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Original Article

The Prevalence and Causes of Visaual Impairment and Blindness in a Rural Population in the North of Iran

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Abstract

Background: Visual impairment is a very important public health problem. In Iran, reports of visual impairment and blindness have been published from the urban population while the prevalence of visual impairment in the rural population has not been reported. The purpose of this study to determine the prevalence and causes of visual impairment, in a rural population in district of based on age and sex

Methods: In a cross-sectional population-based study, using random cluster sampling, 13 of the 83 villages of Khaf County in the north east of Iran were selected. Eye examinations were performed in a Mobile Eye Clinic (Nooravaran Salamat, 2011) and included optometric examinations such as measuring uncorrected and corrected visual acuity along with non-cycloplegic refraction.

Results: The prevalence of visual impairment, low vision, and blindness was 6.3% (95% CI 5.3-7.3), 3.4% (95% CI 2.6-4.1), and 3.0% (95% CI 2.3-3.6), respectively. The prevalence of visual impairment ranged from 1.8% in the participant younger than 20 years of age to 28% in the subjects aged 60 and over (P<0.001). After matching for age, the prevalence of visual impairment and low vision was significantly higher in women. The most prevalent causes of visual impairment were uncorrected refractory error (54.5%) and cataract (17.6%).

Conclusion: The prevalence of visual impairment was significantly higher in the rural population of this study when compared to previous reports from Iran. It seems that provision of therapeutic facilities like cataract surgery and availability of eyeglasses in villages can considerably reduce the prevalence of visual impairment.

Keyword: Visual impairment, Low vision, Blindness, Cross-sectional study, Iran

Introduction

Visual impairment is a very important public health problem that imposes heavy costs and expenses on governments and healthcare systems each year (1-3).

Although the decrease in eye infectious diseases has reduced the prevalence of visual impairment and blindness in the past two decades, visual impairment is still a major health concern in some parts of the world although a major part of visual disorders can be simply prevented or treated. The latest reports of the WHO show that 285 million people in different age groups are visually impaired of whom more than 39 million are blind (4). Although the objective of "Vision 2020" was to reduce preventable low vision in the past decade, about 80% of the cases of visual impairment are

due to preventable refractive errors or cataract, and more than 50% of the cases of blindness are attributed to cataract (4-7). In the past decade, many studies shed light on the status of visual impairment and blindness across the world (8-26). Recent reports of the WHO show that the distribution pattern of the causes of visual impairment has not changed much and refractive errors and cataract are still the major causes of visual impairment (4). Furthermore, replacing corrected visual acuity with presenting visual acuity in defining visual impairment has created a more sensitive criterion to diagnose problematic cases.

One of the prominent points in the recent report of the WHO is the significant difference in the prevalence of visual impairment in different WHO regions (4). The US and Europe have the lowest rates of visual impairment while countries in the Eastern Mediterranean Region have a high prevalence of visual impairment (4). These findings show the effect of modernization and development in the American and European countries (4). Moreover, most of the countries in these two regions have high incomes, which show the effect of income on visual impairment. Iran is one of the most populous countries in the Eastern Mediterranean Region. To date, reports of visual impairment and blindness have been published from Tehran (27), Zahedan (17), and Shahrood (28). However, the prevalence of visual impairment has not been reported in the rural population. Since visual impairment can be affected by urbanization factors like access to healthcare (29) and income (30), it is necessary to conduct more extensive studies in rural areas. For this reason, we decided to evaluate visual impairment in a rural area in Iran for the first time. The aim of the study was to report the prevalence of visual impairment, blindness, and low vision in a rural population in Iran and determine the causes of visual impairment.

Materials and Methods

This cross-sectional study was conducted on the villages of the city of Khaf in northeast of Iran from February 2011 to April 2011.

Sampling

Table 1 shows the age and sex distribution of the rural population of Khaf based on the 2006 national census. The city of Khaf has 83 villages, in this study, using cluster sampling, 13 villages were selected, and all inhabitants of these villages were examined.

All the people from rural areas next to the city of Khaf, for specialty medical care, refer to a 96-bed hospital in Khaf. This hospital includes emergency, gynecology, radiology, paraclinical laboratory, internal medicine, pediatrics, surgery, dialyze, CCU, sonography and endoscopy sections. Despite other specialties, eye health care is not provided by this hospital. The nearest hospital where such people can access very limited eye treatments is located in Torbat Heidarieh, a city 120 km away from Khaf. However, a well-equipped hospital, regarding ophthalmic examination and treatments, can just be reached in Mashhad which is 250 km away from Khaf. In addition, Khaf and its related rural areas have 10 health care centers which consist of 51 health houses. This study was part of another study and the sample size was calculated based on the objectives of that study.

Table 1: The age and sex distribution of the population of rurals of Khaf, selected individuals and participants in the study

	The entire population of rurals of Khaf in 2006				Selected individuals				Participants in this study			
Age (yr)	Male	Female	Total	% of total	Male	Female	Total	% of total	Male	Female	Total	% of total
<=15	9280	7584	16864	26.9	489	431	920	26.5	310	324	634	24.1
16-25	7267	7562	14829	23.7	361	408	769	22.1	257	322	579	22.0
26-35	5395	5820	11215	17.9	298	317	615	17.7	204	278	482	18.3
36-45	3568	3544	7112	11.3	198	192	390	11.2	165	158	323	12.3
46-54	2244	3227	5471	8.7	149	185	334	9.6	141	130	271	10.3
56-65	1282	2162	3444	5.5	97	129	226	6.5	85	81	166	6.3
65+	2110	1624	3734	6.0	116	105	221	6.4	104	76	180	6.8
Total	31027	31642	62669	100.0	1708	1767	3475	100.0	1266	1369	2635	100.0

As seen in Table 1, of the 62669 people who lived in these villages, 3475 were selected. The age and sex distribution of the selected population had no difference with all the villages of Khaf. One of the villages that was close to the rest of the villages and was central to all of them was determined as the location where the examinations were performed. On pre-determined days, villagers were transferred to the central village by car for optometric and ophthalmologic examinations.

Examination

Examinations were conducted in the Mobile Eye Clinic which was equipped with ophthalmology and optometry facilities. At first, the head of the household was interviewed and the demographic data of his family were recorded. After the interview, each individual received optometric and ophthalmic examinations.

Optometry examinations

Optometry examinations were performed in the Mobile Eye Clinic, which had standard illumination conditions for the measurement of visual acuity. In the first phase, non-cycloplegic refraction of all participants was measured using Topcon RM8800 (Topcon Corp., Japan) followed by the HEINE BETA 200 retinoscope (HEINE Optotechnic, Germany) and the trial lenses (MSD, Italy). For the participants who used glasses, lensometry was first performed. In the next phase, Nidek LCD was used to measure uncorrected visual acuity at 4.5 m. In the participants whose uncorrected visual acuity was 20/20 or worse, subjective refraction was performed to determine best corrected visual acuity.

Ophthalmic examinations

These examinations were performed by two ophthalmologists after optometric examinations. All participants underwent examination including direct and indirect ophthalmoscopy, slit lamp biomicroscopy (Slit Lamp; Haag-Streit, Koeniz, Switzerland), measurement of intraocular pressure (IOP) and assessment of Lens opacity. Cataract was graded at the slit lamp using the Lens Opacities Classification System III (LOCS III). In this study, two ophthalmologists, who were trained for conducting the examinations, collaborated with us. The participants who had a history of ocular surgery were excluded from this report.

Definition

In this study, visual impairment was defined based on the WHO definition, and was reported based on the presenting visual acuity (31). Visual impairment included low vision and blindness. Low vision was considered as visual acuity in the better eye of equal to 20/60 or lower than 20/400. Blindness was defined as visual acuity worse than 20/400 in the better eye. If the participant had more than one cause for visual impairment or if each eye had different causes, the one that was more correctable was considered as the cause of visual impairment.

Statistical analysis

The prevalence of visual impairment, low vision, and blindness was reported as percent with CI of 95%, for reporting their prevalence and to calculate the 95%CI, the design effect was regarded. To control of confounding factors and to detect relationships between the evaluated variables and visual impairment, blindness, and low vision, multiple logistic regression was employed. If the prevalence was low and the distribution was not normal, binominal distribution was used to calculate the 95%CI.

Ethical notes

All participants signed the informed written consent in the presence of a witness. Care was taken to protect patient confidentiality throughout the project.

Results

Background and demographic information

Of 3475 selected individuals, 2635 participated in the study (response rate=45.8%). The distribution of the participants in this study is shown in Table 1. Overall, 183 individuals were excluded from analysis because their data of presenting visual

acuity was not available and finally, 2452 people were analyzed.

Overall, 1281 participants were female (52.3%), and the mean age of the participants was 31.4±19.4 years (1-90 years). Of the participants, 31.5% were between 1-19 years, 38.8% were between 20-39 years, 20.1% were between 40-59 years and 9.6% aged 60 and more.

Visual impairment

The prevalence of visual impairment was 6.3% (95% CI 5.3-7.3). Table 2 shows the prevalence of visual impairment based on age and sex. Visual impairment significantly increased with age (OR= 1.05, 95%CI: 1.04-1.06, *P*<0.001); it ranged from 1.8% in people under 20 years of age to 28% in the participants aged 60 and more. The prevalence of visual impairment was 6.7% in women (95% CI 5.3-8.1) and 5.8% in men (95% CI 4.5-7.1). Logistic regression did not show any significant difference between sex and visual impairment (OR=1.17, 95%CI: 0.84-1.62, *P*=0.347). After adjustment for age, the prevalence of visual impairment was significantly higher in women (OR=1.51, 95%CI: 1.06-2.14, *P*=0.021). Nonetheless, the prevalence of visual impairment was higher in men after 60 years of age.

Table 2: The prevalence of low vision, blindness and visual impairment among rural population of Iran

		Low vision % (95%CI)	Blindness % (95%CI)	Visual impairment % (95%CI)
Age (yr)	<20	1.2 (0.4 -1.9)	0.6 (0.1 -1.2)	1.8 (0.9 -2.7)
	20-39	2.9 (1.9 -4)	1.4 (0.6 -2.1)	4.3 (3 -5.6)
	40-59	4.5 (2.6 -6.3)	2.2 (0.9 -3.5)	6.7 (4.5 -8.9)
	>=60	10.2 (6.3 -14.1)	17.8 (12.9 -22.7)	28.0 (22.2 -33.7)
Sex	Female	4.3 (3.2 -5.4)	2.4 (1.6 -3.3)	6.7 (5.3 -8.1)
	Male	2.4 (1.5 -3.2)	3.4 (2.4 -4.5)	5.8 (4.5 -7.1)
	Total	3.4 (2.6 -4.1)	3.0 (2.3 -3.6)	6.3 (5.3 -7.3)

Low vision

Of those with visual impairment, 53.2% (83 people) had low vision and 46.8% (73 people) had blindness. According to our findings, the prevalence of low vision was 3.4% (95% CI 2.6-4.1), ranging from 1.2% in those under 20 years of age to 10.2% in participants aged 60 and more (OR=1.04, 95%CI: 1.03-1.05, *P*<0.001). Table 2 shows the prevalence of low vision in different age groups in both sexes. The prevalence of low vision was significantly higher in women in the univariate model (OR=1.86, 95%CI: 1.17-2.96, *P*=0.008). The association of sex and low vision became stronger after adjustment for age (OR=2.16, 95%CI: 1.35-3.46, *P*<0.001).

Blindness

On the basis of our findings, 3.0% (95% CI 2.3-3.6) of the study population were blind. Of 73 blind people, 1 participant had first degree blindness, 54 had second degree blindness, and 18 had third degree blindness. Blindness ranged from 0.6% in participants under 20 years of age to 17.4% in subjects aged 60 and more (*P*<0.001). The prevalence of blindness in people aged 40 years and more was 7.3% in this study. Simple logistic regression did not show a significant relationship between sex and blindness (OR=0.67, 95%CI: 0.43-1.17, *P*=0.133). This relationship remained insignificant even after adjustment for age.

Causes of visual impairment

Table 3 shows the cause of visual impairment. The most prevalent cause of visual impairment was uncorrected refractive error (54.5%) followed by cataract (27.6%). Table 4 presents the causes of visual impairment in different age groups. According to Table 4, uncorrected refractive errors caused 90% of visual impairments in the age group 20-39 while 30% of visual impairments resulted from uncorrected refractive errors in people over 60 years.

Table 3: Causes of visual impairment in the participants based on presenting visual acuity

Causes of visual impairment	Frequency	Percent
Uncorrected refractive errors	85	54.5
Cataract	43	27.6
Amblyopia	4	2.6
AMD	8	5.1
Glaucoma	3	1.9
Macular edema	2	1.3
corneal opacity	3	1.9
Optic atrophy	1	0.6
Other	7	4.5
Total	156	100.0

Table 4: Causes of visual impairment in the participants based on age group

Age (yr)	Uncorrected refractive errors %	Cataract %	Amblyopia %	AMD %	Glaucoma %	Macular edema %	corneal opacity %	Optic atrophy %	Other %
<20	78.6	0	21.4	0	0	0	0	0	0
20-39	87.8	0	0	0	0	0	4.9	0	7.3
40-59	51.5	27.3	3.0	0	3.0	3.0	3.0	0	9.1
>=60	30.3	50.0	0	12.1	3.0	1.5	0	1.5	1.5

Discussion

This is the first report of visual impairment and blindness in an Iranian rural population. Although the prevalence of visual impairment in Iran has been previously reported (17, 27, 28), an extensive age range, rural region, and visual impairment based on the presenting visual acuity were the advantages of the present study, which were evaluated all together. According to our findings, 6.3% of the study population had visual impairment. Considering the age range of our study population and the fact that the prevalence of visual impairment is low in younger ages and high in middle and old age, comparison should be made in separate age groups although the total prevalence of visual impairment is of paramount importance in public health. However, we tried to compare the results of this study with those of other studies with similar age groups. Reports of visual impairment have been already published from Tehran (27) and Zahedan (17), Iran, but only the Tehran study (27) reported visual impairment based on the presenting visual acuity. According to the Tehran study (27), the prevalence of visual impairment in the whole study population was 2.52%. The prevalence of visual impairment in our study was much higher than the Tehran study (27). As mentioned earlier, this is the first report of visual impairment from an Iranian rural area. Although data collection of the Tehran study (27) was performed 10 years prior to the present study and ophthalmology facilities, especially cataract surgery, have noticeably improved in the past ten years (32), the findings of the present study showed inattention to the correction and treatment of visual impairment in the rural population. This finding is more striking when the prevalence of blindness is reported. As seen in the results section, 3% of our participants were blind while its prevalence was 0.39% in the Tehran study (32). The total prevalence of blindness has been reported to be 0.29% in Malaysia (33), 1.1% in Oman (34), 1.84% in Andhra Pradesh Eye Study (35), 3.2% in Equatorial Guinea (36), and 2.2% in Brazil (37), based on the presenting visual acuity and visual acuity worse than 20/60 in the better eye. As seen, the prevalence of blindness in the present study was higher than all the reports except for the report from the Equatorial Guinea (36). The study population of the present survey was the poor rural people of the northeast of Iran. This finding emphasizes the role of economic status on visual impairment and blindness. Previous studies in Iran and other countries have shown the effect of economic inequality on visual impairment (30). Although most of the studies were conducted in the past decade, our findings show that ophthalmologic facilities have not improved as expected in rural areas or at least diagnostic and treatment methods are inadequate in these areas. The results of visual impairment and blindness in different age groups showed more valuable results. The prevalence of visual impairment in individuals aged 40 and over was 13.6%, with the majority of them being 60 years and over (the prevalence of visual impairment was 28% in people aged 60 and older). These findings reveal the high prevalence of visual impairment in this age group as compared to the Tehran study (27). A summary of the results of other studies is presented in Table 5. According to Table 5, the prevalence of visual impairment in the patients aged 40 and older is higher in studies conducted in Mongolia, China, and Cameron as compared to our study.

Table 5: The prevalence of visual impairment (VI) and blindness in other study

Place	sample size	Age	Criteria	VI (%)	Blindness (%)	Causes of blindness
India (Rajasthan) (42)	4284	50≤	WHO		11.9	Cataract, refractive errors
Nepal (43)	4602	45≤	USA		5.3	Cataract
China (Doumen) (44)	5342	50≤	USA		4.37	Cataract, refractive errors
India(Aravind) (45)	5150	40≤	WHO		4.3	Cataract, refractive errors
India (46)	5411	50≤	WHO		4.1	Cataract, refractive errors
China (Shunyi) (47)	5052	50≤	USA		2.8	Cataract, refractive errors
Gandaki zone, Nepal (48)	5000	45≤	USA		2.6	Cataract, refractive errors
China (Harbin) (14)	5057	50-96	WHO	8.3	1.9	Cataract, corneal opacity
India (Andhra Pradesh) (35)	10293	All	WHO		1.84	Cataract, refractive errors
Hong kong (26)	3441	60≤	WHO	7.9%	1.8	Refractive errors, cataract
Cameroon (Muyuka) (21)	1787	40≤	WHO	6.4	1.6	Cataract, refractive errors
Mongolia (49)	4345	40≤	WHO		1.5	Glaucoma, cataract
Turkmenistan (50)	6011	50≤	WHO		1.26	Cataract, glaucoma
Cameroon (Limbe) (18)	2215	40≤	WHO	3	1.1	Posterior segment disease, Cataract
Taiwan(Shihapai) (51)	1361	65≤	WHO		0.59	AMD, retinal disease
Singapore (Tanjong pagor) (52)	1232	40≤	WHO		0.5	Glaucoma, cataract
This study (Sari, Iran)	937	55≤	WHO	10.5	3.7	Refractive errors, cataract
Iran (Tehran) (27)	1074	40-59	WHO	2.51	0.59	Refractive errors, cataract
Iran (Tehran) (27)	385	60+	WHO	19.98	3.55	
Malaysia (33)	2081	40-49	WHO		0.31	Cataract, retinal disease
Malaysia (33)	1263	50-59	WHO		0.50	Cataract, retinal disease
Australia (Victoria) (53)	4744	40≤	WHO	0.325	0.156	AMD, glaucoma
China (54)	2115			3.59		cataract, refractive error
Rural Shandong Province, China (55)	17 816	≥50	WHO	7.01	1.58	
Shunyi district of Beijing (56)	5118	≥50	WHO	8.38	1.27	Cataract, retinal diseases
urban Indian population (10)	3400	>40	USA	3.4	0.4	

Nonetheless, reports of the prevalence of visual impairment from Barbados (38), Beaver Dam Eye Study (39), Blue Mountain (40) and Baltimore shows that the prevalence of visual impairment in the present study is significantly different from the aforementioned studies. Although they were conducted before 2000, the prevalence of visual impairment, especially blindness, is much lower in those studies in comparison with the results of our study which was conducted after 2010. These findings imply the role of access to ophthalmology facilities in developed countries as compared to rural areas. Unfortunately, a large proportion of the visually impaired participants in our study were blind. According to our findings, 7.3% of the people aged 40 years and over, and 17.8% of the participants aged 60 years and over were blind. As seen in Table 5 which summarizes the results of the prevalence of blindness in a number of studies, and according to the WHO definition of blindness and our findings, Iran ranks the second after Myanmar (41) for blindness in people aged 40 years and over and ranks the first for blindness in people aged 60 years and older. Except for India (42) with a prevalence of 11.9% for blindness in participants older than 50 years of age, the prevalence of blindness is much lower in other reports. Even the Tehran study (27) reported a significantly lower prevalence of blindness as compared with the present study. It seems studying the causes of blindness and visual impairment can show the importance of this problem in rural area. As mentioned earlier, uncorrected refractive errors and cataract were the most common causes of visual impairment in our study. Furthermore, cataract was the first cause of blindness. Resnikoff et al. (7) previously reported the importance of uncorrected refractive errors in visual impairment. According to our findings, 54.5% of the visual impairments were attributed to refractive errors,

that is, by correcting refractive errors, the prevalence of visual impairment declines by 54.5%. In other words, the prevalence of visual impairment can be reduced from 6.3% to 3% by using eyeglasses. Besides refractive errors, with cataract surgery, more than 82% of the cases of visual impairment will be simply treated. However, the main causes of visual impairment in other countries are retinal problems and glaucoma. The findings of the present study revealed lack of access to eyeglasses or proper diagnostic and therapeutic methods for refractive errors in the rural areas. Therefore, we believe that although correcting refractive errors with eyeglasses is the simplest way of treatment, it is still a major problem in some villages.

Cataract was the primary cause of blindness in our study. Most studies in this regard have also confirmed that cataract is the first cause of blindness in the world (Table 5). In the meantime, cataract surgery in the study population can simply treat 55% of the cases of blindness, and many cases of blindness can be simply corrected by eyeglasses. In total, cataract surgery and using eyeglasses can treat 85% of the cases of blindness. It is noteworthy that after implementing Vision 2020 in some countries, other causes have surfaced as the main causes of blindness due to the increase in cataract surgery.

It is important to correct refractive errors at an early age. As seen earlier, more than 78% of the study participants under 20 years of age had visual impairment due to refractive errors. Other studies confirm that refractive errors are the main cause of visual impairment in children. Moreover, 90% of the visual impairment cases in the age group 20-39 years are attributed to refractive errors, which can be simply treated. Correction of refractive errors in this age group is of great importance in terms of the burden of visual impairment on the society. This age group is the most active age group in the society and if their refractive errors are corrected, about 90% of them will no longer suffer from visual impairment.

Special attention should be paid to visual impairment and blindness in managerial levels. Prevention of blindness through early treatment and screening of visual problems, especially after the age of 40, should be included in the health system. Moreover, third level of prevention through low vision clinics can help individuals with low vision or blindness.

The present study had some strong and weak points. Determination of the prevalence of visual impairment in a rural population and its large sample size were the strong points of this study. On the other hand, we did not have access to the ophthalmological history of the patients and the study was limited to only one rural region, which were the weak points of this study. Therefore, it is suggested to design and conduct further studies to determine the prevalence of visual impairment and blindness in a national level in other rural areas of Iran.

Conclusion

This is the first report on the prevalence of visual impairment in an Iranian rural population. The prevalence of visual impairment was significantly higher in the rural population of this study when compared to previous reports from Iran. Considering the fact that visual impairment was mostly (80%) related to refractive errors and cataract, it seems that provision of therapeutic facilities like cataract surgery and availability of eyeglasses in villages can considerably reduce the prevalence of visual impairment.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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