Visual disabilities among diabetics in Oman

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ABSTRACT

Objective: The magnitude, determinants of visual impairment, bilateral blindness and low vision among diabetics in Oman were estimated as part of 'Oman Diabetic Eye Study 2002.' This study presents the outcomes and additional risk of visual impairment in diabetics.

Methods: A cross-sectional study of 2,520 randomly selected diabetics was conducted in 2002 in 10 regions of Oman. The sample was represented by 5,564 diabetics referred for eye checks. Ophthalmologists noted the vision and ocular manifestations of diabetes. Physicians reported the systemic manifestations of diabetes. The magnitude of visual disabilities, bilateral blindness, legal blindness and low vision were estimated and compared to the rates in the population.

Results: The prevalence of visual impairment in diabetics was 28.4% (95% confidence interval [CI] 27.20-29.57). It was 34.6% (95% CI 32.93 to 36.32) in females and 21.2% (95% CI 19.59 to 36.32) in males. The prevalence increased in age. The prevalence of bilateral blindness (vision <0.05) was 0.7%, legal blindness 9.8% (vision <0.1) and low vision 27.7% (vision <0.5).

Conclusion: The risk of visual impairment is 25 times more in diabetics than in the Omani population. Therefore, to prevent further increase of visual disabilities, the national health program should prioritize the eye care in diabetics and the predictors of visual disabilities should be further investigated.

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Diabetes can cause visual disabilities due to retinopathy, glaucoma, cataract, secondary infections causing corneal opacities and endophthalmitis.[1] Diabetic retinopathy is the leading cause of blindness in the industrialized countries. Changes in the life style have increased the risk of diabetes as well as blindness in many developing countries.[2] Thus, for the prevention of blindness at global level, addressing eye complications of diabetes is crucial. The magnitude and determinants of visual disabilities among diabetes are useful information for health planners. The incidence and prevalence of visual disabilities of different grades have been studied in many industrialized countries.[3-6] However, few information is available in the Middle Eastern countries. Oman is a country in the Middle Eastern peninsula and has nearly 1.8 million Omani population (Mid 2001 projections). Rapid socioeconomic development has changed the life style of the population in last 2 decades. Marked decline in communicable diseases and nutritional disorders have been reported. But, the risk for diabetes has increased due to obesity, sedentary life style, smoking, and high consanguinity.[7] The prevalence of diabetes was 10% among Omani population of more than 20 years of age.[8] Approximately 80,000 diabetics are estimated in the Omani population of this age group.[9] To identify them and to provide the standard care, the 'Diabetes Control Programme' initiated the 'National Diabetes Registry' in 2000. A total of 27,450 diabetics were registered by the end of 2001.[10] Since 1990, the health planners have prioritized 'Loss of Vision' as one of the health problem and addressed them systematically. A survey conducted in 1996-1997

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suggested that the prevalence of bilateral blindness was 1.1% in Oman.[11] The ratio of blindness and low vision in the Middle Eastern region was proposed to be 1:2.5.[12] Accordingly, the prevalence of 'Low Vision' in Oman would be 2.7%. The authors reviewed the magnitude and determinant of visual disabilities among diabetics and calculated the additional risk of visual disabilities among diabetics compared to the general population. Based on the study results, we proposed policies of eye care of diabetics to further reduce visual disabilities.

Methods. This was a cross sectional hospital based descriptive study. This study was conducted in 10 regions of Oman during 2002. The study population was 5,564 diabetics that were screened by ophthalmologists. To represent them randomly selected 1,360 subjects were required. This calculation was based on the assumption that 25% of the diabetic have visual impairment. This estimated sample could have a range of 23-27% of visual impairment. Our study would have 95% confidence interval and 90% power. To compensate clustering effect of 24 ophthalmic units from where data was compiled, the sample was multiplied by a factor of 2. Thus, 2,720 was the minimum sample required in our study. This national sample was stratified into regional subgroups depending on the proportion of the registered diabetics in each region. To facilitate the regional sample selection, we made lists of diabetics that were screened by ophthalmologists in each region. We used random table, to select regional sample from these lists. The regional ophthalmologists and physicians were the study staff. They had at least 5 years of experience. The visual assessment was carried out by the qualified optometrists in the ophthalmic units. The attending physician noted the personal details such as age, gender, referring institution and details of diabetes such as duration, blood sugar and hemoglobin A1c levels, associated systemic complications of diabetes such as nephropathy, neuropathy, hypertension, hyperlipidemia and coronary artery diseases. The diabetics were referred to the ophthalmologist for the visual and ocular assessment. The optometrists tested the vision of each eye separately. Snellen's distant vision chart was kept at 6 meter distance from the patient. Ophthalmologists evaluated the anterior segment using bio-microscope. Ocular tension was measured by either applanation or indentation tonometer. The retina was examined after pupil was dilated by mydriatics. A +90 D Volk lens and pan-retinal indirect ophthalmoscope were used for recording retinal status. Senior ophthalmologists reconfirmed the positive findings and determined the principal cause of visual impairment per person. World Health Organization recommended definitions of diabetes were adopted in this study.[13] Bilateral blindness was defined as vision '<0.05' in the better eye. Legal blindness was defined as vision '<0.1' in the better eye. Visual impairment was defined as vision '<0.33' in the better eye. A workshop was carried out for the regional ophthalmologists in which the retina specialist standardized the study criteria for diagnosis and recording the diabetic, ocular and visual status. The form and methodology were pre-tested in 2 regions. Mid-level program managers of the regions supervised the reference system and the eye care given to the diabetics. All study staff used a guideline for standard methodology. The forms used in the Ministry of Health institutions of Oman for reporting the diabetic and their ocular status of diabetics were the data source of our study. Data were collected in the regions and forwarded to the data manager. Pre- tested EPI6 format was used for computing the data. Univariate method of analysis was adopted and we used Statistical Package for Social Studies (SPSS 9) for this purpose. We calculated frequencies and percentage proportion of visual disabilities. The rates were adjusted for the age, gender and regions using the indirect standardization method. The percentage proportions of age groups and gender of diabetics as reported in Nizwa study[14] were used as reference for standardization. To validate the results, we calculated 95% confidence intervals. To compare the rates among determinants, we used relative risk values. We obtained consent of the health administrators both at national and regional levels. We discussed the results with the members of the National Eye Health Care Committee and distributed them to the regional health staff. The outcome was used to improve the eye care of diabetics. Those diabetics having ocular complications were provided free of cost eye care. To calculate the additional risk of visual impairment in diabetics compared to Omani population, rates of bilateral blindness from the prevalence study in 1997 were used. It is assumed that the rates between 1997 and 2001 have changed marginally.

Results. The characteristics of the study population and examined sample are compared **(Table 1)**. Due to wide variation of age and gender proportion in study population and the examined sample, indirect standardization of the visual impairment rates was carried out to make the results more representative. The prevalence of visual impairment was 28.4% (95% CI 27.2 to 29.6) and 1,580 diabetics with visual impairment were estimated in the study population. The frequencies, estimated numbers in population, adjusted prevalence of visual disabilities and their 95% confidence intervals for different variants such as

gender, age group are given in **Table 2** Female diabetics had significantly higher rates of visual impairments than male diabetics. Diabetics of higher age groups had significantly higher rates of visual impairment. Frequencies and prevalence of bilateral blindness, legal blindness and 'Low Vision' by gender were calculated **(Table 3)**. The prevalence of bilateral blindness (<0.05) was 0.7% only, while 9.4% diabetics were legally blind (<0.1). Twenty-seven percent of diabetics had 'Low Vision' (≤0.33). Female diabetics had significantly higher rates 'Low Vision' than male diabetics. The magnitude of corneal opacities, cataract, glaucoma and diabetic retinopathy among diabetics for 3 types of visual impairments were tabulated **(Table 4)**. More than 60% of visually impaired diabetics had corneal opacity and cataract as co-morbidities. Rate of glaucoma among visually disabled diabetics was 10% and diabetic retinopathy was 14%. Among 212 type I diabetics, 9 (4.2%) were bilateral blind, 15 (7%) were legal blind and 65 (30.4%) were visually impaired. Among 1,910 type II diabetics, 54 (2.8%) were bilateral blind, 101 (5.3%) were legal blind and 599 (31.4%) were visually impaired. Approximately, 125 diabetics were of other or undetermined type of diabetes. The difference in visual impairment among type I and type II diabetics was not significant (RR=1.03 [95% CI 0.83 to 1.23]). The rate of visual impairment among study population was 28.4%. The rate of visual impairment in Omani population was projected to be 3.8% (bilateral blindness 1.1% + 'Low vision' 2.7 %.) Thus, the study population seems to have 25% additional risk of having visual disability.

Table 1 - Characteristics of the study population and examined sample (Oman Diabetes Eye Study 2002).

Characteristics	Population		Sample	
	n	(%)	n	(%)
Gender				
Male	2,537	(45.6)	997	(37.7)
Female	3,021	(54.4)	1,523	(57.8)
Age-group*				
<40 yrs	847	(15.2)	487	(19.3)
40 to 49 yrs	1,371	(24.6)	732	(29)
50 to 59 yrs	1,371	(24.6)	584	(23.1)
60 to 69 yrs	1,532	(27.5)	465	(18.5)
70 & above	444	(8)	140	(5.6)
Region				
Muscat	476	(8.6)	495	(19.6)
Dhofar	96	(1.7)	96	(3.8)
Dhakhiliya	773	(17.2)	257	(10.2)
North Sharqiya	959	(13.9)	161	(6.4)
South Sharqiya	340	(6.1)	265	(10.3)
North Batinah	1,870	(33.6)	495	(19.7)
South Batinah	475	(8.5)	283	(11.2)
Dhahira	301	(5.4)	329	(13.1)
Musundam	276	(5)	22	(0.9)
Total	**5,564**		**2,520**	

*Mean age = 49.55 years, SD =12.0 years, blood sugar level was 11.7±5.89 mg/dl (mean±SD), hemoglobin A1c level was 8.62±2.43 (mean±SD).

Discussion. The information on visual impairment among diabetics is crucial for the health planners to improve the quality of life of the diabetics. As the study sample was randomly selected from the old and new cases at the time of their first registration, it fairly represents the study population. Although the registration and screening was carried out at different time, the data were evaluated once and the rates should be considered as the point prevalence.

The diabetics that were screened could systematically differ from those who did not visit the ophthalmic units for eye examination. Hence, the study results should be extrapolated for all the registered diabetics in Oman with caution. The indirect age-gender standardization enabled to minimize their and other potential confounder's effect on the study outcomes. The information of age was not available in 112 (5%) diabetics. They are likely to be of older age groups. As age related visual impairment is more in older age group, systematic bias could have been introduced. If these cases with 'missing age information' are considered to have visual impairment, the rates of blindness and low vision in our study could be an underestimation by 5%. The parameters of visual field restriction were not included in defining visual disability in our study. This non-randomized selection bias could have caused underestimation of visual impairment. The visual impairment rate among diabetics was 28.4% in the present study. Oman being trachoma endemic zone, large number of diabetics with trachomatous corneal opacities might be with severe visual impairment in our study. The rate of visual impairment among diabetics in UK was 2.84%[15] and it was 4% in Iceland.[16] Due to varying definitions of blindness used in other studies, comparison of rates of our study with them is difficult.

Females had significantly higher rates of 'Low Vision,' while gender differences in bilateral as well as legal blindness were not significant in our study. With free and easy access to the health care in Oman,[17] females use health facilities as frequently as males. Hence, gender barrier is unlikely to be responsible for higher rates of blindness among diabetics in Oman. As better quality vision is needed for driving vehicles and out-door activities among male compared to female diabetics, more male diabetics might be opting for frequent eye check up and interventions in early stages than female

Table 2 - Visual disabilities among diabetics (Oman diabetes eye study 2002).

Epidemiological variant	Frequency n	(%)	Estimated disabled	Adjusted rate	95% CI
Gender					
Male	177	(18.6)	537	21.18	19.59 - 22.77
Female	393	(27)	1,046	34.63	32.93 - 36.32
Age (years) (N=2137)*					
<40	35	(7.2)	40	4.67	3.25 - 6.10
40-49	129	(17.6)	232	16.95	14.97 - 18.94
50-59	147	(25.2)	293	21.37	19.20 - 23.54
60-69	191	(41.1)	682	44.54	42.05 - 47.03
≥70	68	(48.6)	332	74.90	70.87 - 78.94
Total	570	(22.6)	1,579	28.39	27.20 - 29.57

*age information of 122 diabetics was missing. **adjusted rates using indirect method of age-gender standardization

Table 3 - Type of disabilities among diabetics (Oman diabetes eye study 2002)

Visual disability	Frequency n	(%)	Estimated disabled	Adjusted rate	95% CI
Bilateral blindness (Vn <0.05)	77	(3.4)	38	0.69	0.47 - 0.91
Male	36	(3.9)	16	0.64	0.33 - 0.95
Female	41	(3)	22	0.73	0.43 - 1.04
Legal blindness (Vn <0.1)	137	(6.1)	546	9.82	9.03 - 10.60
Male	50	(5.6)	219	8.64	7.54 - 9.73
Female	87	(6.4)	327	10.82	9.72 - 11.93
Low vision	493	(22)	1,541	27.70	26.52 - 28.87
Male	142	(15.9)	521	20.54	18.97 - 22.11
Female	351	(26)	1,024	33.89	32.20 - 35.58

**adjusted rates using indirect method of age-gender standardization

Table 4 - Visual disabilities and ocular co-morbidities in diabetics (Oman diabetes eye study 2002).

Ocular co-morbidity	Bilateral blind N=77 n (%)	Legal blind N=137 n (%)	Low vision N=493 n (%)	Visual impairment N=570 n (%)
Corneal opacities	55 (71.4)	102 (74.5)	302 (58.5)	357 (62.6)
Cataract	52 (67.50	98 (71.5)	311 (60.3)	353 (61.9)
Glaucoma	17 (22.1)	27 (19.7)	43 (8.3)	60 (10.5)
Retinopathy	8 (10.4)	14 (10.2)	73 (14.1)	81 (14.2)

diabetics. This might have resulted in reporting of higher rates of 'Low Vision' disabilities among females in our study. Similar higher rates of visual impairment were reported among female than male with older onset diabetes in Madison study.[18] Blindness was reported 4 times more in insulin treated female compared to male diabetics in Copenhagen study.[19] Further analytical studies could confirm the association of visual impairment to female diabetics in Oman. With the increase in age group, the rate of visual impairment increased significantly. Longer duration of diabetes and high rates of age related ocular morbidities in higher age groups could explain this observation. Madison study also reported positive association of age to the higher rates of blindness among diabetics.[20]

In our study, 0.7% diabetics had bilateral blindness. This rate was 0.75% in UK,[8] 7.6% in Sweden[16] and 1.94% in multi-center study of WHO.[21] The lower rates of bilateral blindness in Oman among diabetics could be due to slow progress of the eye changes or it could be due to positive impact of interventions carried out to prevent advanced stages of the complications. Nearly one tenth of diabetics in Oman were legally blind. In UK, this rate was 1.13%.[15] It ranged from 1.8 among type I and 4.8% among type II diabetes in the Madison study.[18] Approximately 3.6% of diabetics were legally blind in Wisconsin study.[22] Higher rates of legally blind diabetics in Oman suggest that better care and early intervention is needed to prevent legal blindness among diabetics. More emphasis of early intervention of cataract and glaucoma among diabetics could reduce legal blindness among diabetics. Frequent check-up of visual acuity and stricter policies for renewing driving licenses for these legally blind could be considered. More than one forth of the diabetics had 'Low Vision' disabilities in Oman. It was 4% in Iceland[16] and 7.3% in Australia.[23] The rate was 4% in Type I and 7% in Type II diabetics.[24] The incidence of visual impairment was high in type II diabetics than type I diabetics.[14] The rates of visual impairment of different grades were not significantly different in both types of diabetes in our study. Further longitudinal studies could confirm the association of visual impairment to the type of diabetes. The causes of visual impairment among diabetics suggest that Oman continues to be a trachoma endemic zone. More than 50% of the visually impaired diabetics had cataract. This indicates the need for increasing cataract surgeries and giving special attention to this high-risk population. Presence of large number of anterior segment morbidities in diabetics could be responsible for the low retinopathy rates. Management of retinopathies in the presence of co-morbidities would be a challenge to the ophthalmologists in Oman. The prevalence of visual impairment in Omani population between 1997[25] and 2002 is assumed to be the same in view of marginal increase in cataract surgery rates. Its comparison to the magnitude of visual impairment in diabetics suggests that diabetes seems to have 25% additional risk of developing visual impairment in Oman. The national prevention of blindness program should focus on this high-risk population and take comprehensive steps to prevent visual impairment. In addition to the primary health care approach that Oman has adopted for early detection and eye care by ophthalmologists, increasing awareness among diabetics for periodic check-up and accepting early intervention could prevent/delay visual impairment. Role of optometrist as proposed in Australia in early detection of eye changes of diabetes should be considered in Oman also for the prevention of visual impairment in diabetics.[23]

In conclusion, we could determine the magnitude and some of the determinants of visual impairment among diabetics through this study. Additional risk of visual impairment in diabetics compared to the general population was demonstrated. Emphasis on prioritizing eye care of diabetic and thus further reduce visual impairment was proposed.

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