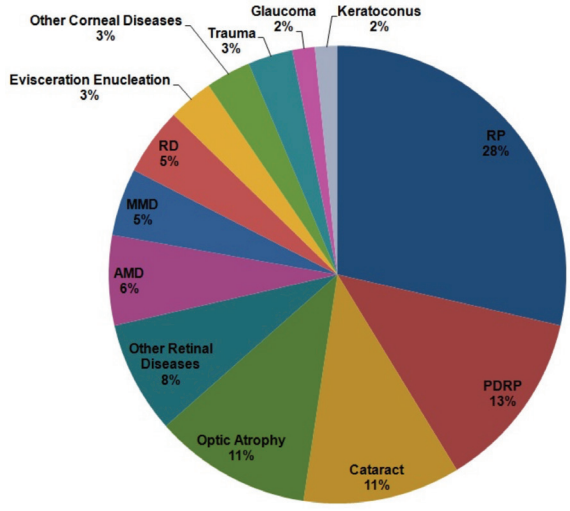

Figure 2. The distribution of the causes of binocular blindness

RP: Retinitis pigmentosa, PDRP: Proliferative diabetic retinopathy, AMD: Age-related macular degeneration, MMD: Myopic macular degeneration, RD: Retinal detachment

Table 1. Descriptive data and frequencies by gender

	n	Binocular blindness			Monocular blindness		
		n (%)	Frequency	Age (years) mean ± SD	n (%)	Frequency	Age (years) mean ± SD
Female	643	12 (19%)	1.9%	62.7±16.0	14 (9%)	2.2%	50.6±22.9
Male	3,625	51 (81%)	1.4%	53.2±11.7	145 (91%)	4.0%	48.7±12.1
Total	4,268	63	1.5%	55.0±13.1	159	3.7%	48.8±13.3

SD: Standard deviation

Discussion

In this study, the three most common causes of binocular blindness were RP, PDRP, and unoperated cataract. The leading cause of binocular blindness was RP, which was diagnosed in a total of 18 applicants, 3 of whom were considered to be binocular blind based on visual field results despite having BCVA better than 10/200. There is no research about the prevalence or distribution of RP in our country, but its high frequency is probably due to the fact that consanguineous marriages are common in our region.

The number of people with diabetes has increased considerably in recent years.[10] In this study, PDRP was the second most common cause of binocular blindness. Eight applicants had binocular blindness due to PDRP and 3 of them had tractional RD. These patients should be diagnosed and treated earlier, before reaching this advanced stage.

Although cataract was the most common cause of blindness in many other prevalence studies, it was the third most common cause of binocular blindness in our study. The main reason for this is likely that cataract surgery was recommended to health committee applicants and their medical board reports were prepared following cataract surgery. Cataract diagnoses in this study were in applicants who refused surgery or could not undergo surgery due to impaired general condition. Another reason is that in the literature, it has been reported that patients lack access to health services or hospitals where cataract surgery can be performed for different reasons, resulting in cataract being more common in the etiology of binocular blindness in some studies.[11,12]

In this study, men significantly outnumbered women among individuals with binocular and monocular blindness applying for health committee reports. In the greater part of our society, men are more likely to be involved in business life than women. In the event of men's disability, families are faced with a lack of income which makes them more likely to apply for a report. Many visually impaired women do not need to apply for a report because men continue to provide for their families. This is supported by the fact that 85% of the 4,268 health committee applicants in our study were men.

In Turkey, there is substantial variability in the demographic and genetic characteristics of the population, economic opportunities, and other environmental factors. There is no recent comprehensive epidemiological study on blindness in this diverse country because a qualified team and equipment to evaluate a sample of randomly selected individuals that accurately represents the population would require extensive time and cost. However, epidemiological studies have great importance in determining health problems in societies. Even if such large studies cannot be conducted in our country, at least this study and similar studies may provide some insight into blindness and its causes.

Table 2. Distribution of pathologies causing monocular blindness by gender

Male			**Female**		
Pathology	**n**	**%**	**Pathology**	**n**	**%**
Amblyopia	17	12	Optic atrophy	4	29
Optic atrophy	16	11	AMD	3	22
Phthisis bulbi	15	10	Cataract	2	14
Blunt/perforating trauma	15	10	Other corneal diseases	2	14
Evisceration/enucleation	13	9	Amblyopia	1	7
Other	69	48	Other	2	14
Total	145	100	Total	14	100

AMD: Age-related macular degeneration

Table 3. Distribution of pathologies causing binocular blindness by gender

Male			**Female**		
Pathology	**n**	**%**	**Pathology**	**n**	**%**
RP	15	29	Cataract	4	33
Optical atrophy	7	13	RP	3	25
PDRP	6	12	PDRP	2	17
Other retinal diseases	4	8	Glaucoma	1	8
AMD	4	8	Other cornea diseases	1	8
Other	15	29	Other retinal diseases	1	8
Total	51	100	Total	12	100

RP: Retinitis pigmentosa, PDRP: Proliferative diabetic retinopathy, AMD: Age-related macular degeneration

As a result of our literature research, the only known epidemiological study related to blindness in our country is a study by Negrel et al.[13] The study included 8,571 subjects around the provinces of Diyarbakır and Mardin. The prevalence of blindness in the region was reported as 0.4% and the main causes of blindness were cataract (50%), corneal opacity (15%), glaucoma (12%), phthisis bulbi (6%), and optic atrophy (6%).[13] The diagnosis of corneal opacity may be associated with trachoma, as trachoma was common in the years that the study was performed. However, it is clear that this may not reflect the current primary causes of blindness in the same region, as more than two decades have passed since the study was conducted. Moreover, their results cannot be generalized to the nation as a whole.

In another prospective study conducted in a rural area of Central Anatolia, Mirza et al.[14] reported that the frequency of blindness was 1.5% and the three leading causes of blindness were cataract (42%), AMD (21%), and uncorrected refractive defect (13%). This study was not an epidemiological study because the study sample determined by the authors was not chosen from random individuals.[14] Nevertheless, this study had a relatively large sample (n=3,423) and reflected the frequency and common causes of blindness in a rural region of Turkey. Another study conducted in our country was by Ceyhan et al.[15], who grouped people receiving reports from the Yüzüncü Yıl University Faculty of Medicine Hospital Health Committee (n=415) according to the frequency of ocular pathology as maculopathy (13.9%), phthisis bulbi/evisceration (12%), amblyopia (11%), and optic nerve diseases (10.6%).[15]

In addition, Sahin et al.[16] conducted a retrospective study including 88 blind people with no systemic disease who applied to the Dicle University Research Hospital Health Committee. The most important causes of blindness were collected under the heading of retinal pathologies (n=35) and RP (n=15). The leading causes of monocular blindness (n=79) were corneal and anterior segment pathologies (n=30), the most common of which was cataract/congenital cataract (n=11). However, their results did not fully reflect the true rates of blindness and ocular pathologies due to the exclusion of people with systemic diseases. As mentioned before, it is known that blindness increases with age, and the ocular pathologies that can lead to blindness at older ages were ignored in their study.[16]

In many developed countries, as in the US and Europe, the most common cause of blindness is AMD.[7,17] AMD was also reported as the most common cause of blindness in the Copenhagen and Rotterdam studies.[18,19] Other causes were MMD (14%), glaucoma (14%), RP (11%), and PDRP (7%) in the Copenhagen study and glaucoma (8%), cataract (6%), MMD (6%), and optic neuropathy (6%) in the Rotterdam study.[18,19] Looking at the rest of the world, the most common cause of blindness has been reported as cataract, especially in underdeveloped or developing countries.[20,21,22,23,24] In the Beijing Eye study in China, the most common causes of blindness were reported as cataract (38.5%), MMD (15.4%), and glaucoma (7%).[25] Cataract was also reported as the primary cause of blindness (59.3%) in the Singapore-India Eye study, with other causes including AMD (11.1%), uncorrected refractive disorder (7.4%), MMD (7.4%), glaucoma (3.7%), PDRP (3.7%), and amblyopia (3.7%).[26] In the Tajimi study, which included 3,021 people in Japan, the primary causes of monocular blindness were reported to be MMD (22.4%), glaucoma (12.2%), and trauma (12.2%).[27] In the Barbados Eye study, the leading causes of blindness were reported to be primary open angle glaucoma (25%) and AMD (25%), followed by retinal/choroidal diseases (15%) and optic atrophy (11%).[28]

In the studies mentioned above, the prevalence of blindness ranged from 0.04% to 30%.[12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28] As the sample of our study did not consist of randomly selected individuals, the results do not fully reflect the prevalence of blindness in this region. Nevertheless, our study includes not only people with disabilities but also those seeking health reports for various reasons (e.g., job application, registration to higher education institutions, firearms license application). This detail should also be considered. When all age groups were examined together irrespective of gender, the frequency of monocular blindness was found to be 3.7%. Monocular blindness was seen in 2.2% of female applicants and 4% of male applicants. The frequency of binocular blindness was 1.5% in the sample overall, 1.8% in female applicants, and 1.4% in male applicants.

Conclusion

In brief, the most important result of the present study was the detailed presentation of the ocular pathologies causing blindness. Our findings demonstrate that many of the pathologies causing monocular blindness (amblyopia, phthisis bulbi, trauma, and evisceration) and binocular blindness (PDRP, cataract, RD, trauma, glaucoma, and keratoconus) are preventable or treatable conditions. In addition, this study shows a cross-section of the diagnoses which can cause blindness. Further research to determine why these diseases continue to cause blindness is warranted. To reiterate, blindness is an important public health problem. Being aware of the pathologies that cause blindness, providing early diagnosis and treatment, and most importantly, taking preventive measures against the causes of blindness are essential both for public health and reducing the economic burden of blindness.

Ethics

Ethics Committee Approval: The local ethics committee approved the study, which adhered to the principles of the Declaration of Helsinki.

Informed Consent: In this study, the records of individuals over 18 years of age who applied to the health committee of Meram School of Medicine Hospital between January 2015 and December 2018 were examined retrospectively.

Peer-review: Externally peer reviewed.

Authorship Contributions

Concept: G.D.M., M.O., Design: G.D.M., M.O., E.M., Data Collection or Processing: G.D.M., E.M., Analysis or

Interpretation: G.D.M., S.B., M.O., Literature Search: G.D.M., E.M., Writing: G.D.M.

Conflict of Interest: No conflict of interest was declared by the authors.

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