



## Causes of Blindness and Moderate to Severe Visual Impairment in Niğde, Central Anatolia, Turkey

Erkut Küçük<sup>1</sup>, Kürşad Ramazan Zor<sup>1</sup>, Uğur Yılmaz<sup>2</sup>

### ABSTRACT

**Objective:** We investigated the causes of blindness and moderate to severe visual impairment (MSVI) in the Niğde province of Turkey using the disability health board records of the Niğde State Hospital.

**Materials and Methods:** The disability health board reports of Niğde State Hospital recorded between 2011 and 2015 were retrospectively evaluated. The causes of blindness and MSVI were determined using the cause in the better-seeing eye, based on World Health Organization (WHO) criteria. The overall, age-related, and gender specific causes of blindness and MSVI were identified.

**Results:** During the study period, 335 subjects were recorded as blind and 381 subjects were recorded as having MSVI. The main causes of blindness were retinitis pigmentosa (14.6%), age-related macular degeneration (AMD) (12.2%), and diabetic retinopathy (12.2%). In the MSVI group, the main causes were cataract (18.4%), AMD (16.5%), and diabetic retinopathy (13.9%).

**Conclusion:** Retinitis pigmentosa, AMD, and diabetic retinopathy were the leading causes of blindness, and, in addition to these, cataract was a prominent cause of MSVI. The prevalence of retinitis pigmentosa was unexpectedly high in this region of Turkey, which may be due to the high frequency of consanguineous marriages that are commonly seen in Middle Eastern countries. This information is important for planning public health policies and raising public awareness of the visual impairment, given that several leading causes of visual impairment are reversible or preventable.

**Keywords:** Blindness, visual impairment, retinitis pigmentosa

**Cite this article as:**  
Küçük E, Zor KR, Yılmaz U.  
Causes of Blindness and  
Moderate to Severe Visual  
Impairment in Niğde,  
Central Anatolia, Turkey.  
Erciyes Med J 2019; 41(4):  
420-4.

<sup>1</sup>Department of  
Ophthalmology, Niğde Ömer  
Halisdemir University Faculty  
of Medicine, Niğde, Turkey  
<sup>2</sup>Department of  
Ophthalmology, Pamukkale  
University Faculty of  
Medicine, Denizli, Turkey

Submitted  
26.07.2019

Accepted  
09.09.2019

Available Online Date  
05.11.2019

**Correspondence**  
Erkut Küçük,  
Niğde Ömer Halisdemir  
University Faculty of  
Medicine, Bor Street, Main  
Campus, 51240, Niğde, Turkey  
Phone: +90 388 225 2573  
e-mail:  
erkutkucuk@yahoo.com

©Copyright 2019 by Erciyes  
University Faculty of Medicine -  
Available online at  
www.erciyesmedj.com

### INTRODUCTION

Blindness and low vision are important health problems with grave economic and social costs. According to the World Health Organization (WHO), there are 285 million people with visual impairment worldwide (1). Approximately 40 million are blind and a 25 billion have low vision. Population growth and aging causes an increase in the number of people affected by blindness and visual impairment (2, 3). The prevalence and causes of blindness and visual impairment are important for planning public health policies, allocating the budget for health services, and raising public awareness of visual impairment. Bourne et al. reported that the leading global causes of blindness were cataract, uncorrected refractive errors, and macular degeneration (4). They also reported that for moderate and severe visual impairment (MSVI), the leading global causes were uncorrected refractive error, cataract, and macular degeneration. The causes of blindness and MSVI also differ substantially by region (4–6).

Population-based cross-sectional studies are necessary to obtain data about the epidemiology of ocular diseases, but these studies are expensive and time-consuming. There are limited studies investigating the causes and prevalence of blindness and MSVI in Turkey. One study conducted by Negrel et al. investigated the epidemiology of blindness and low vision in southeast Turkey (7). They reported the prevalence of blindness as 0.4% and low vision as 1.5%. Cataract, corneal opacity, and glaucoma were the main causes of blindness and cataract, and refractive errors were the prominent causes of low vision, according to their study.

Due to the scarcity of population-based cross-sectional studies, the various disability registries can be helpful in helping to determine the principal causes of blindness and MSVI and in setting the priorities of the health services. In Turkey, several benefits are provided to the disabled, such as tax reductions and allowances, increased employment opportunities, financial support from the government, early retirement, and use of special education services. To benefit from these opportunities, one should certify his or her disability status by the disability health board report for the handicapped, which can be acquired from one of the health institutions authorized by the government.

In this study, we investigated the causes of blindness and MSVI in Niğde, a province in central Anatolia, using the Niğde State Hospital disability health board records.

## MATERIALS and METHODS

Niğde is a province located in the central Anatolia region of Turkey. It has a population of 346,114, according to the 2015 census. The Niğde State Hospital is the biggest health facility of the province and the only one that has a disability health board. In this institution, patients with vision problems apply to the disability health board to get their disability certified by an examining ophthalmologist, who is a member of the disability health board. Using the Snellen chart, subjective refraction status is determined, and best corrected visual acuity (BCVA), measurement is performed. Anterior and posterior segment examination and intraocular pressure measurements are carried out. Visual field testing, optical coherence tomography, and ocular ultrasonography are also performed if necessary in the same hospital. If electrophysiological testing is needed, the patient is referred to the Department of Ophthalmology at the Kayseri Erciyes Faculty of Medicine, which is the nearest facility that can perform these tests. The results of the examination and the tests are collected and the patient's visual system impairment rating is determined. These data are collected and recorded in the patient's file and a report is given to the patient.

The patients who applied to the disability health board of the Niğde State Hospital between 2011 and 2015 were included in the study. All of the authors were working in this facility at that time period. The patient's files were evaluated retrospectively by the authors. The demographic characteristics and the causes of visual impairment for each eye were also recorded. The WHO has proposed changes to the definition of blindness and low vision described in the International Classification of Diseases (ICD) (8). The term "low vision" has been replaced by two categories to avoid confusion with those requiring low vision cares; moderate visual impairment (category 1) and severe visual impairment (category 2). This classification was used in the International Classification of Diseases (ICD) (9) launched in June 2018 to describe visual impairment. This classification was used by the authors for identifying and grouping patients into blindness and MSVI groups. The BCVA of the better-seeing eye having a value worse than 0.05 was accepted as blindness and a BCVA value of the better-seeing eye being less than 0.3 but at least 0.05 was accepted as MSVI. In patients with visual field loss, a visual field of the better eye less than 10° in radius around the central fixation was accepted as blindness. The cause of blindness and MSVI was determined using the causes of vision-loss in the better-seeing eye. If there was more than one cause of visual impairment in the better-seeing eye, the underlying cause or the disorder causing the greatest limitation of vision was determined by an agreement between the authors. For investigating the causes at specific age groups, 3 age-based groups were formed: 0–14 years, 15–49 years, and 50 years and older. The overall specific causes of blindness and MSVI were identified. Also, age and gender specific causes were evaluated.

Some of the rare diseases, are grouped under more general and inclusive topics like "disorders of the globe" in our study. Some diseases are grouped under the name of the common late-stage appearance of the affected tissue, such as "corneal opacities" and "optic atrophy." By doing so, we aimed to make the manuscript easier to read and to avoid confusion. The corneal dystrophies, traumatic corneal pathologies, scars, and other acquired or hereditary corneal diseases are grouped under the topic "corneal opacities." Likewise,

**Table 1.** Distribution of patients based on age groups and gender

|                                            | Blindness |      | MSVI |      |
|--------------------------------------------|-----------|------|------|------|
|                                            | n         | %    | n    | %    |
| Gender                                     |           |      |      |      |
| Male                                       | 155       | 46.3 | 199  | 52.2 |
| Female                                     | 180       | 53.7 | 182  | 47.8 |
| Age (years)                                |           |      |      |      |
| 0–14                                       | 25        | 7.5  | 23   | 6.1  |
| 15–49                                      | 98        | 29.3 | 111  | 29.1 |
| ≥50                                        | 212       | 63.3 | 247  | 64.8 |
| Total                                      | 335       | 100  | 381  | 100  |
| MSVI: Moderate to severe visual impairment |           |      |      |      |

phthisis bulbi, traumatic loss or surgical removal of the eye, and congenital anomalies or absence of the globe is grouped under the topic "disorders of the globe." Optic atrophy includes primary and secondary optic atrophy. Consecutive optic atrophy (optic atrophy due to diseases of the retina and/or the choroid) and glaucomatous optic atrophy is not included in this topic. The other group consists of uveitis, retinopathy of prematurity, retinal detachment, and retinal vascular diseases other than diabetic retinopathy (DRP). In our study, the hereditary retinal dystrophies (HRD) group comprises all hereditary dystrophies of the posterior segment, except retinitis pigmentosa. The frequency of retinitis pigmentosa is given separately because it is very common and is one of the leading causes of blindness and visual impairment in Niğde.

The study followed the tenets of the Declaration of Helsinki and received approval from the Niğde Ömer Halisdemir University Ethics Committee. For this type of study, formal consent is not required.

The SPSS (Statistical Package for Social Sciences, Chicago, IL, ABD) version 19.0 statistical program was used for conducting descriptive statistics and comparing groups.

## RESULTS

During the study period, 335 subjects were recorded as blind. Of these subjects, 155 (46.3%) were male and 180 (53.7%) were female. The mean age of these subjects was  $56.7 \pm 25.5$  years (range: 1–101 years). When we look at the age groups, 25 (7.5%) patients were in the 0–14-year age group, 98 (29.3%) patients were in the 15–49-year age group, and 212 (63.3%) patients were in the 50 years and above age group (Table 1).

In our study, 381 subjects were recorded as having MSVI. Of these subjects, 199 (52.2%) were male and 182 (47.8%) were female. The mean age of patients in this group was  $57.6 \pm 24.6$  years (range: 3–95 years). When we look at the age-based subgroups, 23 (6%) patients were in the 0–14 age group, 111 (29.1%) patients were in the 15–49 age group, and 247 (64.8%) patients were in the 50+ age group (Table 1).

The five main causes of blindness were retinitis pigmentosa (14.6%), AMD (12.2%), diabetic retinopathy (12.2%), optic atrophy (11.9%), and glaucoma (9.6%). In the MSVI group, the

**Table 2.** Causes of blindness and MSVI

| Cause                  | Blindness |      | MSVI |      |
|------------------------|-----------|------|------|------|
|                        | n         | %    | n    | %    |
| Retinitis pigmentosa   | 49        | 14.6 | 22   | 5.8  |
| AMD                    | 41        | 12.2 | 63   | 16.5 |
| Diabetic retinopathy   | 41        | 12.2 | 53   | 13.9 |
| Optic atrophy          | 40        | 11.9 | 33   | 8.7  |
| Glaucoma               | 32        | 9.6  | 22   | 5.8  |
| Cataract               | 30        | 9.0  | 70   | 18.4 |
| Corneal opacities      | 28        | 8.4  | 25   | 6.6  |
| Disorders of the globe | 27        | 8.1  | 8    | 2.1  |
| HRD                    | 25        | 7.5  | 26   | 6.8  |
| Other                  | 16        | 4.8  | 6    | 1.6  |
| Degenerative myopia    | 6         | 1.8  | 39   | 10.2 |
| Amblyopia              |           |      | 14   | 3.7  |
| Total                  | 335       | 100  | 381  | 100  |

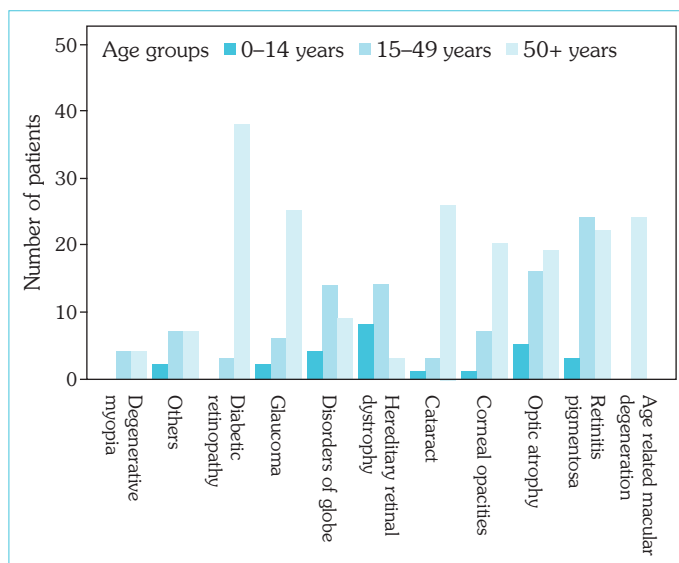
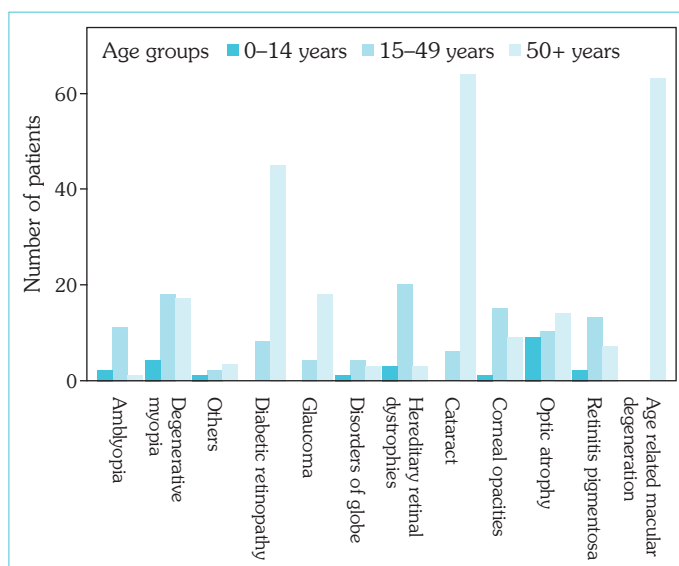
MSVI: Moderate to severe visual impairment; AMD: Age related macular degeneration; HRD: Hereditary retinal dystrophy. Other: This group consists of uveitis, retinopathy of prematurity, retinal detachment, retinal vascular diseases other than DRP. For blindness number of patients for uveitis (5), retinopathy of prematurity (2), retinal detachment (8), retinal vascular diseases other than diabetic retinopathy (1). For MSVI number of patients for uveitis (1), retinal vascular diseases other than diabetic retinopathy (5). Disorders of the globe include phthisis bulbi, traumatic loss or surgical removal of the eye and congenital anomalies or absence of the globe. For blindness number of patients for phthisis bulbi (12), traumatic loss or surgical removal of the eye (4), congenital anomalies or absence of the globe (11). For MSVI number of patients congenital anomalies or absence of the globe (8)

five main causes were cataract (18.4%), AMD (16.5%), diabetic retinopathy (13.9%), degenerative myopia (10.2%), and optic atrophy (8.7%) (Table 2).

In the blindness group, the leading causes were AMD, retinitis pigmentosa, and diabetic retinopathy in the decreasing frequency for females, and retinitis pigmentosa, optic atrophy, diabetic retinopathy, and glaucoma for males. In the MSVI group, the leading causes were cataract, diabetic retinopathy, and AMD in decreasing frequency for females, and AMD, cataract, and optic atrophy for males.

When we look at the age groups, the leading causes of blindness were HRD (32%), optic atrophy (20%), and disorders of the globe (16%) in the 0–14-year age group. In the 15–49-year age group, the leading causes of blindness were retinitis pigmentosa (24.5%), optic atrophy (16.3%), and HRD (13.8%). In the over 50 years group, the leading causes of blindness were AMD (19.3%), diabetic retinopathy (17.9%), and cataract (12.3%) (Fig. 1).

The leading causes of MSVI in the 0–14-year age group were optic atrophy (39.1%), degenerative myopia (17.4%), and HRD (13%). In the 15–49-year group, the leading causes of MSVI were HRD (18%), degenerative myopia (16.2%), and corneal opacities (13.5%). In the over 50 years group, the leading causes of MSVI were cataract (25.9%), AMD (25.5%), and diabetic retinopathy (18.2%) (Fig. 2).

**Figure 1.** Distribution of causes of blindness based on age groups**Figure 2.** Distribution of causes of MSVI based on age groups

## DISCUSSION

In this study, we evaluated the causes of blindness and MSVI in a medium-sized province in the central Anatolia region of Turkey. The records of the Disability Health Board of the Niğde State Hospital were evaluated for identifying patients (who were registered between 2011 and 2015) with blindness and MSVI and describing their causes. Using the records of the health board to identify visually disabled patients may not represent all the visually impaired people, because the patients that did not apply are not included in the study, but the benefits provided to the handicapped can only be obtained if the level of disability is certified by a health board report acquired from one of the health institutions authorized by the government. We believe that the substantial benefits provided by the government to the handicapped are important and would encourage many patients with disabilities to apply for the certification of their disability. Therefore, in the absence of cross-

sectional surveys, we think that using the records of the disability health board may give us an accurate estimation of the causes of blindness and MSVI in this region.

Stevens et al. reported that vision impairment was more prevalent in those patients aged 50 years and older (5). About 84.6% of blind patients and 77.5% of MSVI patients were reported to be in this age group. Consistent with this study, we found that 63.3% of our patients in the blindness group were 50 years and older, while 64.8% of patients in the MSVI group were in the 50 years and older age group in our study.

It has been reported that blindness and MSVI due to cataract and macular degeneration were more prevalent in females than in males worldwide (4). In our study, higher proportions of blindness and MSVI were caused by cataracts in females than in males (Fig. 1, 2). Also, a higher proportion of blindness due to macular degeneration was seen in females than in males, but for MSVI due to macular degeneration, the proportion of male patients was higher. Global reports have suggested that females access care less often than males in many areas of the world (5, 10, 11). This may be an explanation for our cataract results as well. Female longevity may also have an effect in this difference, especially with respect to AMD.

Negrel et al. investigated the prevalence and causes of blindness and low vision in a population-based survey in southeast Turkey in 1996 (7). They examined 7497 persons and found cataract, corneal opacity, and glaucoma to be the main causes of blindness. Cataract and refractive errors were main causes of low vision. However, their findings were based on small numbers, i.e., 34 patients were blind bilaterally, 125 had low vision, and 73 had monocular blindness. We had an opportunity to evaluate 335 patients with bilateral blindness and 381 patients with MSVI in our study. Due to the differences in the methodology, a direct comparison may be problematic, but we can say that due to improved health services and improved and widespread performance of cataract surgery, cataract is not the main cause of blindness according to our study. Nevertheless, it is still the main cause of MSVI (18.4%). Regional differences may also be important in this respect, because in a recent study using health board reports in southeast Turkey, it has been reported that cataract was still the main cause of blindness (8).

Retinal degenerations were reported as a leading cause of visual loss in neighboring countries with high rates of consanguineous marriages (9). Consanguineous marriage rates were reported to be high in North Africa, the Middle East, and West Asia (12). In our study, retinitis pigmentosa was the leading cause of blindness. We think that this is due to the high rate of consanguineous marriages in Turkey, which causes an increase in the prevalence of rare recessive diseases (13–15). It has been reported that the consanguineous marriage frequency was 18.5%, and of these, 57.8% were first cousin marriages in Turkey (16). Similar to our results, another study conducted in the Aegean region of Turkey also reported that the leading cause of low vision and blindness was retinal dystrophy in the 18–50-year age group (17).

In the Tehran Eye Study from the neighboring country of Iran, the authors reported the main causes of visual impairment as cataract, macular degeneration, and amblyopia (18). In that

study, uncorrected refractive errors, cataract, and macular degeneration were the main causes of visual impairment. No distinction between blindness and MSVI was made. We could not determine the effect of refractive errors in our study because the level of visual disability is determined using the BCVA in our country. In our study, AMD was the second most common cause of blindness with cataract being a less common cause. We think that the widespread performance of cataract surgery is an important factor in this respect. For MSVI, cataract, and AMD were the most common causes.

A recent hospital-based study from Turkey by Ozturk et al. investigated the causes of severe visual impairment and blindness in a group of patients with an age range of 1 month to 17 years (19). The leading causes were reported as cortical visual impairment (30.5%), retinal pathologies (most commonly chorioretinal dystrophies) (24.6%), and disorders related to crystalline lens (17.1%) for blindness and SVI in that study. In our study, the leading causes of blindness were hereditary retinal dystrophies (32%), OA (20%), disorders of the globe (16%), while the leading causes of MSVI were OA (39.1%), degenerative myopia (17.4%), and HRD (13.0%) in the 0–14-year age subgroup. The comparison of the study by Ozturk et al. with our study is not easy because it was conducted in the pediatric ophthalmology and strabismus unit, which is a tertiary referral clinic and is a part of a multi-specialty university hospital, while our study was conducted in the state hospital ophthalmology clinic. Also, it should be kept in mind that these studies were conducted in different regions of Turkey; one was conducted in the Aegean region, while the other was conducted in the central Anatolia region. Although there are regional variations, the most common anatomical site affected in severe visual impairment and blindness of children is retina worldwide (20, 21). We also found that retinal diseases HRD and RP together constitute nearly 44% of causes of blindness in the 0–14-year age group in our study.

Kıvanç et al. also investigated the health board records to identify the ophthalmologic conditions leading to blindness and visual impairment in severely disabled patients aged over 64 years in Turkey (22). They found that the most common ophthalmologic diseases in that group were cataract, glaucoma, and age-related macular degeneration (AMD) with cataract being the main cause of blindness in their study. The main causes of blindness and MSVI in the older age group (>50 years) were AMD, diabetic retinopathy, and cataract in our study, which is similar to results of Kıvanç et al. Diabetic retinopathy is more prevalent and glaucoma is less prevalent in our study, which can be due to different cutoff values for patient age (>64 years vs. >50 years). Cataract is also reported to be the leading worldwide cause of blindness and visual impairment in those aged 50 years and older (23).

A limitation of our study is that our data was retrospectively obtained from the disability health board records. Patients who were not registered or who were registered elsewhere could have been overlooked during our study period. Nevertheless, our hospital is the only institution with a disability health board in the Niğde province. Also considering the substantial benefits provided to the disabled in our country we think that many people with visual disability was recorded in disability health board of our institution. This helps us in estimating the major causes of blindness and MSVI in

the province. The sample size of our study was relatively large and we were able to describe specific causes of blindness and MSVI for different age groups, which is strength of our study.

In conclusion, this study provides an estimate of the major causes of blindness and MSVI in central Anatolia region of Turkey. Retinitis pigmentosa, AMD, and diabetic retinopathy were found to be the main causes of blindness. Cataract, AMD, and diabetic retinopathy were found as the main causes of MSVI. This information is important in the planning of public health policies and for allocating the budget for health services, given that several leading causes of visual impairment are reversible or preventable. Also, these results improve our knowledge regarding the ocular health status of this region and raise public awareness of visual impairment. Educating the population about the risks of consanguineous marriages is especially important, since retinitis pigmentosa is a major cause of blindness. Cross-sectional surveys of the population are necessary to obtain data regarding the prevalence and causes of blindness and MSVI in Turkey.

**Ethics Committee Approval:** The study followed the tenets of the Declaration of Helsinki and received approval from the Niğde Ömer Halisdemir University Ethics Committee (Date: 27/6/2018, No: 2018/10-11).

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – EK; Design – EK, KRZ, UY; Supervision – EK, KRZ; Resource – EK, KRZ, UY; Materials – EK, UY; Data Collection and/or Processing – EK, KRZ, UY; Analysis and/or Interpretation – EK, KRZ, UY; Literature Search – EK; Writing – EK; Critical Reviews – EK, KRZ, UY.

**Conflict of Interest:** The authors have no conflict of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

## REFERENCES

- Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. *Br J Ophthalmol* 2012; 96(5): 614–8.
- 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(9): e888–e97.
- Ackland P, Resnikoff S, Bourne R. World blindness and visual impairment: despite many successes, the problem is growing. *Community Eye Health* 2017; 30(100): 71–3.
- Bourne RR, Stevens GA, White RA, Smith JL, Flaxman SR, Price H, et al. Causes of vision loss worldwide, 1990–2010: a systematic analysis. *Lancet Glob Health* 2013; 1(6): e339–e49.
- Stevens GA, White RA, Flaxman SR, Price H, Jonas JB, Keeffe J, et al. Global Prevalence of Vision Impairment and Blindness. *Ophthalmology* 2013; 120(12): 2377–84.
- Ramke J, Evans JR, Gilbert CE. Reducing inequity of cataract blindness and vision impairment is a global priority, but where is the evidence? *Br J Ophthalmol* 2018; 102(9): 1179–81.
- Negrel AD, Minassian DC, Sayek F. Blindness and low vision in south-east Turkey. *Ophthalmic Epidemiol* 1996; 3(3): 127–34.
- Erdem S. Evaluation Of The Causes Of Blindness In Patients Admitted To The Health Board Of A Hospital Servicing Souteastern Anatolia. *Dicle Med J* 2019; 46(2): 209–14.
- Al-Merjan JI, Pandova MG, Al-Ghanim M, Al-Wayel A, Al-Mutairi S. Registered Blindness and Low Vision in Kuwait. *Ophthalmic Epidemiol* 2005; 12(4): 251–7.
- Abou-Gareeb I, Lewallen S, Bassett K, Courtright P. Gender and blindness: a meta-analysis of population-based prevalence surveys. *Ophthalmic Epidemiol* 2001; 8(1): 39–56.
- Doyal L, Das-Bharmik RG. Sex, gender and blindness: a new framework for equity. *BMJ Open Ophthalmol* 2018; 3(1): e000135.
- Hamamy H, Antonarakis SE, Cavalli-Sforza LL, Temtamy S, Romeo G, Kate LP, et al. Consanguineous marriages, pearls and perils: Geneva International Consanguinity Workshop Report. *Genet Med* 2011; 13(9): 841–7.
- Koc I. Prevalence and sociodemographic correlates of consanguineous marriages in Turkey. *J Biosoc Sci* 2008; 40(01): 137–48.
- Tuncbilek E. Clinical outcomes of consanguineous marriages in Turkey. *Turkish J Pediatr* 2001; 43(4): 277–9.
- Dündar M, Karabulut Y. Rare Disease and Orphan Drugs in Turkey; Medical and Social Problem. *Erciyes Med J* 2010; 32(3): 195–200.
- Kaplan S, Pinar G, Kaplan B, Aslantekin F, Karabulut E, Ayar B, et al. The prevalence of consanguineous marriages and affecting factors in Turkey: a national survey. *J Biosoc Sci* 2016; 48(05): 616–30.
- Koc F, Erden V, Sefi-Yurdakul N. Causes of low vision and blindness in a Turkish adult population: the Izmir eye study. *Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit* 2018; 24(2): 161–8.
- Fotouhi A, Hashemi H, Mohammad K, Jalali KH; Tehran Eye Study. The prevalence and causes of visual impairment in Tehran: the Tehran Eye Study. *Br J Ophthalmol* 2004; 88(6): 740–5.
- Ozturk T, Er D, Yaman A, Berk AT. Changing trends over the last decade in the aetiology of childhood blindness: a study from a tertiary referral centre. *Br J Ophthalmol* 2016; 100(2): 166–71.
- Gilbert C. Worldwide causes of blindness in children. In: Wilson ME, Saunders R, Rupal T, editors. *Pediatric Ophthalmology: Heidelberg, Germany: Springer Verlag*; 2009. p. 47–60.
- Heijthuijsen AAM, Beunders VAA, Jiawan D, de Mesquita-Voigt AMB, Pawiroredjo J, Mourits M, et al. Causes of severe visual impairment and blindness in children in the Republic of Suriname. *Br J Ophthalmol* 2013; 97(7): 812–5.
- Kivanc SA, Akova-Budak B, Olcaysu OO, Cevik SG. Sociodemographic status of severely disabled and visually impaired elderly people in Turkey. *Arq Bras Oftalmol* 2016; 79(1): 24–9.
- Flaxman SR, Bourne RRA, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV, et al. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. *Lancet Glob Health* 2017; 5(12): e1221–e34.