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Prevalence and Causes of Blindness: Results from Rapid Assessment of Avoidable Blindness (RAAB) survey in Gezira State, Sudan, 2010.

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Abstract:

Objectives: To estimate the prevalence of avoidable blindness in people aged 50 years and older in Gezira state, Sudan using Rapid Assessment for Avoidable Blindness (RAAB) methodology.

Design: Cross-sectional population-based survey.

Participants: Forty three clusters of 50 people aged 50 years or older were selected by probability proportionate to size sampling of clusters. Households within clusters were selected through compact segment sampling.

A total of 2150 eligible persons were selected, of whom 2103 (97.8%) were examined.

Methods: Participants underwent a comprehensive ophthalmic examination in their homes by specially trained ophthalmic teams, including measurement of visual acuity (VA) with a tumbling-*E* chart and the diagnosis of the principal cause of visual impairment.

Results: The prevalence of bilateral blindness (presenting VA < 3/60) was 9.37% (95% confidence interval [CI], ± 1.95), and prevalence of bilateral visual impairment (VA of <6/18-6/60) was 3.9% (95% CI, ± 1.10) in the sample. Definite avoidable causes of blindness (i.e., cataract, refractive error, trachoma, and corneal scarring) were responsible for 74.6% of bilateral blindness. Cataract was the major cause of blindness (57.4%) followed by glaucoma (17.3%).

Conclusions: The prevalence of blindness in people aged 50 years and older in Gezira state was slightly higher than expected. The main cause of blindness is cataract, followed by glaucoma. Three quarters of blindness is due to avoidable causes.

Introduction:

The World Health Organization (WHO) estimates that there are 45 million people in the world who are blind (vision worse than 3/60 in the better eye with presenting vision)^(1,2). This is expected to rise to 76 million by 2020 if current services are not improved. VISION 2020 is a joint initiative by the WHO and the International Association for the Prevention of Blindness that aims to eliminate avoidable blindness by the year 2020⁽³⁻⁶⁾. The priority diseases in the first phase of Vision 2020 are cataract, refractive error and low vision, childhood blindness, onchocerciasis, and trachoma. These conditions constitute more than 75% of blinding diseases⁽⁷⁾, and are amenable to effective preventive and curative interventions. The first step in achieving this target is to obtain baseline data on visual impairment at country and sub-country (state, district) levels for planning and monitoring eye care programs. WHO estimates for East Mediterranean Region (EMR), which

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includes Sudan, suggest that the prevalence of blindness is 7% in the population aged 50 years and above⁽⁷⁾. Population based data in relation to prevalence of blindness in Sudan is rather deficient. National programme for prevention of blindness estimates that 1.5% of the population is blind. Main causes of blindness, according to NPPB estimates, are cataract, trachoma, glaucoma and other diseases including onchocerciasis responsible for 60%, 18%, 17% and 5%, respectively⁽⁸⁾. Sudan adopted vision 2020 in 2003. Since then cataract surgical rate (CSR), which is the number of cataract surgeries per million populations per year, increased from 560 to 2025 cataract surgeries per year per million populations. SAFE strategy for trachoma is applied in 12 out of 15 northern states of Sudan. The number of ophthalmologists increased from 60 in 2003 to 260 in 2009. There is remarkable variation in CSR between different states. In 2009, reported CSR was 1696 in Gezira state, compared to a CSR exceeding 7000 in Khartoum (the capital city). Likewise, there is marked discrepancy in access to other components of eye care between the center and the peripheries.⁽⁹⁾ Large-scale surveys of blindness are expensive and time consuming. Rapid Assessment of Avoidable Blindness (RAAB) is a rapid survey method. It is rapid because it measures visual impairment only in those over 50 years, who account for over 80% of blindness in the population yet a small proportion of the total population size. RAAB includes detailed data on causes of low vision and blindness besides cataract and has an updated data entry and analysis package. Many countries in Africa conducted RAAB surveys to generate base-line data for planning Vision 2020 activities.^(10 - 13)

The objective of this study is to estimate the prevalence and causes of blindness in Gezira state using RAAB survey methodology.

Materials and Methods:

Sample selection:

When deciding on the sample size it was assumed that population size of adults aged 50 years and older in Gezira state is 310208, prevalence of blindness in people aged 50 years and older is 7%⁽¹⁾, required confidence is 95%, precision is 20%, design effect is 1.5 and non-response rate is 10%. Population data was generated from Sudan national census in 2008 where percentage of population aged 50 years and older was 9.6 %.⁽¹⁴⁾

The required sample size in Gezira state was 2150 individuals. The fieldwork was carried out in December 2010. The clusters were selected with probability-proportionate to size using updated data from the 2008 national census as the sampling frame. Households within clusters were selected through compact segment sampling. Maps of the enumeration area showing major landmarks and the approximate distribution of households were obtained or drawn. Enumeration areas were then divided into 43 segments, each including approximately 50 people aged 50 years and older. The first house in the segment was selected at random by drawing lots. The survey team then visited that house and neighboring houses in that segment, door to door, until 50 people aged 50 years and older were identified. If the target number of 50 people was not reached, another segment was chosen at random and sampling continued. If an eligible household member was

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absent, at least two return visits were made. Information about visual status was ascertained from relatives or neighbors for people who were not available after repeated visits.

Ophthalmic examination

Visual acuity (VA) was measured with a tumbling “E” chart with a Snellen optotype size 6/18 on one side and size 6/60 on the other side at a distance of 6 meters. Pinhole vision was measured if the VA was less than 6/18 in either eye. All measurements were taken in full daylight with available correction, and people were categorized according to presenting visual acuity (PVA) with available correction as follows:

- Blind: PVA 3/60 in the better eye
- Severely visually impaired: PVA < 6/60 to 3/60 in the better eye
- Visually impaired: PVA < 6/18 to 6/60 in the better eye
- Normal vision: PVA 6/18 or better in the better eye

The lens status of all individuals was assessed by specially trained ophthalmic residents and ophthalmic medical assistants using a torch and direct ophthalmoscope in a shaded or dark environment without dilatation of the pupil. All people with presenting VA less than 6/18 were examined by an ophthalmologist using a direct ophthalmoscope or portable slit lamp, as appropriate. The principal cause of blindness or visual impairment was recorded, assigning the major cause to the primary disorder or (if there are two existing primary disorders that contribute equally to the visual impairment) the cause registered was that which is easiest to treat.

Training

All survey teams received structured training. The inter-observer agreement for measurement of VA, lens examination and cause of blindness was assessed between the teams to ensure that it was of an acceptable standard (ie, kappa > 0.60).

Statistical analysis

Special software (RAAB program version 4.02) was used for data entry and automatic standardized data analysis. The prevalence estimates took account of the design effect (DEFF) when estimating the confidence intervals.

Ethical approval

Ethical approval for this work was granted by Sudanese Federal Ministry of Health. All participants gave verbal consent for the examination. All people with operable cataract or other treatable conditions were referred for free treatment.

Results:

The study population consisted of 2150 individuals. Twenty five (1.2%) were not available, and seven (0.3%) refused to be examined and 15 (0.7%) were not capable to be examined, so 2103 (97.8%) were included in the survey. The mean age of those who were examined was 62.9 years, while it was 65.3, 70.1 and 70.0 for those who were unavailable, those who refused and those who were not capable, respectively. The examined sample included 1098 men (52.2%) and 1005 women (47.8%). Table (1) shows age and sex composition of population 50 years and above in Gezira

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state and table (2) shows Age and sex composition of population in the same age groups in the examined sample. There was a slight over-representation of people 65 years old and above with a corresponding slight under-representation in younger age groups in the sample.

There were 197 bilaterally blind people, giving a sample prevalence of blindness of 9.37% (95% CI, ± 1.95) (Table 3). The prevalence of severe visual impairment was 3.9% (95% CI, ± 1.1), and prevalence of visual impairment was 10.79% (95% CI, ± 1.92). The age and gender-adjusted prevalence of blindness was 7.68% (95% ± 1.95); that of severe visual impairment, 3.36% (95% CI, ± 1.1); and that of visual impairment, 9.71% (95% CI, ± 1.92) (Table 4).

Extrapolating survey data to the age and gender distribution of Gezira state, in people aged 50 years and older, there were an estimated 13251 blind men and 10580 blind women, 5670 severely visually impaired men and 4740 severely visually impaired women, and 18356 visually impaired men and 11770 visually impaired women (Table 5). Assuming that 80% of blindness is in people over 50 and then the population prevalence of blindness can be estimated to be 0.8%.

Untreated cataract was the primary cause of bilateral blindness (53.8%) (Table 6). Posterior segment disease (including glaucoma, diabetic retinopathy, and age related macular degeneration [AMD]) accounted for 25.4% of bilateral blindness. Glaucoma was the second cause responsible for 17.8% of bilateral blindness. Corneal scarring and trachoma complications were third, responsible for 11.1%. Surgical complications, uncorrected aphakia and diabetic retinopathy account for 5.1%, 3.0% and 1.5% of bilateral blindness, respectively. Refractive errors caused only 0.5% of bilateral blindness. Avoidable causes—that is, cataract (including un-operated and postoperative complications), refractive error, trachoma, and other causes of corneal scars—were responsible for 74.6% of bilateral blindness.

Table 1: Age and sex composition of population (50 years and above) in Gezira state

Age groups	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
50 - 54 Yrs	48,122	28.2%	42,519	30.5%	90,641	29.2%
55 - 59 Yrs	28,983	17.0%	23,661	16.9%	52,644	17.0%
60 - 64 Yrs	31,534	18.5%	25,689	18.4%	57,223	18.4%
65 - 69 Yrs	18,851	11.1 %	13,961	10.0%	32,812	10.6%
70-74 Yrs	19,023	11.2%	15,396	11.0%	34,419	11.1%
75 - 79 Yrs	9,279	5.4%	6,707	4.8%	15,986	5.2%
80 - 99 Yrs	14,797	8.7%	11,686	8.4%	26,483	8.5%

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Total	170,589	100.0%	139,619	100.0%	310,208	100.0%
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Table 2: Age and sex composition of population (50 years and above) in the examined sample

Age groups	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
50 - 54 Yrs	272	24.8%	312	31.0%	584	27.8%
55 - 59 Yrs	147	13.4%	123	12.2%	270	12.8%
60 - 64 Yrs	154	14.0%	160	15.9%	314	14.9%
65 - 69 Yrs	145	13.2%	117	11.6%	262	12.5%
70-74 Yrs	158	14.4%	121	12.0%	279	13.3%
75 - 79 Yrs	90	8.2%	55	5.5%	145	6.9%
80 - 99 Yrs	132	12.0%	117	11.6%	249	11.8%
Total	1,098	100.0%	1,005	100.0%	2,103	100.0%

Table 3:

Prevalence of blindness, severe visual impairment (CVI), and visual impairment (VI) in the sample (age and sex not adjusted)

	Males			Females			Total		
	n	%	CI95%	n	%	CI95%	n	%	CI95%
Blindness - VA<3/60 in better eye, with available correction									
Bilateral blind	105	9.56	±2.21	92	9.15	±2.20	197	9.37	±1.95
Blind eyes	398	18.12	±2.71	326	16.22	±2.69	724	17.21	±2.45
Severe Visual Impairment (SVI) - VA<6/60 - 3/60 in better eye with available correction									
Bilateral SVI	43	3.92	±1.33	39	3.88	±1.41	82	3.90	±1.10
SVI eyes	100	4.55	±1.04	93	4.63	±1.37	193	4.59	±0.97
Visual Impairment (VI) - VA<6/18 - 6/60 in better eye with available correction									
Bilateral VI	136	12.39	±2.53	91	9.05	±2.32	227	10.79	±1.92
VI eyes	291	13.25	±2.20	209	10.40	±2.03	500	11.89	±1.66

Table 4: Age and sex adjusted prevalence of blindness, severe visual impairment (CVI), and visual impairment (VI) in people 50 year and above in Gezira state

	Males			Females			Total		
		%	CI95%	n	%	CI95%		%	CI95%
Blindness - VA<3/60 in better eye, with available correction									

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Bilateral blind		7.77	±2.21		7.58	±2.20		7.68	±1.95
Blind eyes		15.54	±2.71		14.09	±2.69		14.89	±2.45
Severe Visual Impairment (SVI) - VA<6/60 - 3/60 in better eye with available correction									
Bilateral SVI		3.32	±1.33		3.40	±1.41		3.36	±1.10
SVI eyes		3.90	±1.04		4.17	±1.37		4.02	±0.97
Visual Impairment (VI) - VA<6/18 - 6/60 in better eye with available correction									
Bilateral VI		10.76	±2.53		8.43	±2.32		9.71	±1.92
VI eyes		11.95	±2.20		10.07	±2.03		11.10	±1.66

Table 5: Estimated cases of blinding diseases (in people 50 years and above) in Gezira state

	Male		Female		Total	
	n	%	n	%	n	%
Blindness - VA<3/60 in better eye, with available correction						
Bilateral blind	13,251	7.77	10,580	7.58	23,831	7.68
Blind eyes	53,014	15.54	39,351	14.09	92,365	14.89
VA<6/60 in better eye with available						
Bilateral <6/60	18,921	11.09	15,320	10.97	34,241	11.04
Eyes <6/60	66,312	19.44	50,982	18.26	117,294	18.91
VA<6/18 in better eye with available						
Bilateral <6/18	37,278	21.85	27,090	19.40	64,368	20.75
Eyes <6/18	107,083	31.39	79,094	28.33	186,177	30.01

Table 6: Principal causes of blindness in persons: VA<3/60 in better eye with available correction

	Male		Female		n	%
	n	%	n	%		
Refractive error	1	1.0	0	0	1	0.5%
Cataract, untreated	46	43.8	60	6	106	53.8%
Aphakia, uncorrected	3	2.9	3	3	6	3.0%
Total curable	50	47.6	63	6	113	57.4%
Surgical complications	7	6.7	3	3	10	5.1%
Trachoma	1	1.0	2	2	3	1.5%
Phthysis	1	1.0	1	1	2	1.0%
Other corneal scar	14	13.3	5	5	19	9.6%
Onchocerciasis	0	0.0	0	0	0	0.0%
Total preventable	23	21.9	11	1	34	17.3%
Total avoidable	73	69.5		8	147	74.6%
Glaucoma	24	22.9	11	1	35	17.8%
Diabetic retinopathy	1	1.0	2	2	3	1.5%
Potentially preventable	25	23.8	13		38	19.3%
Globe abnormality	1	1.0	0	0	1	0.5%
ARMED	0	0.0	3	3	3	1.5%

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Other post segment / CNS	6	5.7	2	2	8	4.1%
Total posterior segment	32	30.5	18	1	50	25.4%
	105	100.	92	1	197	100.0%
* Because an accurate diagnosis of glaucoma and diabetic retinopathy can be difficult with the limited facilities used in a Rapid Assessment, these potentially or partially preventable causes are listed separately.						

Discussion:**Prevalence of Visual Loss**

The age and gender-adjusted prevalence of blindness (VA<3/60 with available correction) in Gezira state is 7.68% (95% \pm 1.95); that of severe visual impairment, 3.36% (95% CI, \pm 1.1); and that of visual impairment, 9.71% (95% CI, \pm 1.92) in people aged 50years and older. These were similar in men and women. The prevalence of blindness was assessed only in those 50 or older; however, the prevalence is low in those under 50. The prevalence of blindness in Gezira state is slightly higher than expected by WHO for Sudan. Estimates of blindness for WHO-EMR region suggest that 7% people aged 50years and older are blind ⁽¹⁾. The prevalence estimate in Gezira state is higher than most of African countries where RAAB surveys were conducted ⁽¹¹⁾, ⁽¹²⁾, ⁽¹³⁾. Other RAAB surveys in other states of Sudan showed prevalence of blindness to be 4.90% in Northern state, 7.38% in Sinnar, 8.77% in North Kordofan and 14.00% in Kassala ⁽⁹⁾. Extrapolating for total population of Gezira state, prevalence of blindness in all ages is estimated to be 0.7%. That is far lower than the previous national estimate in 2003 of 1.5% prevalence of blindness in Sudan ⁽⁸⁾. That reduction in prevalence of blindness may be attributed to increase in cataract surgical services in Gezira state in the previous years.

Causes of Visual Loss

Cataract was the major cause of blindness (53.8%). This is similar to the other reported studies from Sudan ⁽⁹⁾ and the current global estimate ⁽¹⁾. Altogether, nearly 75% of all blindness was attributed to definitely avoidable causes— again, similar to the global estimates. This does not include cases of glaucoma and diabetic retinopathy, which are potentially avoidable and classed as diseases of the posterior segment. The RAAB survey was designed to be rapid and field based to diagnose avoidable causes of blindness, so the ability to diagnose posterior segment causes of blindness accurately was low. The diagnosis of refractive error depended on the accuracy of measurement of VA and did not allow differentiation between types of refractive errors.

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