Prevalence and causes of blindness and diabetic retinopathy in Southern Saudi Arabia

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ABSTRACT

الأهداف: تقييم مدى انتشار وأسباب اعتلال الشبكة السكري في منطقة جازان في الجزء الجنوبي من المملكة العربية السعودية.

الطريقة: اعتمدت هذه الدراسة المقطعية على استخدام التقييم السريع للعمى الممكن تجنبه، واعتلال الشبكية السكري لدى 3800 من المرضى الذين تم اختيارهم عشوائياً ممن تبلغ أعمارهم 50 عاماً أو أكثر وذلك خلال الفترة من نوفمبر 2011م إلى يناير 2012م. لقد خضع المشاركين في الدراسة للتقييم من خلال المقابلات، واختبار جلوكوز الدم العشوائي، وتقييم النظر من ناحية الحدة واختبار منظر قاع العين. بعدها قمنا بتحديد الأسباب المؤدية إلى ضعف البصر بين المشاركين الذين كانت حدة البصر لديهم أقل من 6/18 في إحدى العينين. وتم تصنيف المرضى على أنهم مصابين بالسكري وذلك عندما كانوا مشخصين بالمرض سابقاً، أو عندما بلغت نتيجة جلوكوز الدم العشوائي أكثر من 200 مع/دي أي. ولقد قمنا باستخدام اختبار منظر قاع العين وذلك من أجل المسح عن اعتلال الشبكية السكري بين المرضى المصابين بالسكري. وتم تسجيل البيانات في نماذج وذلك باستخدام التقييم السريع للعمى الممكن تجنبه، واعتلال الشبكية السكري.

النتائج: لقد وصلت نسبة العمى المزدوج >3/6 إلى3.3% (95% confidence interval [CI]: 2.74-3.90). وقد كان اعتام عدسة العين السبب الرئيسي المؤدي إلى العمى (58.6%)، تلته أمراض الأجزاء الخلفية (20%) والتي شملت اعتلال الشبكية السكري (7; 3.3%). وكانت نسبة انتشار مرض السكري 22.4% (95% CI: 21.09-23.79)، وكانت نسبة المرضى المصابين باعتلال الشبكية السكري بين مرضى السكري 27.8%. وكانت نسبة اعتلال الشبكية السكري المهدد بفقدان البصر 5.7%.

الخاتمة: أظهرت الدراسة بأن نسبة انتشار مرض السكري واعتلال الشبكية السكري في منطقة جازان قد يكون أقل من النسب المسجلة في مناطق المملكة العربية السعودية الأخرى. غير أن انتشار العمى الغير مرتبط باعتلال الشبكية السكري قد يكون أعلى من المناطق الأخرى.

Objectives: To determine the prevalence and causes of blindness and diabetic retinopathy (DR) in Jazan district, Southern Saudi Arabia.

Methods: Using the standardized Rapid Assessment for Avoidable Blindness (RAAB) and DR cross-sectional methodology, 3800 subjects were randomly selected from the population of ≥50 years of age in Jazan, Saudi Arabia between November 2011 and January 2012. Participants underwent screening comprised of interview, random blood glucose test, and ophthalmic assessment including visual acuity (VA) and fundus examination. Among participants with VA <6/18 in either eye, the cause(s) of visual impairment was determined. Participants were classified as diabetic if they had previous diagnoses of diabetes, or random blood glucose >200 mg/dl. Diabetic participants were assessed for DR using dilated fundus examination. All data were recorded using the RAAB + DR standardized forms.

Results: The prevalence of bilateral blindness <3/60 was 3.3% (95% confidence interval [CI]: 2.74 - 3.90). Cataract was the leading cause of blindness (58.6%); followed by posterior segment diseases (20%), which included DR (7; 3.3%). The prevalence of diabetes mellitus (DM) was 22.4%, (95% CI: 21.09 - 23.79), among them; 27.8% had DR. The prevalence of sight-threatening DR was 5.7%.

Conclusion: The prevalence of DM and the corresponding proportion of DR in this region is lower than that reported in other regions of Saudi Arabia. However, the prevalence of blindness not related to DR is relatively higher than the other studies.

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The Kingdom of Saudi (KSA) ranks seventh in the global burden of diabetes mellitus (DM), with an estimated prevalence of 23.5% for age groups 20-79 years.[1] Ocular complications are quite common among diabetic patients. It is well established that within 15 years of diabetes approximately 2% of diabetics may turn legally blind, and approximately 10% may develop severe visual impairment. Diabetic retinopathy (DR) is one of the serious potential complications. It occurs in approximately 77% of the type 2 diabetics within 10 years of the diabetes onset, and almost in all type 1 diabetics.[2] A global review of diabetic retinopathy reported that on average, 34.6% of all diabetic patients have some forms of DR.[3] Recent studies in KSA have reported a high prevalence of DR among diabetics in different regions of the country. A recent population based study in Taif,[4] in the Western region of KSA reported that 33% of all diabetics have some form of DR; while another hospital based study in the Madinah region reported the same estimate at 36%.[5] With this high burden of the disease, the Saudi Ministry of Health (MoH) in collaboration with the Saudi National Prevention of Blindness Committee (NPBC) commissioned more studies to determine the magnitude of the problem in other regions of the vast country. Thus, a population-based survey was conducted to estimate both prevalence and pattern of DR, in addition to the magnitude and causes of blindness and visual impairment in the Jazan district, in the Southwestern region of KSA. Jazan covers an area of 11,670 Km,[2] and has a population of 1,533,496 inhabitants. It lies to the Southwest coast of the Red Sea and is bordered by Yemen to the south. The study adopted the Rapid Assessment for Avoidable Blindness and Diabetic Retinopathy (RAAB+DR) technique, which is a survey methodology developed by the International Centre for Eye Health, London School of Hygiene and Tropical Medicine (ICEH-LSHTM), London, United Kingdom.[6] The RAAB+DR is a simple and cost effective cross-sectional community-based survey of persons 50 years and older, that focuses primarily on the prevalence of avoidable blindness. It estimates the prevalence of blindness and visual impairment, their causes, and magnitude of DR in a specific geographical area, usually at the district, or province level. The RAAB+DR methodology has concrete proven reliability and validity.[4,7]

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Methods. Using the standardized RAAB+DR survey methodology, a population based cross-sectional survey was conducted in Jazan district of KSA between November 2011 and January 2012. Prior to conducting the survey, literature was reviewed based on a well-designed search strategy targeting quality publications from the region. The survey targeted eligible persons in the age of 50 years and older who were normal residents of Jazan district during the study period. A minimum sample size of 3,800 inhabitants was calculated using RAAB software version 4.2 (ICEH, LSHTM, London, UK), considering the prevalence of blindness as 2.6% (as indicated by Al-Ghamdi et al[4]) among the population 50 years and above, precision was set to 25%, within a 95% confidence interval (CI), design effect of 1.5%, in addition to 10% contingency for non-respondents. The study population was selected by a multistage cluster random sampling technique. Clusters to be examined were selected based on the probability proportional to size sampling technique using a sample frame of 140 communities in the study area. Within each cluster, a number of segments were identified through the compact segment sampling approach using a recent village map (routinely available in the village health unit) where each segment contained around 50 inhabitants in the age 50 years and above.[8] Eventually, one segment was randomly chosen to be examined in each cluster.

Prior to fieldwork implementation, one week hands-on training was conducted engaging the local coordinators, fieldwork, and office teams. The training included the RAAB concept and applications, standardized vision assessment procedure, clinical eye examination, interviewing skills in addition to other field work technicalities following the RAAB standardized methodologies and guidelines. Also lectures on DR and grading according to the Scottish DR grading scheme (**Table 1**) followed by inter-observer variation test for grading the DR were instructed. By the end of the training, 5 teams were established where each team consisted of: an ophthalmologist, 2 nurses, an optometrist, a local guide, and a driver. Furthermore, in the post-training phase, an inter-observer variation test for visual acuity (VA) recording, lens grading, identification of causes of visual impairment as well as grading of DR was applied to all teams using the RAAB methodology operational definitions until a satisfactory agreement of at least 0.75 kappa was achieved for each parameter. A detailed time schedule was developed within an action oriented plan for all teams including team-allocated clusters and working days. Each team was asked to cover one cluster per day within a maximum capacity of 25 households per field working hours (9:00 AM - 5:00 PM). The teams conducted house to house visits in each selected cluster segment until 50 eligible subjects were recruited. During such visits, and after introducing the team and the survey project, the local guide sought oral consent from the available household head. Examination procedure included: assessment of VA by the optometrist in appropriate daylight and avoiding direct sun using the WHO recommended tumbling "E" chart. Further VA assessment using the pinhole correction was carried out for those with VA <6/18 in either eye. Lens or corneal status was then assessed by the ophthalmologist using a torch and a direct ophthalmoscope in a relatively shaded area inside the house. Eyes with VA <6/18 were further examined in details to identify the major cause of visual impairment. The principal cause of visual impairment or blindness was determined following the RAAB guidelines. Cases in need of urgent intervention and / or further serious investigations were advised and referred to the local hospital to receive appropriate eye care. Each survey participant had a finger-prick random blood glucose test (RBG), which was conducted by the accompanying nurse using a digital calibrated glucometer. All participants with history of diabetes (known diabetes) or a RBG reading of >200 mg/dl were considered as 'diabetes'. For known diabetes a blood glucose level >200 mg/dl was considered as 'poorly controlled diabetes mellitus'. All 'diabetes' were examined through dilated fundus examination within the household via both direct and indirect Ophthalmoscopes (20 diopter lens) to evaluate the retinal status including the macula. Presence / absence of any sign of DR was then recorded. Among subjects with positive signs of DR, the severity of DR was graded according to the Scottish DR grading system.[9] Ethical approval was obtained from the institutional research and ethics boards (IREB) of both King Fahd Medical City (KFMC) and MoH, Riyadh, Saudi Arabia. The study adhered to the tenets of the Declaration of Helsinki for research involving humans.

Table 1 - Scottish Diabetic Retinopathy Grading Scheme.[9]

Grade	Description
Retinopathy (R)	
R0	No visible retinopathy
R1 (mild)	The presence of any of following: Dot or blot hemorrhage Microaneurysms Hard exudate Cotton wool spots Superficial flame shape hemorrhage
R2 (observable)	4 or more blot hemorrhage in one hemi-field only
R3 (referable)	Any of the following features: 4 or more blot hemorrhage in both hemi-field venous beading IRMA
R4 (proliferative)	Any of the following features: Active new vessels Vitreous hemorrhage
R5 (inadequate)	Not adequately visualized Retina not sufficiently visible for assessments
Maculopathy (M)	
M0	No signs of maculopathy
M1 (observable)	Lesions as specified bellow within a radius >1 but ≤2 disc diameters the center of the fovea Any hard exudates
M2 (referable)	Lesions as specified bellow within a radius of 1 but ≤1 disc diameters the center of the fovea Any blot hemorrhage Any hard exudates

IRMA - intra-retinal microvascular abnormality

Data related to the standardized eye examination form were reviewed and double entered into a specific database using RAAB 4.2 software. The prevalence and causes of visual impairment and blindness were generated (after being adjusted for age and gender) using the automated RAAB report options. Data related to diabetic retinopathy was entered in a separate database developed using Microsoft Access 2007® software (Microsoft Corporation, Redmond, WA, USA). After data management, both databases were linked using Microsoft Excel 2007® (Microsoft Corporation, Redmond, WA, USA) and imported to the IBM SPSS Statistics for Windows (IBM Corp, Armonk, NY, USA) for the analysis. Prevalence, univariate associations, and multivariate adjusted analyses were then conducted using IBM SPSS Statistics for Windows version 19.0, and StatsDirect® statistical software, version 2.7.2 (StatsDirect Ltd., Cheshire, UK).

Results. Jazan district has an estimated population of 1,533,496 inhabitants of whom, 8.2% are aged ≥50 years.[10] A total number of 3800; 1927 (50.7%) male, and 1873 (49.3%) female inhabitants aged 50 years and above were initially enumerated in the current study. Out of them, 3659 (1872; 51.2% male, and 1787; 48.8% female) were examined with a total coverage rate of 96.3%. Only 141 (5.7%) subjects were not examined, of them: 38 (26.9%) were unavailable, 65 (46.1%) refused, while the other 38 (26.9%) were unable to communicate. The mean (±SD) age of the examined population was 63.3 (11.5) years.

Status of DM. Diabetes mellitus was detected in 821 subjects (22.4%, [95% CI: 21.09 - 23.79]), male; 447 (54.4%) and 374 (45.6%) female. Out of them, 705 (85.9%) were aware of being diabetic. Of those who were aware; 425 (60.3%) were 'poorly' controlled (blood glucose >200 mg). Meanwhile, 679 (96.3%) of those who were aware, have reported being on treatment, where the majority of those on treatment (510; 72.3%) were using tablets, 175; 24.8% were using insulin, and 4 (0.6%) were only on diet while 15 (2.1%) persons reported nonuse of any medication. Among these known diabetics, only 262 (37.2%) were ever examined by an ophthalmologist, with most (159; 60.7%) examined in the last one year.

Table 2 - Age and gender specific prevalence of diabetic retinopathy according to a study in Saudi Arabia.

Age group	Male	Female	All
50-59	27/121 (22.3)	34/157 (21.7)	61/278 (21.9)
60-69	46/136 (33.8)	21/94 (22.3)	67/230 (29.1)
70-79	32/90 (35.6)	17/59 (28.8)	49/149 (32.9)
80+	21/56 (37.5)	8/27 (29.6)	29/83 (34.9)
Total	**126/403 (31.3)**	**80/337 (23.7)**	**206/740 (27.8)**

Table 3 - Prevalence and distribution of diabetic patients by grade of retinopathy and/or maculopathy according to a study in Saudi Arabia.

Grade	Male	Female n (%)	Total
Retinopathy (R)			
No retinopathy (R_0)	263 (65.3)	241 (71.5)	**504 (68.1)**
Mild DR (R_1)	80 (19.9)	53 (15.7)	**133 (18.0)**
Observed DR (R_2)	26 (6.5)	13 (3.9)	**39 (5.3)**
Referable DR (R_3)	16 (4.0)	10 (3.0)	**26 (3.5)**
Proliferative DR (R_4)	4 (1.0)	4 (1.2)	**8 (1.1)**
Undetectable DR (R_6)	14 (3.5)	16 (4.7)	**30 (4.1)**
Any retinopathy	126 (31.3)	80 (23.7)	**206 (27.8)**
Total	**403**	**337**	**740**
Maculopathy (M)			
No maculopathy (M_0)	331 (82.1)	283 (84.0)	**614 (83.0)**
Observed maculopathy (M_1)	36 (8.9)	22 (6.5)	**58 (7.8)**
Referable maculopathy (M_2)	23 (5.7)	16 (4.7)	**39 (5.3)**
Undetectable maculopathy (M_6)	13 (3.2)	16 (4.7)	**29 (3.9)**
Any maculopathy	59 (14.6)	38 (11.3)	**97 (13.1)**
Any retinopathy and/or maculopathy	127 (31.5)	81 (24.0)	**208 (28.1)**
Total	**403**	**337**	**740 (5.4)**
Sight threatening DR (R_4 and/or M_2)	23 (5.7)	19 (5.6)	42 (5.7)

DR - diabetic retinopathy

Among the 821 confirmed diabetic subjects, 81 (9.9%) subjects were excluded from the detailed diabetic group analysis mainly because; 21 (2.6%) cases refused to be examined, 26 (3.2%) refused dilatation, while the remaining 34 (4.1%) subjects refused to have fundus photo. Eventually, 740 (90.1%) subjects completed the detailed DR examination with males and older subjects more affected (**Table 2**).

Diabetic retinopathy. Among the 740 diabetic subjects who accepted full DR examination, in 30 people (4.1%) the retina could not be visualized; 68.1% had no signs of any retinopathy, 18% had mild DR, 5.3% had observable DR, 3.5% had referable DR, and 1.1% had proliferative DR. Overall, 206/740 (27.8%) subjects were found to have any form of retinopathy. As regards to maculopathy, in 3.9% subjects the macula could not be visualized; 83% were maculopathy free, 7.8% had observable maculopathy, and 5.3% had referable maculopathy; thus, 13.1% of the examined subjects had any detectable type of maculopathy. Overall, 28.1% of cases had either retinopathy and / or maculopathy in their eyes. Moreover, 5.7% of subjects had a sight threatening DR either from referable retinopathy or maculopathy, or both (**Table 3**).

Prevalence and causes of blindness and visual impairment. The prevalence of bilateral blindness (<3/60 with available correction-presenting vision) was 5.7% (95% CI: 4.99 - 6.49), which was 3.3% (95% CI: 2.74 - 3.90) after age and gender adjustments. Meanwhile, such prevalence was slightly higher among females: 6.1 (95% CI: 4.99 - 7.21) than males: 5.4

Table 4 - Unadjusted prevalence of blindness, visual acuity (VA) <3/60, <6/60, and <6/18 with available correction as found in the study sample from Saudi Arabia.

Visual impairment level and category	Male	Female n (%)	Total
VA <3/60 in the better eye, with available correction			
Persons	101 (5.4)	109 (6.1)	**210 (5.7)**
Eyes	424 (11.3)	430 (12.0)	**854 (11.7)**
VA <6/60-3/60 in the better eye, with available correction			
Persons	158 (8.4)	152 (8.5)	**310 (8.5)**
Eyes	581 (12.5)	558 (15.6)	**1139 (15.6)**
VA <6/18-6/60 in the better eye, with available correction			
Persons	408 (21.8)	421 (23.6)	**829 (22.7)**
Eyes	1160 (40.0)	1159 (32.4)	**2319 (61.7)**

Table 5 - Principal causes of blindness and severe visual impairment in the better eye according to a study in Saudi Arabia.

Causes	Severe visual impairment (<6/60 - 3/60)			Blindness (<3/60)		
	Male	Female	Total	Male	Female	Total
Refractive errors	7 (12.3)	6 (14.0)	**13 (13.0)**	0 (0.0)	2 (1.9)	**2 (1.0)**
Untreated cataract	39 (68.4)	32 (74.4)	**71 (71.0)**	52 (51.5)	71 (65.7)	**123 (58.9)**
Uncorrected aphakia	0 (0.0)	0 (0.0)	**0 (0.0)**	2 (2.0)	0 (0.0)	**2 (1.0)**
Surgical complications	3 (5.3)	1 (2.3)	**4 (4.0)**	5 (5.0)	3 (2.8)	**8 (3.8)**
Trachoma	0 (0.0)	0 (0.0)	**0 (0.0)**	1 (1.0)	0 (0.0)	**1 (0.5)**
Phthisis	0 (0.0)	0 (0.0)	**0 (0.0)**	3 (3.0)	0 (0.0)	**3 (1.4)**
Other corneal scars	0 (0.0)	1 (2.3)	**1 (1.0)**	11 (10.9)	9 (8.3)	**20 (9.6)**
Glaucoma	0 (0.0)	0 (0.0)	**0 (0.0)**	6 (5.9)	5 (4.6)	**11 (5.3)**
Diabetic retinopathy	4 (7.0)	1 (2.3)	**5 (5.0)**	5 (5.0)	2 (1.9)	**7 (3.3)**
Globe abnormality	0 (0.0)	0 (0.0)	**0 (0.0)**	2 (2.0)	2 (1.9)	**4 (1.9)**
Age related macular degeneration	1 (1.8)	0 (0.0)	**1 (1.0)**	3 (3.0)	4 (3.7)	**7 (3.3)**
Other posterior segment	3 (5.3)	2 (4.7)	**5 (5.0)**	11 (10.9)	10 (9.3)	**21 (10.0)**
Total	**57 (100)**	**43 (100)**	**100 (100)**	**101 (100)**	**108 (100)**	**209 (100)**

(95% CI: 4.37 - 6.42). The prevalence of bilateral severe visual impairment (< 6/60 - 3/60) in the better eye with the available correction was 2.7 % (95% CI: 2.20 - 3.26), and the prevalence of bilateral moderate visual impairment (VA <6/18 - 6/60) was 14.2% (95% CI: 13.05 - 15.31). The total population of people 50 years and older in Jazan is estimated at 126,207 inhabitants (55.2% male, and 44.8% female); thus, the estimated number of bilaterally blind (VA <3/60 in the better eye) in Jazan is 4,190 persons, the estimated number of people with severe visual impairment is 2,764 persons, while the estimated number of people with moderate visual impairment is 17,896 persons (**Table 4**). The major causes of blindness in persons (VA <3/60 in the better eye with available correction) were: cataract (58.6%); other posterior segment causes (10%); corneal opacities (9.5%); glaucoma (5.3%); surgical complications (3.8%), DR (7; 3.3%), and age related macular degeneration (3.3%) (Table 5). The major causes of severe visual impairment were: Cataract (71%); uncorrected refractive errors (13%); DR (5%); other posterior segment causes (5%), and surgical complications (4%) (**Table 5**). Additionally, the major causes of moderate visual impairment were: refractive errors (55.1%); cataract (30.8%); other posterior segment (4.2%); diabetic retinopathy (3.5%); surgical complications (1.7%), and age related macular degeneration (1.3%).

Discussion. The study achieved a high response rate of 96.3% due to good publicity and supportive collaboration with the primary health centers in the study area. The examined population is similar to the age and gender structure of the total population of Jazan district of Southern KSA.[10] Some of the known studies that have used the RAAB+DR survey methodology are the studies in Taif, KSA,[4] Chiapas, Mexico,[7] Irbid, Jordan,[11] and Moldova.[12] The prevalence of DM in this study is estimated at 22.4%, lower than the reported prevalence in the nearby communities of Taif in the Western region of KSA (29.8%),[4] and Irbid in northern Jordan (28.6%).[11] However, it is almost similar to the findings in Chiapas, Mexico (21%),[7] an agrarian community with the lowest socioeconomic indicators in Mexico, and with a higher percentage of illiteracy than the rest of the country.[13] The republic of Moldova, with a larger population (>60%) of the Moldavians living in rural areas also reported lower prevalence of diabetes like the Jazan district. Similarly, the population of Jazan is mostly rural and agrarian and relatively poor compared with Taif, or Irbid that are more urbanized.

Diabetes mellitus is known to be more common in urban populations with less physical activity, sedentary lifestyles, and consumption of unhealthy foods.[14,15] As in many other similar studies (like that of Taif,[4] Irbid,[11] Moldova,[12] and Mexico[7]) approximately 80-90% of the people with diabetes are already aware of the disease. However, the number of persons with random blood sugar higher than 200 mg/dl (which is the WHO suggested cut off limit for normal random blood sugar) is high 60.3%, similar to findings from Taif (56%),[4] Irbid (60.8%),[11] and Mexico (73%).[7] This suggests a higher number of people with poor control of DM. Furthermore, the number of people that have ever had ophthalmic examination for DR is lower in Jazan (37.2%)[4] compared with Irbid (66%),[11] and in Moldova (70%).[12] This may be due to the fact that Jazan district consists mostly of rural settlements with less literacy level and in comparison; it has less health care and eye health facilities. For example; the ratio of General Practitioner (GPs) per population in the area is one GP to 6,000, while it is one GP to 3,800 in Taif.[16]

The proportion of DR in patients with diabetes in Jazan (28.1%) is relatively close to the global estimate of 34.6% (95% CI: 34.5 - 34.8).[3] It is also close to other studied areas in Taif, Saudi Arabia (36.1%),[4] and a hospital based study in Madinah, Saudi Arabia (34.5%)[5] Mexico (47%),[7] and Irbid (49.9%).[11] However, this agrees with the fact that the estimated prevalence of DM in Jazan is much lower than in these areas. This may seem to be due to the higher proportion of people with poorly controlled diabetes in this study, and hence higher likelihood of complications like DR. This higher proportion of people with poorly controlled diabetes may in itself be attributed to lack of awareness and limited eye health care facilities. The Saudi Health Statistics 2011[16] showed that the proportion of population to one physician/GP is higher in Jazan than in many other governorates in the Kingdom, also the proportion of population to PHC is 1,200 people compared with one to 900 population in Taif. Fortunately, the proportion of Sight Threatening-DR (ST-DR) is significantly lower (5.7%) than that of Taif (17.5%),[4] Irbid (14.4%),[11] Moldova (14.6%),[12] and Mexico (21%).[7] Thus, DR as a cause of blindness and severe visual impairment was much lower (3.3% and 5%) than in other studies in comparison with the high prevalence of DR. This relatively lower ST-DR compared with the overall high prevalence of DR may need in-depth understanding and future studies.

Despite the low prevalence of sight threatening DR in this study area, the prevalence of blindness is higher (5.4%) compared with other places like Taif (2.3%),[4] Moldova (1.6%),[12] and Irbid, Jordan (1.3%).[11] This may be attributed to a high burden of avoidable blindness (75.7%), contributed by high magnitude of cataract, and presence of some infectious causes of blindness like corneal scar, which is responsible for 9.5%, being the third major cause of blindness, while trachoma is responsible for another 0.5% of blindness. This is in contrast to Irbid with 46.7%,[11] and Taif with 63.1%[4] avoidable blindness, as they have lower burden of cataract, minimal corneal scarring, and no trachoma. The higher proportion of infectious causes of blindness in the study area is not surprising considering the high prevalence of communicable diseases in the region. Indeed, the region ranks among the highest in incidence of communicable diseases in Saudi Arabia. A 2006 report of modifiable diseases reports that Jazan has been responsible for 53% of all measles cases (429/807)[17] in Saudi Arabia. Measles in association with vitamin A deficiency is a major cause of corneal scarring in childhood in many developing countries; it eventually leads to corneal scars the adulthood. This could probably explain the high incidence of corneal scars in this study. A similar explanation was preferred for corneal opacity as a major cause of blindness in parts of Libya.[18]

Trachoma as a disease of poverty and less access to health care is also a cause of blindness in this area, whereas it was found to be almost none existent in Taif,[4] and Irbid.[11] Also the climatic set up in terms of aridity in this area is a common risk factor for trachoma. The second major cause of blindness in this study is posterior segment disease. However, the percentage of blindness due to posterior segment diseases in this study is in comparison with the results of many other RAAB studies that have reported posterior segment diseases, glaucoma, DR, and age related macular degeneration. In Irbid, Jordan,[11] posterior segment disease (aside from previously mentioned diseases) was responsible for 10% of blindness; it was 10.9% in Moldova,[12] and 16% in Chiapas, Mexico.[7] Although globally, glaucoma is showing a trend to be the third major cause worldwide,[18] it is the fourth major cause of blindness in Jazan (5.2%) as the high prevalence of corneal scar had displaced it to the third position. However, as with international trends, glaucoma tends to be ranked as the second or third major cause in other similar studies.[4,11,12]

The limitations of this study include the limited definition of glaucoma used in the study, which does not include visual field parameters; thus, glaucoma might have been underestimated. Also, the study did not explore in detail the causes of 'other posterior segment diseases' as it is aimed mainly at determining the magnitude and causes of avoidable blindness and visual impairment, and magnitude of DR. Therefore, a survey with detailed posterior segment assessment may be required to specifically identify these diseases.

In conclusion, Jazan district has higher prevalence of visual impairment than other parts of KSA, mainly due to the higher burden of avoidable causes of blindness. There is a need to improve its local eye health facilities to curb such high burdens. Patients with significant visual loss should be prioritized to receive cataract surgery. Primary eye care needs to be strengthened to prevent corneal scarring. Community eye health awareness needs to be introduced to encourage adults with a family history of glaucoma to have periodic eye screening. A specific study on posterior segment eye diseases may need to be commissioned to determine the specific diseases responsible for the high proportion of 'other posterior segment disease'.

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