

Original Article

# Adults visual impairment and blindness – An overview of prevalence and causes in Saudi Arabia



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## Abstract

**Background:** A major socio-economic development in Saudi Arabia affected the pattern and causes of visual impairment for the past 40 years. Moreover, an up-to-date summary of available data is vital for planning, monitoring, and evaluating national blindness prevention program.

**Aim:** This study conducted to provide a summary overview of prevalence, causes, and changes in the pattern of blindness and visual impairment for the past 40 years among Saudi adults, with brief discussion of the related socio-economic and ecological factors.

**Methods:** The review was confined to the published epidemiological studies performed in Saudi Arabia covering the age group 18 year and older from 1985 onwards.

**Results:** Six epidemiological studies were included from 1985 onwards. In 1986, the prevalence of blindness and visual impairment in Saudi Arabia were 1.5% and 7.8%, respectively which is 20 times the magnitude of blindness in the United States. Multiple regional population based studies conducted later in areas with disparate ecological and socio-economical determinants at different time intervals showed variable prevalence of blindness 3.3% Eastern Province 1986, 0.7% Bisha 1993. Recently, in older than 50 year population the reported prevalence was 2.6% Taif 2012 and 5.7% Jazan 2015 and 6.4% in Ahsa. Since 1986, the single leading cause of adult blindness in Saudi Arabia is cataract. Although, Trachoma reported to be the second primary cause of blindness on 1986, its burden is reduced in Jizan (2015) and minimal in Taif (2012) which is replaced by chronic diseases related etiologies i.e Diabetic Retinopathy.

**Conclusion:** Ecological and socio-economical determinants play critical role in the magnitude and causes of blindness and visual impairment in Saudi Arabia. Significant data gaps obscure monitoring and evaluation of the eye health. Eye health indicators should be integrated into the national health information system for dynamic monitoring and evaluation.

**Keywords:** Blindness, Cataract, Low vision, Prevalence, Saudi Arabia, Visual impairment, Adults

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<https://doi.org/10.1016/j.sjopt.2019.10.001>

## Introduction

Saudi Arabia has experienced a dramatic socio-economic development and improved eye healthcare services being a vast country with various topographic and environmental factors.

Blindness and poor vision remain a growing health challenge in most Eastern Mediterranean Region (EMR) countries including Saudi Arabia.<sup>1</sup> Three decades ago, the reported

prevalence of blindness in Saudi Arabia was 10–20 times higher than United States and Europe.<sup>2</sup> In 2010, WHO estimated that Africa and EMR had 15% and 12.6% of world total blindness, respectively.<sup>3</sup> In 2015, WHO estimated that around 36.0 million people were blind and around 216 million people had moderate to severe vision impairment MSVI, almost 60% were women. Respectively, among adults ( $\geq 50$  years). The reported age-standardized prevalence of blindness and MSVI ranged between 4% – 5.7% and 11.8%

Received 1 August 2018; received in revised form 27 July 2019; accepted 7 October 2019; available online 7 November 2019.

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Peer review under responsibility of Saudi Ophthalmological Society, King Saud University



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to 23.7% in Africa, South Asia and EMR, compared to  $\leq 0.4\%$  and  $\leq 5\%$  in the high-income regions.<sup>4-6</sup> Globally, researchers noticed a substantial increase in the number of affected blind people from 30.6 million in 1990 to 36.0 million in 2015, which was explained by the natural growth and ageing of the world's population.<sup>6</sup>

Right to Sight is a global project, launched by WHO in 1999. The project aims to reduce the expected doubling of blind cases in the world by the year 2020 as a result of decline in both mortality and fertility rates with a rapid aging of populations in most countries.<sup>7</sup> Recently, reports showed strong association between Socioeconomics and prevalence and causes of visual impairment and blindness which become of great interest to ophthalmologist and public eye health planners.<sup>8</sup> This study conducted to provide a summary overview of prevalence, causes, and changes in the pattern of blindness and visual impairment for the past 40 years among Saudi adults, with brief discussion of the related socio-economic and ecological factors.

## Methodology

A literature search has been carried out at a broad spectrum from different libraries and scholarly platforms including; Medline, ERIC, PubMed, and Google Scholar to retrieve quality studies. The published literature was searched using the following key words; Blindness, Cataract, Low Vision, Prevalence, Saudi Arabia, Visual Impairment.

The selection and validation of studies was conducted by two independent researchers applying the inclusion and exclusion criteria. Discussion and agreement between the researchers in each stage of the study procedure was insured.

This review included the published population based studies in Saudi Arabia and the official reports from the Prevention of Blindness Union and the National Committee for the Prevention of Blindness. Studies were evaluated and appraised according to the criteria of World Health Organization (WHO) And The International Classification of Diseases 11 (2018). According to these criteria, blindness is defined as presenting distance visual acuity worse than 3/60 (20/400, 0.05) in the better eye with best possible correction, or a visual field of the better eye no greater than 10° in radius around central fixation. Distance vision impairment is categorized into: Mild or no VI (category 0) for visual acuity (VA)  $\geq 6/18$ , moderate VI (category 1) for VA  $\leq 6/18$  to  $\geq 6/60$  and severe VI (category 2) for VA  $\leq 6/60$  to  $\geq 3/60$  and blindness (category 3, 4 and 5) for VA  $< 3/60$  to no light perception. The researchers excluded studies on childhood blindness, as well as, hospital based studies from the final analysis.

The procedure followed in conducting this study involves a set of statistical techniques that are used for reviewing independent studies concerned with a specific area of research which include five phases as follow:

- Identifying relevant studies
- Determining the inclusion and exclusion criteria
- Coding
- Extraction of data and calculations
- Data analysis

The abstracts showing visual impairment and blindness among the adults were promoted. The first phase has resulted in 21,500 reports globally. 4700 reports on pediatric VI and blindness were excluded. The remaining articles (16,800) were endorsed for the second phase of scrutiny. The second phase has resulted in exclusion of 16,560 were unpublished reports, personal views and/or institutional reports. The remaining 240 global published articles were endorsed for the third phase of scrutiny. The third phase has resulted in exclusion of 159 studies were hospital based, outcome studies and/or not using the WHO definition for VI and blindness. The remaining 81 population based published articles were endorsed for the fourth phase of scrutiny. The fourth phase has resulted in exclusion of 43 studies on the basis of their ecological and /or socio-economical factors.

Finally, 38 articles were finalized, which were used for systematic review analysis.

## Results

Six community based studies on the prevalence and causes of blindness (VA  $< 3/60$ ) and moderate or severe visual impairment MSVI (VA  $< 6/18$  -  $\geq 3/60$ ) among adults in Saudi Arabia during the past 40 years. Single nationwide survey on 1986 that includes all ages, two regional community based all age studies on 1990, 1993 while others, were Rapid Assessment for Avoidable Blindness and Diabetic Retinopathy (RAAB + DR) that includes 50 year and above.

The nationwide survey (1986) reported age-standardized prevalence of blindness and visual impairment as 1.5% and 7.8% respectively of the total population. More recently, multiple regional Age-standardized prevalence of blindness were variable from region to another within Saudi Arabia, 3.3% in Jizan (south western) region and 2.0% in Taif (western) region using the standardized Rapid Assessment for Avoidable Blindness and Diabetic Retinopathy (RAAB + DR). Al Ahsa (Eastern) region reported the highest age-standardized prevalence of blindness 6.2% while, Bisha (south western) reported the lowest prevalence of blindness (Table 1). Females tend to suffer a higher prevalence of blindness than males. There was a significant variability in the reported prevalence of blindness and visual impairment from region to region within Saudi Arabia (Table 1). The prevalence rate of blindness and visual impairment were higher in people  $> 50$  years in Saudi Arabia. Three decades ago, Over 20% of the Saudi population older than age 60 year, are blind and 66.2% were visually impaired.

Cataract remained the single leading cause of blindness in Saudi Arabia in 1986 till 2015. However, the proportion of blindness attributable to cataract in Saudi Arabia was almost double that reported in the high income countries. Cataract surgery related complication contributes to significant percentage of blindness reaching up to 15.9% in Bisha region 1993 which had been improved to 1.3% in Taif 2012. The top prevalence of blindness by the cause in Saudi Arabia from 1986 to 2015 compared to the Middle East countries are presented in (Table 2). In 1986, cataract (52.8%) was the most frequent Cause of blindness, followed by trachoma (10.5%), nontrachomatous corneal scars (8.8%), uncorrected refractive errors (8.8%), failure of medical or surgical treatment (4.4%), and glaucoma (3.5%). However, the regional

**Table 1.** Prevalence of blindness and visual impairment in Saudi Arabia 1986–2015.

Parameters	National survey <sup>2</sup>	Eastern province <sup>1</sup>	South Western (Bisha) <sup>22</sup>	TAIF region* <sup>18</sup>	JIZAN region* <sup>19</sup>	AHSA region* [npbc]
Year Published	1986	1990	1993	2012	2015	unpublished
Age Group	0–>60		0–>60	50 and Above	50 and Above	50 and Above
Sample size	14,577	–	2882	3052	3659	2842
Response rate (%)	90	–	97.3%	92.5	96.3	94.7
Prevalence of blindness % (Age and sex adjusted)	1.5	–	0.7	2.0	3.3	6.2
Prevalence of blindness % (sample)	1.5	1.5	0.7	2.6	5.7	6.4
Prevalence of blindness % (adults >60 y)	20	–	9.3	2.6	5.7	6.4
Prevalence of Severe Visual Impairment % (Age and sex adjusted)£	–	–	–	1.5	2.3	3.8
Prevalence of Severe Visual Impairment % (sample)	7.8 β	–	10.9 β	1.7	2.7	4.3
Prevalence of moderate Visual Impairment % (sample)	7.8 β	–	10.9 β	7.5	22.7	–

£ Adjustment according to RAAB + DR Methodology.  
 β Includes both sever and moderate visual impairment.  
 npbc: National Prevention of Blindness Saudi Arabia.  
 \* Standard RAAB + DR Methodology.

**Table 2.** Percentage of total blindness by cause for all ages in Saudi Arabia and the Middle East countries (all ages).

Region	All age prevalence of blindness	Cataract	AMD €	Glaucoma	Uncorrected refractive error	Diabetic retinopathy	Corneal disease	Trachoma
Saudi Arabia 1985–2015 <small>1,2,18,19,22</small>	0.7–6.2£	41.0–58.6	0.6–8.9	3.5–16.5	0.9–5.3	1.3–10.0	1.9–9.5	0.5–10.5
Oman 2002 <sup>16</sup>	1.1	30.50	2.9	11.5	1.5–6	0.8	31.6 β	–
Qatar 2009 <sup>13,14</sup>	1.28	18	3	39	–	3	21 Trachoma endemic belt	–
Jordan 2015 <sup>31</sup>	1.33	46.7	–	8.9	–	33.2	–	–
Palestinian Territories <sup>13,14</sup>	3.4–4.9	55	–	5.8	–	8.3	14.2	1.71–13.4
Yemen 2010 <sup>13,14</sup>	7.9–8.6	71.4	14.3	11.4–13.4	–	0.00	9.8	–
	In >50 y							
	In >50 y							

€ (AMD) Age-related macular degeneration.  
 β: include both Trachomatus and non-Trachomatus corneal scar.  
 £: the presented ranges indicate the lowest and highest reported prevalence.

ranking of the top causes of blindness were variable from region to another within the country. In the late 80 s, Diabetic retinopathy was not listed as a cause of blindness; however in 2012, the burden of Diabetic retinopathy has a 3rd rank, after cataract and glaucoma, in a semi-urban community in Saudi Arabia. Trachoma take a major part as a 2nd rank of blindness etiology in the late 80 s while, it was almost none existent in semi-urban community in 2012. In rural communities, Jizan and Ahsa, Trachoma had significant contribution to blindness and visual impairment in 2015. Ranking and proportion of the top causes of blindness (VA < 3/60) in Saudi Arabia 1986–2015 compared to high-income countries and in Eastern and Central Europe and world burden are presented in (Table 3).

The Crude and age-standardized prevalence of blindness and MSVI in semi-urban community of Taif region, Saudi Arabia, are almost 10X higher than that reported in high-income countries and in Eastern and Central Europe(all ages) presented in (Table 4).

The top causes of MSVI (VA <6/18–≥3/60) in Saudi Arabia from 1986 to 2015 are presented in (Table 5). Constantly, uncorrected refractive error was the most frequent etiology of MSVI followed by cataract over the past 40 years.

Diabetes Mellitus (DM) is the most prevalent endocrine disorder in Saudi Arabia affecting almost 30% of Saudi adults. The national DM survey 2014 showed The prevalence of DM in the age groups 30–44 years was 14.7%, 45–64 years was 37.5%, and >65 years was 44.7%. However, the overall mean of these three age groups was 32.8%. Furthermore, there is dramatic increase of the prevalence of DM in Saudi population over the past 4 decades, 5.3% in 1992, 9.3% in 2010, 10% in 1999, 25% in 2004 and 30% in 2009 (Fig. 1). RAAB + DR reported prevalence of diabetes 29.7% in 2012 (Taif), 43% 2015 (Jizan) and 22.4% in 2016 (Ahsa) (among adults ≥ 50).

The prevalence of Diabetic Retinopathy in different regions of Saudi Arabia among diabetic population above 50 ranged between 28.1%–45.7% compared to 28.5% (95% confidence interval, 24.9%–32.5%) among US adults above 40. While the prevalence of sight threatening diabetic retinopathy among Saudi adults was 4.5%–17.5% compared to 4.4% (95% confidence interval, 3.5%–5.7%) among US diabetic adults (Table 6).

According to the hospital based studies conducted in Saudi Arabia cataract was the most prevalent cause of blindness and visual impairment followed by Diabetic Retinopathy

**Table 3.** Ranking and proportion of the top causes of blindness (VA < 3/60) in Saudi Arabia 1986–2015 compared to high-income countries and in Eastern and Central Europe and world burden.

Region	1st Rank	2nd Rank	3rd Rank	4th Rank	5th Rank	6th Rank	7th Rank
Nationwide 1986 All ages <sup>2</sup>	Cataract 52.8%	Trachoma 10.5%	Corneal scar 8.8%	URE 8.8%	Congenital anomalies 5.1%	Surgical complications 4.4	Glaucoma 3.5%
Bisha 1993 All ages <sup>22</sup>	Cataract 52.6%	Surgical complications 21%	Phthisis bulbi 10.5%	Glaucoma 5.3%	Retinal dystrophy 5.3%	URE 5.3%	–
Taif 2012 >50 year old <sup>18</sup> €	Cataract 41%	Glaucoma 16.5%	DR 10%	ARMD 8.9%	Corneal scar 6.3%	Aphakia 3.0%	Phthisis bulbi 3.0%
Jizan 2015 >50 year old <sup>19</sup> €	Cataract 58.9%	Corneal scar 9.5%	Glaucoma 5.2%	Surgical complications 3.8%	DR 3.3%	ARMD 3.3%	Trachoma 0.5%
Ahsa 2015 >50 year old unpublished €	Cataract 43.1%	Corneal scar 9.4%	Phthisis bulbi 10.5%	Trachoma 6.1%	DR 5.5%	Surgical complications 5.5%	Glaucoma 5.0%
High-income countries and in Eastern and Central Europe All ages <sup>5</sup>	Cataract 19.7–25.4	AMD 15.4–19.5	Glaucoma 13.5–14.3	URE 13.0–13.1	DR 3.1–4.9	Corneal disease 2.4–3.6	Trachoma 0.00–0.00
World blindness burden All ages <sup>5</sup>	Cataract 26.4–44.03	URE 18.23–22.24	Glaucoma 2.99–15.66	AMD 1.46–12.18	Corneal disease 0.50–7.19	DR 0.15–2.38	Trachoma 0.80–1.15

(URE) uncorrected refractive error (DR) Diabetic retinopathy, (ARMD) Age related macular degeneration.  
 €: The causes for individuals above 50 years of age.

**Table 4.** Crude and age-standardized prevalence (%) of blindness and MSVI in 2015 in high-income countries and in Eastern and Central Europe (all ages); 80% uncertainty intervals are given in brackets compared to Taif region in 2012 (semi-urban community).

	Blindness	MSVI	Presbyopia
Crude prevalence			
Eastern and Central Europe All ages <sup>5</sup>	0.32 (0.13–0.55)	2.42 (1.08–4.08)	18.94 (5.59–35.22)
Taif region >50 year <sup>18</sup>	2.6 (2.0–3.2) 95% CI	9.50 (7.80–10.70) 95% CI	Not reported
Age-standardized prevalence			
Eastern and Central Europe <sup>5</sup>	0.15 (0.06–0.26)	1.27 (0.55–2.17)	18.58 (5.47–34.60)
Taif region <sup>18</sup>	2.0	9.0	Not reported

**Table 5.** Ranking and proportion of the top causes of moderate and severe visual impairment MSVI (VA <6/18–≥3/60) in Saudi Arabia 1986–2015.

Region	1st Rank	2nd Rank	3rd Rank	4th Rank	5th Rank	6th Rank	7th Rank	8th Rank
Nationwide 1986 <sup>2</sup>	URE 9.3%	Cataract 4.3%	Glaucoma 2.0%	Corneal scar 0.8%	Amblyopia 0.8%	Trauma 0.7%	DR ∞ 0.33%	Surgical complications 0.33%
Bisha 1993 <sup>22</sup> €	URE 67.9%	Cataract 20.6%	Corneal scar 1.9%	Trachoma 1.9%	DR 1.3%	Amblyopia 1.3%	Glaucoma 1.0%	Retinal degeneration 0.6%
Taif 2012 <sup>18</sup> €	URE 48%	Cataract 80%	DR 23%	Surgical complications 18%	Retinal degeneration 16.5%	Corneal scar 9%	Glaucoma 1.3%	Trachoma 0.4%
Jizan 2015 <sup>19</sup> €	URE 34%	Cataract 50.9%	Trachoma 10%	Corneal scar 9.5%	Retinal degeneration 5.2%	Optic atrophy 4.6%	DR 4.25%	Glaucoma 3.8%

(URE) uncorrected refractive error (DR) Diabetic retinopathy, (ARMD) Age related macular degeneration.  
 ∞ includes DR, pigmentary degeneration and other noncongenital retinal disease.  
 €: The causes for individuals above 50 years of age.

and glaucoma (Tables 7 and 8). Notably, advanced Diabetic Retinopathy and glaucoma reported to be the two major causes of irreversible blindness in Baha 2016.

**Discussion**

Saudi Arabia is divided into 13hugeregions. Each region further subdivided into governorates. Regions within Saudi Arabia are extremely diverse in the ecological and socio-

economical determinants. Furthermore, the population within regions may range from well educated, rich individuals who have accessible state of the art eye care, to stricken members, with low education, poor awareness, little or no access to reasonable eye care. Over the past four decades major socio-economic development, progressive urbanization and ageing of the populations have occurred in Saudi Arabia accompanied by lifestyle shift to more sedentary life with higher-fat diets and obesity.

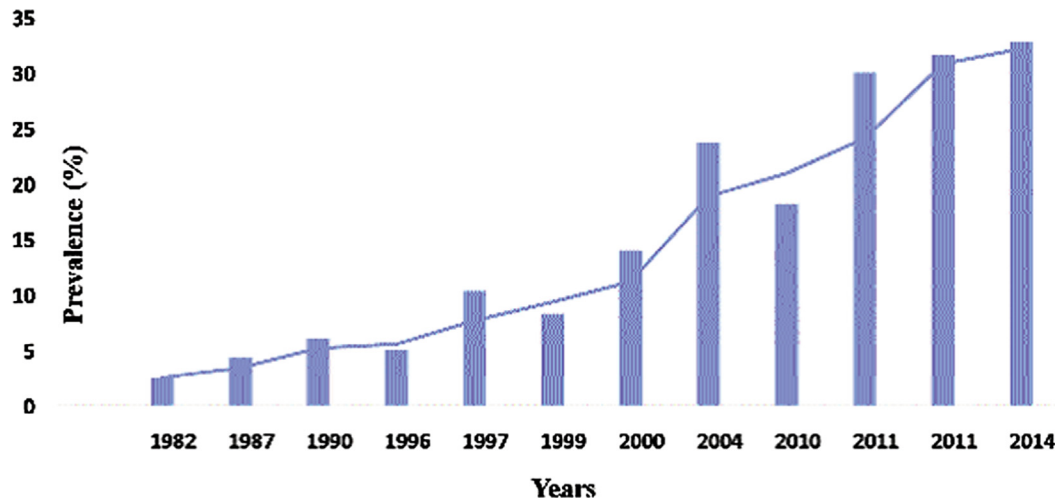


Fig. 1. Prevalence of type 2 diabetes mellitus in Saudi Arabia from 1982 to 2014. (Courtesy of Sultan AyoubMeo, Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia.

Table 6. Prevalence of Diabetic Retinopathy in Saudi Arabia percentages (%)\*

Parameters	TAIF region* <sup>18</sup>	JIZAN region* <sup>19</sup>	AHSA region* €
Year Published	2012	2015	unpublished
Prevalence of Diabetes Mellitus %	29.7	22.4	43
Prevalence of Diabetic Retinopathy among Diabetics %	36.8	28.1	45.7
Prevalence of Diabetic Maculopathy among Diabetics %	20.3	13.1	17.1
Prevalence of Sight Threatening Diabetic Retinopathy among Diabetics %	17.5	5.7	4.5

€: Courtesy of Prevention of Blindness Union <http://www.pbunion.org/blinddata.html>.  
\* Standard RAAB + DR Methodology.

There are old (80 s and 90 s) and another recent published population based data from Saudi Arabia on blindness and visual impairment that described the changing pattern and burden of blindness. This Study provide a summary overview of prevalence, causes, and changes in the pattern of blindness and visual impairment for the past 40 years among Saudi adults, with brief discussion of the related socio-economic

and ecological factors. Although, significant population based data have been collected, there were substantial time gaps that mandates carefulness during the interpretation and monitoring of eye care services in Saudi Arabia.

Saudi Arabia government invested huge budget on the establishment of modern ophthalmic care for all Saudi citizens that was initiated in November 23, 1983 by King Khalid Eye Specialist Hospital (KKESSH) establishment. Furthermore, there are another two eye specialized hospitals providing tertiary eye care in Saudi Arabia. As well as, in each region of Saudi Arabia there is at least a well-equipped ophthalmology department that provides primary and secondary eye care. The rapidly growing eye care facilities have a positive impact on the prevalence of blindness in Saudi Arabia.<sup>9</sup>

In 1984, the first- all ages- national survey showed a prevalence of blindness and visual impairment of 1.5% and 7.8% among Saudi citizens respectively. Surprisingly, the prevalence of blindness among the high risk group (adult >60 years) was 21% which was 20-folds more than the reported prevalence in the United States for the same age group.<sup>10</sup>

The Global Initiative VISION 2020, launched in 1999 aimed to eliminate the Avoidable Blindness by the year 2020. Experts anticipate a worldwide doubling of the burden of visual impairment by 2020. Poverty and old age (>50 year) considered as important risk factors for visual impairment.

Table 7. Prevalence of the major causes of blindness in Saudi Arabia 1986–2015 As reported by the hospital based studies.

Parameters	Bisha (South Western) Asir Desert <sup>38</sup>	Aljof province α <sup>37</sup>	Al Baha (irreversible causes of blindness) <sup>35</sup>	Arar (Northern Border) <sup>36</sup>
Year published	1993	2011	2016	2017
Cataract	46.3	29.1		50
Refractive errors	1.6	36 π		
Diabetic retinopathy	–	20.9	41	16.7
Trachoma	2.4			
Other corneal scar	14.6			8.3
Glaucoma	11.8	5.8	20	16.7
Retinal dystrophy	0.4		4	
Congenital anomalies			16	

π including individuals with visual impairment as well.

α prevalence includes blindness and visual impairment.

**Table 8.** Prevalence of the major causes of visual impairment in Saudi Arabia 1986–2015 As reported by the hospital based studies.

Parameters	Bisha (South Western) Asir Desert <sup>38</sup>	Aljouf province <sup>37</sup>	Arar (Northern Border) <sup>36</sup>
Year published	1993	2011	2017
Cataract	54.5	29.1	59.4
Diabetic retinopathy		20.9	25.8
Other corneal scar	8.6		
Optic atrophy		8.1	
Glaucoma	6.3	5.8	10.2
Age related macular degeneration	–	–	–
Trachoma	7.2		
Uncorrected Aphakia			7.8
Refractive errors	13	36	42.3
Keratoconus	2.1		7.7

From 1990 – 2002, worldwide population has increased by 18.5% and individuals 50 years of age and older has increased by 30%. Notably, developing countries experienced more population growth and ageing. Globally in 2010, around 82% of blind or visually impaired individuals were older than 50 years of age caused by cataract and refractive errors. In 2015, WHO estimated 36 million blind individuals compared to 30.6 million blind in 1990. These facts mandate expanding the preventive and therapeutic efforts to face the huge increase in the number of affected individuals due to the natural growth and ageing of populations.<sup>11,12</sup>

Our study shows a 68%–87% reduction in the prevalence of blindness in Saudi Arabia from 1986 to 2015 in the population older than 50 years. The reported prevalence of blindness in the population older than 50 years was 20% in 1986 versus 2.6% in Taif (western) region (2012), 5.7% in Jizan (south western) region (2015) and 6.4% in Ahsa (eastern) region (2015). Similar findings reported in North Africa and the Middle East (NAME) for the period 1990–2010, Which showed 43% decrease in the prevalence of blindness (7.0% versus 4.0%) as well as a 34% decrease in the prevalence of MSVI (23.1% versus 15.3%) for the same age group. Worldwide, a descending trend observed in the prevalence of blindness 34% (2.9% versus 1.9%) as well as a 27% decrease in the prevalence of MSVI (14.2% versus 10.4%) for the same age group.<sup>13</sup> In 2015, a further reduction of 8% in the prevalence of blindness reported in NAME countries as it was the case worldwide.<sup>14</sup>

The prevalence of blindness and MSVI were significantly higher among women than men in Saudi Arabia from 1986 to 2015 as it was in other NAME countries and worldwide. In 1986, Saudi Arabian women had twice the prevalence of trachomatous corneal scarring more than males as it was also reported in Oman 2005.<sup>2,15</sup> Furthermore, Saudi women tend to develop senile cataract earlier than males with greater severity. In Oman eye study (2005) women had lower cataract surgical coverage than men.<sup>2,17</sup> Globally, there is a pattern of gender imbalance in eye care with higher prevalence of blindness and MSVI among females in all age groups.<sup>14,15</sup> This difference in gender may be explained by elderly women literacy and inadequate awareness about the need and availability of surgery and often limited approach to family finan-

cial resources to secure access to eye care compared to men. Local strategies need to be addressed to improve the gender equity in eye care services.

Cataract was the 1st ranked cause of blindness and the 2nd ranked cause of MSVI in Saudi Arabia from 1986 to 2015. There was a significant reduction (20%) of the burden of cataract from 1986 (52.8%) to (41%) Taif 2012.<sup>18</sup> Proportions of blindness and MSVI from cataract showed large differences between regions within Saudi Arabia 41% in Taif versus 58.9% in Jizan as it was reported in other NAME countries.<sup>13,14,19</sup> Furthermore, the cataract surgical rate (operations/million/year) was Variable between regions in Saudi Arabia as it was reported in other NAME countries.<sup>13,14,17</sup> Despite the progress in cataract surgery rate, surgical techniques and a lower rate of complications, iatrogenic etiology related to cataract surgery remain a significant contributor to the prevalence of blindness in Saudi Arabia (3.8%–5.5%).<sup>18,19</sup> Genetics and the geographical location of Saudi Arabia with ultraviolet radiation exposure may play a role in the early presentation and high prevalence of cataract in Saudi Arabia as the situation in most NAME countries.<sup>2,13</sup> Recent reports showed a significant correlation between socio-demographic index (SDI) and the reduction in the age-standardized prevalence of blindness and in the rate of years lived with disability (YLDs) from vision loss due to cataract in (EMR) as was reported globally.<sup>21</sup> Focused efforts to improve promotion, availability and affordability of cataract surgery in Saudi Arabia are needed to tackle the increasing burden of cataract.

Uncorrected refractive errors (URE) were the fist-ranked cause of MSVI followed by cataract in Saudi Arabia from 1986 to 2015.<sup>2,18,19,22</sup> A similar observation reported regionally and globally.<sup>13,14,20</sup> Amblyopia was ranked as a significant cause of MSVI in Saudi Arabia. URE had a considerable impact on the socioeconomic status and could limit the educational and employment opportunities [23]. Targeting URE by implementing a mandatory national pediatric screening program that is linked to the national identification registration system could cure a large amount of vision loss.<sup>24</sup>

Trachoma was the leading cause of infectious blindness in Saudi Arabia and worldwide.<sup>25,26,27</sup> In 1997, the WHO launched the Agreement for Global Elimination of Trachoma (GET) by the year 2020.<sup>13</sup> In 1984, Saudi Arabia considered as a hyper endemic area with prevalence rate of trachoma (active and inactive) 22.2%, one third of them had moderate to severe infection and at least there was one family member suffer from active trachoma in 45% of the affected families. Trachoma was the second ranked cause of blindness in Saudi Arabia in 1986, women over the age of 60 had 50% greater risk of sever lid and corneal scaring than men. A reduction of 52% in the prevalence of Trachoma and 58% in the prevalence of the active trachoma among Saudi citizens reported from 1984 to 1994. The pattern and magnitude of trachoma vary strongly from region to region within Saudi Arabia with minimal prevalence in the southwest region and highest prevalence in the eastern region for same period. Recently, this regional variation was reported with trachoma almost none exist in Taif region (2012) versus being the third major cause of blindness in Jizan (2015) among the population over 50 years. Both ecological and socio-economic factors play a major role in the transmission and prevention of trachoma.

Recently, Saudi Arabia has experienced major socio-economic developments that positively support the national plan for the elimination of trachoma in Saudi Arabia by 2019.<sup>13</sup>

In contrast, the proportion of blindness and MSVI due to diabetic retinopathy (DR) is rapidly growing from 1986 to 2015 which becoming a serious health problem in Saudi Arabia as it was reported in other NAME countries and globally.<sup>28,29,30,31,32</sup> The reported prevalence of DR among diabetics in Saudi Arabia is close to the global estimate (36% versus 34.6%) respectively.<sup>33</sup> The proportion of Sight Threatening Diabetic Retinopathy(ST-DR) is variable within Saudi Arabia were the sea level regions had the lowest prevalence Jizan (5.7%) and Ahsa (4.5%) compared to (4.4%, 95%-confidence interval, 3.5%–5.7%) among US diabetic adults. Whereas, the Saudi high altitude region, Taif region reported much higher prevalence of ST-DR (17.5%) which is very close to Irbid, Jordan (14.4%), both regions share almost similar ecological and socio-economic factors.<sup>18,31</sup> An organized public health approach must be adopted to control the growing burden of visual disabilities due to DR.<sup>34</sup>

Furthermore, the proportion of blindness due to glaucoma is increasing in Saudi Arabia as it was reported in the other NAME countries.<sup>13</sup> Genetics, ageing of the population and the implementation of new diagnostic tools improve our ability to secure early diagnosis of glaucoma cases that used to be underestimated.<sup>1,2</sup> Glaucoma was the second ranked cause of irreversible vision loss after diabetic retinopathy in a hospital based study in Saudi Arabia.<sup>35</sup> Effective screening program and early detection is mandatory to reduce the permanent visual loss caused by late diagnosis of glaucoma.

Our study has some limitations including the huge data gap for a significant period of time that makes the monitoring and evaluation very difficult. The included studies in this study used different research methodologies, unequal age groups and regions with diverse ecological factors.

## Conclusion

Ecological and socio-economical determinants play critical role in the magnitude and causes of blindness and visual impairment in Saudi Arabia. Significant data gaps obscure monitoring and evaluation of the eye health. Eye health indicators should be integrated into the national health information system for dynamic monitoring and evaluation.

## Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

## Funding

This research is not funded by any resource

## Declaration of Competing Interest

The authors declared that there is no conflict of interest.

## Acknowledgements

The author is very thankful to all the associated personnel in any reference that contributed in/for the purpose of this research.

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