Prevalence and Causes of Visual Impairment Among the Elderly of Sari, 2011

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Abstract

***Purpose*:** 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 1,185 selected individuals over 54 years of age, of whom 79.1% participated. Participants underwent eye examinations to test presenting visual acuity (VA), best corrected visual acuity (BCVA), and refraction.

***Results*:** Based on their presenting VA, 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 BCVA, 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 VA, the most common causes of visual impairment were refractive errors (68.6%) and cataracts (16.7%).

***Conclusion*:** Refractive errors and cataracts were the main causes of visual impairment in the elderly population of Sari. Correcting refractive errors and cataracts could reduce 85% of visual impairment, depending on the presenting VA.

***Keywords*:** Visual Impairment, Iran, Elderly People, Cross-Sectional Study

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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 (BCVA),[10] 161 million people have visual impairment. However, 259 million people have visual impairment based on their presenting visual acuity (VA).[11] Annual global reports provide a better estimation of the extent of 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 VA, 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 VA 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.

Methods

Population and samples

This cross-sectional study was conducted between September 2010 and July 2011. The target population of this study was the 55-year-old and over population of Sari. The population of Sari was 273,972 based on the report of the last census in 2007. Of this population, 29,118 were 55-year-old and over.

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. The method of calculating the sample size of this study was reported in the previous report of this study.[22]

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 VA was measured with the Snellen chart at a distance of six meters in luminance conditions between 80 and 120 $^{cd}/_{m^2}$. Pinhole testing was used to rule out uncorrected refractive errors as the cause, and BCVA 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 (IOP) 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 VA and BCVA. According to WHO, visual impairment is defined as VA worse than $^{20}/_{60}$ in the better eye. Visual impairment included low vision and blindness. Low vision was defined as VA worse than $^{20}/_{60}$ to $^{20}/_{400}$ in the better eye. People with VA 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 1,185 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 VA. 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 VA, blindness, and low vision was higher in people over 75 years than the 55-59 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 VA, 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 BCVA, 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 BCVA, 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 VA and 7.7% (95%CI: 5.7-9.9) based on BCVA (Table 4).

Table 1. The prevalence of visual impairment, blindness, and low vision based on presenting visual acuity and best corrected visual acuity, according to WHO definition

	Presenting visual acuity			best corrected visual acuity		
	Visual impairment	**Blindness**	**Low vision**	**Visual impairment**	**Blindness**	**Low vision**
Age	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)
55 to 59	7.5 (4.5-10.6)	2.1 (0.4-3.7)	5.5 (2.9-8.1)	0.7 (0.2-1.6)	0	0.7 (0.2-1.6)
60 to 64	8.3 (4.5-12.2)	2.0 (0-3.9)	6.4 (3-9.8)	2.9 (0.6-5.3)	0	2.9 (0.6-5.3)
65 to 69	15.5 (10.2-20.8)	6.1 (2.6-9.6)	9.4 (5.1-13.7)	4.4 (1.4-7.4)	1.1 (0.2-2.6)	3.3 (0.7-5.9)
70 to 74	11.9 (6.4-17.5)	5.2 (1.4-9.0)	6.7 (2.4-11.0)	3.7 (0.5-7.0)	2.2 (0.5-4.8)	1.5 (0.6-3.6)
≥75	16.7 (10.1-23.3)	5.6 (1.5-9.6)	11.1 (5.5-16.7)	7.9 (3.2-12.7)	2.4 (0.4-5.1)	5.6 (1.5-9.6)
Sex						
Male	11.5 (8.5-14.5)	4.4 (2.4-6.3)	7.1 (4.7-9.6)	3.2 (1.6-4.9)	0.7 (0.2-1.5)	2.5 (1.0-4.0)
Female	10.8 (8-13.5)	3.2 (1.6-4.7)	7.6 (5.2-9.9)	3.4 (1.8-5.0)	1.0 (0.1.0-1.9)	2.4 (1.0-3.7)
Total	11.1 (9.1-13.1)	3.7 (2.5-5.0)	7.4 (5.7-9.0)	3.3 (2.2-4.5)	0.9 (0.3-1.4)	2.5 (1.5-3.4)
Standardized	11.6 (9.3-13.8)	4.0 (2.6-5.4)	7.6 (5.7-9.5)	3.7 (2.3-5.1)	1.0 (0.2-1.7)	2.7 (1.5-3.9)

CI: Confidence interval

Table 2. Association of visual impairment based on presenting visual acuity and best corrected visual acuity with some sex and age based on multiple logistic regression

		Presenting visual acuity		Best corrected visual acuity	
		OR (95%CI)	**P-value**	**OR (95%CI)**	**P-value**
Sex					
	Male	1		1	
	Female	0.92 (0.44-1.90)	0.817	1.10 (0.73-1.66)	0.650
Age group					
	55 to 59	1		1	
	60 to 64	4.42 (0.88-22.12)	0.071	1.17 (0.6-2.27)	0.651
	65 to 69	6.70 (1.41-31.93)	0.017	2.36 (1.3-4.3)	0.005
	70 to 74	5.66 (1.08-29.58)	0.04	1.74 (0.87-3.45)	0.115
	≥75	12.55 (2.71-58.15)	0.001	2.57 (1.35-4.9)	0.004

OR: Odds ratio
CI: Confidence interval

Table 3. Causes of visual impairment based on presenting visual acuity and best corrected visual acuity

	Presenting visual acuity	Best corrected visual acuity
Cause of visual impairment	n (%)	n (%)
Refractive errors	70 (68.6)	-
Cataract	17 (16.7)	19 (61.3)
Diabetic retinopathy	5 (4.9)	8 (25.8)
Age-related macular degeneration	2 (2.0)	2 (6.5)
Glaucoma	-	1 (3.2)
Amblyopia	-	1 (3.2)
Unknown	8 (7.8)	-

Table 4. Prevalence of visual impairment based on presenting visual acuity, best corrected visual acuity according to American Standard (visual acuity worse than $^{20}/_{40}$ of the better eye)

	presenting visual acuity	Best corrected visual acuity
Age	% (95%CI)	% (95%CI)
55 to 59	20.2 (15.6 -24.8)	1.4 (0 -2.7)
60 to 64	19.6 (14.1 -25.1)	4.4 (1.6 -7.3)
65 to 69	30.4 (23.6 -37.2)	6.6 (3 -10.3)
70 to 74	40.3 (31.9 -48.7)	10.4 (5.2 -15.7)
≥75	33.3 (25 -41.7)	17.5 (10.7 -24.2)
Sex		
Male	24.8 (20.8 -28.9)	6.4 (4.1 -8.8)
Female	28.3 (24.3 -32.2)	6.6 (4.4 -8.7)
Total	26.7 (23.8 -29.5)	6.5 (4.9 -8.1)
Age standardized	26.8 (23.7 -29.9)	7.7 (5.7 -9.7)

CI: Confidence interval

Discussion

Although studies of visual impairment have been conducted in Tehran,[16] Varamin[23] 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.

However, in an rapid assessment of avoidable blindness study performed in Varamin,[23] blindness was reported in an Iranian population. Nonetheless, since the protocol of data collection and definitions of the Varamin[23] study are different with our study, it is rather difficult to compare the results of the two study.

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 VA. The presenting VA 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[24] to 0.15% in Australia.[25] The results of the present study show that Sari of Iran had the second highest rate of blindness after India.[24]

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 VA was higher in our study than those conducted in India.[24] A comparison of our findings in people aged over 60 years with those in Tehran,[16] Varamin[23] and Zahedan[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.[26]

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.[25,27] In developed countries, diseases such as AMD and glaucoma are the main causes of blindness.[28-30] 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[31] and Resnikoff[10] is that addressing refractive errors as causes of visual impairment reduces the rate of visual impairment.[11] 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.

Table 5. Summary of other studies on visual impairment based on presenting visual acuity

Place	sample size	Age	Criteria	VI (%)	Blindness (%)	Causes of blindness
India (Rajasthan)[3]	4284	50≤	WHO		11.9	Cataract, refractive errors
Nepal[4]	4602	45≤	USA		5.3	Cataract
China (Doumen)[5]	5342	50≤	USA		4.37	Cataract, refractive errors
India (Aravind)[6]	5150	40≤	WHO		4.3	Cataract, refractive errors
India[7]	5411	50≤	WHO		4.1	Cataract, refractive errors
China (Shunyi)[8]	5052	50≤	USA		2.8	Cataract, refractive errors
Gandaki zone, Nepal[9]	5000	45≤	USA		2.6	Cataract, refractive errors
China (Harbin)[10]	5057	50-96	WHO	8.3	1.9	Cataract, corneal opacity
India (Andhra Pradesh)[11]	10293	All	WHO		1.84	Cataract, refractive errors
Hong kong[12]	3441	60≤	WHO		1.8	Refractive errors, cataract
Cameroon (Muyuka)[13]	1787	40≤	WHO	6.4	1.6	Cataract, refractive errors
Mongolia[14]	4345	40≤	WHO	8.1	1.5	Glaucoma, cataract
Turkmenistan[15]	6011	50≤	WHO		1.26	Cataract, glaucoma
Cameroon (Limbe)[16]	2215	40≤	WHO	3	1.1	Posterior segment disease, cataract
Taiwan (Shihapai)[17]	1361	65≤	WHO		0.59	AMD, retinal disease
Singapore (Tanjong pagor)[18]	1232	40≤	WHO		0.5	Glaucoma, cataract
This study	937	55-87	WHO	11.1	3.7	Refractive errors, cataract
Iran (Tehran)[19]	1074	40-59	WHO	2.51	0.59	Refractive errors, cataract
Iran (Tehran)[20]	385	60+	WHO	19.98	3.55	
Malaysia[21]	2081	40-49	WHO		0.31	Cataract, retinal disease
Iran (Varamin)[23]	2819	≥50		6.91	1.33	Cataract
Malaysia[24]	1263	50-59	WHO		0.50	Cataract, retinal disease
Australia (Victoria)[25]	4744	40≤	WHO	0.325	0.156	AMD, glaucoma

VI: Visual impairment
AMD: Age-related macular degeneration

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,[32] Rotterdam,[21] Melbourne,[33] Bangladesh,[34] and Meiktila[14] have reported higher rates of blindness and visual impairment in women. Some have reported a higher rate of blindness and visual impairment in men,[18] 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

Conclusion

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 of Sari. Correcting refractive errors and cataracts could reduce 85% of visual impairment based on presenting VA.

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