Prevalence and causes of visual impairment among the elderly

Hadi Ostadimoghaddam PhD1,2 - Hassan Hashemi MD1 - AbbasAli Yekta, PhD, FAAO, FIACLE1,2 - Shokrolah Shafaee2 - Reza norouzirad1 - Mehdi KhabazkhoobMSc5,3

1- Refractive Errors Research Center, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran

2- Department of Optometry, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran

3- Noor Ophthalmology Research Center, Noor Eye Hospital, Tehran, Iran.

4- Dezful University of Medical Sciences, Dezful, Iran

5- Department of Epidemiology, Faculty of Public Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Running title: visual impairment in elderly

Financial Support: This project is funded in part by the Noor Ophthalmology Research Center and Shahroud University of Medical Sciences.

Conflict of Interest: No conflicting relationship exists for any author.

Running Title:

Corresponding Author

AbbasAli Yekta, PhD, FAAO, FIACLE

Department of Optometry, School of Paramedical Sciences, Mashhad University of Medical Sciences, Mashhad, Iran

E-mail: yektaa@mums.ac.ir
Abstract

AIM: To determine the prevalence of visual impairment, blindness, and low vision among the elderly population of Sari in northern Iran.

Methods: Random cluster sampling of 1185 selected individuals over 54 years of age, of whom 79.1% participated. Participants underwent eye examinations to test presenting visual acuity, best-corrected visual acuity, and refraction.

Results: Based on their presenting visual acuity, the prevalence of visual impairment, blindness, and low vision were 11.1% (95% CI: 9.1-13.1), 3.7% (95% CI: 2.5-5.0), and 7.4% (95% CI: 5.7-9.0), respectively. Based on the best-corrected visual acuity, the results were 3.7% (95% CI: 2.3-5.1), 1.0% (95% CI: 0.2-1.7), and 2.7% (95% CI: 1.5-3.9), respectively. Based on the presenting visual acuity, the most common causes of visual impairment were refractive errors (68.6%) and cataracts (16.7%).

Conclusions: Refractive errors and cataracts were the main causes of visual impairment in the elderly Iranian population. Correcting refractive errors and cataracts could reduce 85% of visual impairment, depending on the presenting visual acuity.
INTRODUCTION

During the past two decades, many studies have investigated ophthalmic diseases worldwide. Some studies have reported important results using a cross-sectional design, \(^1\)-\(^5\) while others have studied eye diseases prospectively.\(^1\)-\(^2\) These studies report the incidence of visual impairment and their causes. Based on these studies, we know that the prevalence rates of visual impairment around the world vary greatly.\(^1\)-\(^5\) Furthermore, they play an important role in determining the quality of life, life expectancy, expenses, and even the risk of accidents.\(^1\)-\(^6\) Visual impairment is also affected by economic, social, and ophthalmological developments.\(^7\)-\(^9\) According to the latest statistics from the World Health Organization (WHO), based on best-corrected visual acuity,\(^10\) 161 million people have visual impairment. However, 259 million people have visual impairment based on their presenting visual acuity.\(^11\) Annual global reports provide a better estimate of the extent this problem. Causes of visual impairment differ throughout the world, but major ones include refractive errors, cataracts, glaucoma, and age-related macular degeneration (AMD).\(^12\)-\(^18\)

Based on the presenting visual acuity, recent reports have suggested that uncorrected refractive errors are the leading cause of visual impairment, although reports from Pakistan\(^19\) and Sudan\(^20\) indicated that cataracts were more a common cause when presenting visual acuity is taken into account.\(^11\) In more developed countries, the rising number of cataract operations has reduced visual impairment by more than 50% and has made AMD the leading cause.\(^21\) Iran is one of the most populated countries in the Eastern Mediterranean region where the epidemiology of visual impairment has been studied. The Iranian population is aging, so more extensive studies are required to reveal descriptive and analytic aspects of visual impairment in Iran. Previous studies
conducted in Iran had a wide age range and a limited number of studies have evaluated the elderly population, so we conducted a cross-sectional study in the city of Sari in northern Iran to determine the prevalence and causes of visual impairment in this city.
MATERIALS AND METHODS

Population and samples

Sampling was done between September 2010 and July 2011 from among people over 55 years of age in the first municipal district of Sari. In this study, cluster sampling was used based on information in local health centers, and 60 clusters were randomly selected. From each cluster, 20 people were systematically selected.

In each cluster, the first household was selected randomly and then every other household was selected from the list and invited to the study. The team proceeded to the next household if no one answered in a household and the household was again contacted later. Also, the team approached the next household if there was no one above 55 years of age in a household.

The selected families were invited by health care workers of the centers. The appointment was set at the time of invitation and the importance of the study was explained to them. After inviting 20 people in each cluster, we moved to the next cluster. At the meeting with the selected people, they filled out a questionnaire about age, sex, type and duration of the present systemic or eye disease, family history of diseases, and previous treatments.

Examination

Ophthalmic examinations were done by experienced optometrists and ophthalmologists. Monocular and binocular visual acuity was measured with the Snellen chart at a distance of 6 meters in luminance conditions between 80 and 320 cd/m2. Pinhole testing was used to rule out uncorrected refractive errors as the cause, and best corrected visual acuity was determined based on refraction. The best sphere was determined and then cross cylinder was used to check the
power and the axis of corrected cylinder. Any participants whose vision could not be corrected to at least 20/20 was examined by an ophthalmologist to detect the cause of visual impairment. Ophthalmic examinations included slit lamp biomicroscopy, intraocular pressure measurement, clinical grading of lens opacities, assessment of vitreous opacities, as well as a fundus exam using direct and indirect ophthalmoscopy. At the conclusion of the examination, the ophthalmologists confirmed the presence of visual impairment and recorded its cause as their diagnosis.

**Definitions**

In this study, visual impairment was defined based on WHO and the US definitions. In both cases, visual impairment was reported on the basis of presenting visual acuity and best corrected visual acuity. According to WHO, visual impairment is defined as visual acuity worse than 20/60 in the better eye. Visual impairment included low vision and blindness. Low vision was defined as visual acuity worse than 20/60 to 20/400 in the better eye. People with visual acuity worse than 20/400 in the better eye were considered blind. According to the US definition, vision worse than 20/40 in the better eye was considered visual impairment. In order to determine the cause of visual impairment when there were several causes, the most correctable cause was considered the main cause of visual impairment just similar to previous studies.

**Statistical analysis**

In this study, the prevalence of visual impairment, blindness and low vision is reported as percentages and their 95% confidence intervals (CI). The prevalence of visual impairment, blindness and low vision were directly standardized to the National 2006 Census by age and sex.
In order to study determinants of visual impairment and blindness, logistic regression was used. Age and gender were entered in the multiple logistic regression model using the backward method. In this model, age was entered as a categorical variable, and results are presented as odds ratios (OR) and their 95% CI. In light of the sampling method, clusters were taken into account in calculating standard errors and 95% CI. For the analyses, we used the STATA software and defined clusters as primary sampling units for survey data analysis.

**Ethical issues**

Each individual signed an informed consent form prior to participation after receiving information about the objective of the study. The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences.
RESULTS

Of 1185 invited subjects, 937 (response rate=79.1%) participated in the study; their mean age (± standard deviation) was 64.7±7.5 years, and 53.6% were female.

Visual impairment based on presenting visual acuity

Of all participants, 11.1% (95%CI: 9.1-13.1) had visual impairment based on presenting visual acuity. The prevalence of blindness and low vision was 3.7% (95%CI: 2.5-5.0), and 7.4% (95%CI: 5.7-9.0), respectively. Age and gender standardized rates of visual impairment; low vision and blindness are shown in Table 1. The prevalence of visual impairment, blindness and low vision was respectively 11.5 %(95%CI: 8.5-14.0), 4.4%(95%CI: 2.4-6.3) and 7.1% (95%CI: 4.7-9.6) in men, and 10.8%(95%CI: 8.0-13.5), 3.2%(95% CI: 1.6-4.7), and 7.6% (95% CI: 5.2-9.9) in women. According to the univariate logistic regression models, visual impairment (OR=1.08, 95%CI: 0.72-1.62; p=0.720), blindness (OR=1.39, 95%CI: 0.70-2.73; p=0.344) and low vision (OR=0.94 95%CI: 0.57-1.53; 0.796) were not correlated with gender. As demonstrated in Table 1, the prevalence of visual acuity, blindness, and low vision was higher in people over 75 years than the55-59 year old group; after setting this age group as base in the logistic regression, low vision rate was shown to be significantly higher in over 75 year olds compared to this group. The same was true for blindness in age groups of 64-69 years old and over 75 years old as compared with the 55-59 year age group (Table 2).

Table 3 shows the causes of visual impairment; the leading cause, based on presenting visual acuity, was uncorrected refractive errors followed by cataracts, diabetic retinopathy, and AMD. The contribution of refractive errors decreases and that of cataract increased with age.
**Visual impairment based on best corrected visual acuity**

Table 1 shows the prevalence of visual impairment based on best corrected visual acuity, age, and sex; 3.7% (95% CI: 2.3–5.1) of the studied people had visual impairment, 1.0% (95% CI: 0.2–1.7) were blind, and 2.7% (95% CI: 1.5–3.9) had low vision. No significant difference was seen between men and women with regard to visual impairment (p=0.886), blindness (p=0.613), or low vision (p=0.891). As seen in Table 2, visual impairment was lowest in the 55-59 year old age group. Relationships were still observed after adjusting for sex. As seen in Table 3, cataract was the most common cause of visual impairment based on best corrected visual acuity, followed by diabetic retinopathy.

**Visual impairment based on presenting visual acuity and best corrected visual acuity according to the United States standard**

According to the US definition, the prevalence of visual impairment was 26.7% (95% CI: 23.7-29.9) based on presenting visual acuity and 7.7% (95% CI: 5.7-9.9) based on best corrected visual acuity.
DISCUSSION

Although studies of visual impairment have been conducted in Tehran$^{16}$ and Zahedan$^{6}$ in Iran, differences in race, genetics, environment, and medical services and facilities in different parts of the country have necessitated more studies. Further information on the status of visual impairment throughout the country can elucidate different epidemiologic aspects and possibly provide wider insights into the Eastern Mediterranean region. The findings of the current study were different from those of similar studies in Iran.$^{6,16}$ We found that visual impairment is one of the main problems affecting the elderly in Sari. We used both the WHO and the US definitions to report the prevalence of visual impairment so that results can be compared with those of other studies. It is noteworthy that one of the main criteria highlighted in the comparison of this study with others was the presenting visual acuity. The presenting visual acuity is of great importance because people live with this level of vision.$^{11}$ Based on this measure of vision, the standardized prevalence of visual impairment and blindness (based on age and sex) in our study were 11.6% and 4%, respectively. Table 5 shows the results from similar studies conducted throughout the world; the prevalence of visual impairment was higher in our study than some other studies. According to the literature, highest rates of visual impairment and blindness are seen in Middle Eastern and Southeastern countries. Globally, the prevalence of blindness ranges from as high as 11.9% in India$^{22}$ to 0.15% in Australia$^{23}$. The results of the present study show that Iran had the second highest rate of blindness after India$^{22}$. It seems that one reason for the higher prevalence of blindness in this study is the age cohort effect. According to the findings, the prevalence of blindness increased significantly in the individuals aged 65 and over in comparison with younger age groups. It seems that lack of
access to ophthalmologic facilities and services in this age group is a major reason for this finding, considering the fact that most diseases occur in the fifth decade of life. However, based on the WHO definition, which is less sensitive than the US definition, the level of blindness based on the presenting visual acuity was higher in our study than those conducted in India\textsuperscript{22}. A comparison of our findings in people aged over 60 years with those in Tehran\textsuperscript{16} and Zahedan\textsuperscript{6} revealed that the elderly in Sari were less affected by visual impairment. There may be several explanations for this observation. Although racial, genetic, and environmental differences cannot be discounted, one of the main reasons may be the advances in ophthalmic science, diagnostic techniques, and the increasing number of ophthalmologists. In particular, the number of cataract surgeries and the diagnoses of retinal diseases using advanced equipment has increased in Iran.\textsuperscript{24}

This study showed that about 70\% of the people in this study suffered from visual impairment due to uncorrected refractive errors. This shows that refractive errors, which can be simply corrected using glasses, significantly increased the rate of visual impairment in the elderly. Cataracts and the unavailability of diagnostic and therapeutic equipment for uncorrected refractive errors were among the most common causes of blindness. This agrees with previous studies (Table 5). From a public health point of view, it is important to note that about 85\% of our subjects suffered from these two ophthalmic problems, although both can be treated easily. One of the main factors affecting visual impairment in different countries is the availability of advanced surgical equipment for treating cataracts and refractive errors. In developed countries and those with a high rate of cataract surgery, there is a low proportion of refractive errors and cataract as causes of blindness.\textsuperscript{23, 25} In developed countries, diseases such as AMD and glaucoma are the main causes of blindness.\textsuperscript{26-28} Irrespective of refractive errors and their correction, 3.7\% of
the study population had visual impairment. Thus, after correcting for refractive errors, we observed a reduction of visual impairment in 7.8% of the whole population. The main challenge highlighted in reports by Dandona and Resnikoff is that addressing refractive errors as causes of visual impairment reduces the rate of visual impairment. In general, health authorities should be worried about non-treatable diseases such as AMD and diabetic retinopathy. Visual impairment caused by these diseases is one of the major problems affecting many societies. Therefore, providing facilities for operating on cataracts and refractive errors could significantly reduce the rate of visual impairment. One of the objectives of Vision 2020 is to improve the quantitative and qualitative level of cataract surgery.

Based on our findings, there was no significant difference between two sexes in terms of visual impairment. There have been contradictory reports about the relationship between visual impairment and sex from throughout the world. India, Rotterdam, Melbourne, Bangladesh, and Meiktila have reported higher rates of blindness and visual impairment in women. Some have reported a higher rate of blindness and visual impairment in men, while others have proposed that the main reason for this discrepancy is a difference in accessing health services between men and women. Most eye diseases are found in people aged over 75 years, so visual impairment is more common in these people than younger subjects. In our study, there was no significant difference between participants at the two ends of the age range, probably because the age range in our study started at over 55 years. At that age, most people have several eye problems and little change occurs later. Some studies have shown that visual impairment increases linearly among subjects aged over 40 years. After heart disease and arthritis, visual problems in the elderly make them most dependent on others in their daily life.
The current study had some limitations. The participants’ lifestyle, education, socioeconomic status, nutrition, and occupation were variables that were not evaluated in the present study although previous studies have reported their relationship with visual impairment. Moreover, lack of information on the advancements of ophthalmological services in this city limited our ability to evaluate the relationship of the visual problems and ophthalmological services.

**Conclusions**

Prevalence of visual impairment and blindness were not significantly different in this study compared with other studies conducted in Iran. Contrary to our expectations, refractive errors and cataracts were still the main causes of visual impairment among the elderly Iranians. Correcting refractive errors and cataracts could reduce of 85% of visual impairment based on presenting visual acuity.

**Acknowledgements**

We thank the research vice chancellor of Mashhad University of Medical Sciences for supporting this study (grant code: 89824). The results described in this paper were part of a thesis for a master degree in optometry.
REFERENCE


