

Prevalence and causes of avoidable blindness and visual impairment, including the prevalence of diabetic retinopathy in Siwan district of Bihar, India: A population-based survey

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Purpose: The aim of this study was to estimate the prevalence and causes of visual impairment (VI) and blindness and diabetic retinopathy (DR) in Siwan district, Bihar. **Methods:** A population-based cross-sectional study was done from January to March 2016 using the Rapid Assessment of Avoidable Blindness 6 (RAAB 6, incorporating DR module) methodology. All individuals aged ≥ 50 years were examined in 57 randomly selected clusters within the district. **Results:** A total of 3476 individuals were enumerated and 3189 (92%) completed examination. The overall prevalence of blindness and severe VI was 2.2% (95% confidence interval (CI): 1.6–2.8) and 3.4% (95% CI: 2.6–4.3), respectively. Untreated cataract was the leading cause of blindness (73%) and severe VI (93%). The cataract surgical coverage (CSC) at $< 3/60$ was 71.5% for eyes and 89.3% for persons in this sample and the CSC was similar between the genders. Refractive error (71%) was the primary cause of early VI. The overall prevalence of known and newly diagnosed diabetes was 6.3% (95% CI, 5.4–7.2%). Prevalence of any DR, maculopathy, and sight-threatening DR was 15, 12.4, and 6%, respectively. **Conclusion:** To conclude, as compared to previous reports, the prevalence of blindness and DR in Siwan district of Bihar was found to be lower and the CSC was higher. However, the problem of avoidable blindness remains a major problem in this region.

Key words: Avoidable blindness, cataract surgical coverage, diabetic retinopathy, visual impairment, RAAB 6

Globally, 253 million people are visually impaired, of which 36 million are blind and 90% of the burden of blindness affects persons in low and middle-income countries, including India.^[1] More than 86% of the blindness is among persons aged 50 years and above and 80% of this blindness is avoidable.^[1]

There are many global, regional, and national initiatives that led to a decline in the overall prevalence of blindness. With India being the first country in the world to initiate a national program for control of blindness, a reduction in the prevalence of blindness from 1.49% in 1989^[2] to 1% (2006–2007 RAAB)^[3] has been observed in the country.

Although there is a decline in the overall prevalence of blindness in India, blindness and visual impairment (VI) continues to be a major public health problem and there are significant disparities in the prevalence and its causes across different regions in the country.^[4] Despite availability of cost-effective interventions to eliminate blindness caused by cataract, cataract still remains the leading cause of blindness.

In addition, currently India is emerging as the diabetic capital of the world and the number of people with diabetes is estimated

to be around 79.4 million by the year 2030.^[5] Approximately 34.6% of persons with diabetes will develop any diabetic retinopathy (DR) and 10.2% will develop vision-threatening DR.^[6] This has led to DR being identified as an emerging cause of blindness, which requires early identification and regular treatment to prevent irreversible blindness.^[7] Hence DR has been considered as one of the priority conditions to be included in VISION 2020 national plans.

One of the key objectives of the Global Action Plan 2014–2019 (World Health Organization (WHO) and member states) to achieve Universal Eye Health is to generate evidence on the magnitude of vision impairment and to evaluate the success of blindness prevention and other similar initiatives. Rapid Assessment of Avoidable Blindness (RAAB) is a worldwide proven and effective tool for the estimation of VI and avoidable blindness. RAAB 6 has an additional module on DR which makes it more comprehensive in covering another major public eye health problem (DR) apart from cataract and other causes of VI and blindness.

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Given the variation in the prevalence within the country, there is a need for evidence-based regional data for planning, implementation, monitoring, and evaluation of any community-based intervention. Previous data used for situation analysis in Bihar was based on figures obtained from Vaishali district NPCB Survey 2001–2002^[8] and RAAB 2007.^[3] Although there are many studies on the prevalence of blindness and VI in different parts of India, no recent data has been obtained from rural Bihar. This is of significance as Bihar is the third most populous state of India (census 2011) with lowest GDP per capita. In addition, till date there are no data on the prevalence of DR specifically from the state of Bihar.

This study was done by Akhand Jyoti Eye Hospital (AJEH), the largest community eye care service provider in rural Bihar, with the aim of estimating the prevalence and causes of avoidable blindness including DR in rural Bihar.

Methods

This study was approved by the Institutional Review Board of Vivekananda Mission Ashram, Netra Niramaya Niketan, West Bengal. Written informed consent was obtained either from the study participants or from the head of the household after explaining the purpose of the study in the local language.

This survey was planned in the catchment areas of AJEH and using random sampling Siwan district was selected. This district has a population of 3.33 million and predominantly a rural area (Census 2011) with the literacy rate of 69%. The data collection occurred between January and March 2016. A stratified random cluster sampling method was used to select the clusters. A sample frame consists of all individuals aged 50 and above who are habitual residents (living at the current location for > 6 months) in the chosen cluster. Considering the previous RAAB report available with the Directorate General of Health Services, Government of India,^[3] an estimated prevalence of blindness of 5% in the age group of ≥ 50 and 12% prevalence of diabetes mellitus were used for sample size calculation. A sample size of 3476 individuals above 50 years was determined for a 20% relative precision, 95% confidence interval (CI) with 90% anticipated response rate and a design effect of 1.5%. This required a total of 57 clusters to be included in this study.

Examination procedures

A total of three teams were involved in the data collection. Each team consisted of one ophthalmologist, two optometrists (trained paramedical ophthalmic personnel), one supervisor, and two volunteers from the local area. A door-to-door survey was conducted in the selected clusters and examination was performed inside every participant's house in the survey locations. Before the survey, a one-week training was given to the entire study team on cluster selection, enumeration, clinical examination, data coding, and management of daily records. Reliability was assessed in two randomly selected clusters for all examinations including visual acuity (VA), both presenting and best corrected with pinhole (PH), lens examination and ascertaining the cause in each eye and in person, and a κ value of 0.9 was achieved in RAAB. For DR screening, the reliability was assessed between the three ophthalmologists for DR and maculopathy grading using fundus images against a gold standard and a κ value of 0.7 was achieved.

Compact segment sampling was used to determine the sample size and the number of clusters to be examined. In the randomly selected segment within a cluster, participants were recruited moving from house to house in a sequence till the required number is examined. Distance VA was measured using simplified Snellen's "E" chart. Distance VA was measured outdoors in front of the house in day light, preferably in the courtyard taking care that day light was not falling on the eyes. A rope, 6 m in length, was used to measure the distance of 6 m between the individual and the chart. If the subject was unable to see the 6/60 optotype at the distance of 6 m, then the distance between the chart and the subject was decreased to 3 m and VA assessment was done. If the subject failed to identify the largest optotypes at 3 m, then finger counting was performed. PH VA was recorded, if VA was $< 6/12$ in either eye.

Torch light and portable slit lamp (Appasamy, model no: PSLA1A-11) examination was performed inside a room to assess cataract and anterior segment pathology only if the subject had presenting VA $< 6/12$ in either eye. Pupils were dilated only in subjects whose VA does not improve to 6/12 or better with PH, using tropicamide 0.5% (two drops with 5 min gaps) and all newly detected and self-reported persons with diabetes.

Barriers questions were asked to all those who had VI due to cataract in either eye. A printed referral letter was provided to the referred subjects and the community outreach workers were made responsible for referral follow-ups.

All the participants were asked if they had previously been diagnosed with diabetes and/or are currently taking medicines to control blood glucose levels. All participants, regardless of their past history of diabetes, underwent random blood glucose (RBG) testing using a digital glucometer (Accu-Check). Both newly diagnosed and self-reported persons with diabetes underwent DR evaluation.

Dilated fundus examination was conducted using direct and indirect ophthalmoscope inside a dark room. Fundus pictures were taken using portable nonmydriatic cameras (Shin Nippon). Fundus images were graded by the ophthalmologists using Scottish grading system (<https://www.ndrs.scot.nhs.uk/wp-content/uploads/2013/04/Grading-Scheme-2007-v1.1.pdf>). The DR grading was based primarily on the clinical findings, and the camera images were considered while making the final decision by the study ophthalmologists.

Definitions

The WHO definition was used to categorize VA: Blindness was defined as VA $< 3/60$, VI as VA $< 6/18$ in better eye with available correction (presenting VA) or with best correction VA (BCVA) or PH VA, severe visual impairment (SVI) as VA $< 6/60 - 3/60$, moderate visual impairment (MVI) as VA $< 6/18 - 6/60$, and early visual impairment (EVI) as VA $< 6/12 - 6/18$. Functional low vision was defined as corrected VA $< 6/18$ - to more than no perception of light in individuals with untreatable causes of visual loss.

Uncorrected refractive error was defined as presenting VA $< 6/18$, improving to 6/18, or better with PH.

Cataract was defined as opacity of crystalline lens in the pupillary area as seen with torch light and causing VI (presenting VA $< 6/18$ and not improving with PH).

Glaucoma was diagnosed as per the guidelines given in the RAAB 6 manual updated in 2013.

Cataract surgical coverage (CSC) is the percentage of people who had cataract surgery compared to the number of people with operable cataract and this was calculated for both persons and eyes for different VA cut-offs. The primary cause for VI was assessed and if there was more than one cause for VI, the more easily treatable or correctable cause was considered.

For the purpose of this survey, persons with diabetes was defined as anyone having a previous diagnosis or having RBG of 200 mg/dl or more. People with diabetes were further subdivided into having “known diabetes” or “newly diagnosed diabetes” for further analyses.

RAAB6+DR software’s inbuilt data entry module was used to enter the data. All data were entered twice independently to minimize data entry errors and all analyses were performed using the same software. Age and gender adjusted results were reported with 95% CI.

Results

A total of 3189 (91.7%) people aged ≥ 50 years were examined out of 3476 individuals enumerated from 57 randomly selected clusters. Among the examined, 56% were females; 44% were males, and 95% of the participants belong to rural area. Mean

age of men and women in the study sample was 63.5 and 60.5 years, respectively. Overall 79% of the examined persons were aged between 50 and 69 years.

The prevalence of blindness based on presenting VA was 2.2% (95% CI: 1.6–2.8). Table 1 shows the age adjusted prevalence in the study and in the population. The prevalence of blindness was similar in both gender (male: 2.3% vs. females: 2.1%) and the prevalence of blindness was higher among the persons aged ≥ 80 years, with 15.2% (95% CI: 9.0–21.4) compared to participants aged 50–59 years with 0.9% (95% CI: 0.3–1.4). The prevalence of SVI, MVI, and EVI were 3.4% (95% CI: 2.6–4.3), 18.3% (95% CI: 16.8–19.9), and 16.9% (95% CI: 15.1–18.7), respectively [Table 1]. Around 1% (95% CI: 0.6–1.4) of the sample population was identified with functional low vision in this study.

Cataract was the main cause of blindness (VA $< 3/60$) in 72.9% of the sample population [Table 2] and another 7.1% of blindness was due to complications from cataract surgery. In addition, untreated cataract was the major cause for SVI and MVI and uncorrected refractive error was responsible for MVI in 13.2%, and 71.4% for EVI in this population. Uncorrected aphakia, DR, and glaucoma were responsible for 1.4% of blindness each. The CSC at $< 3/60$ was 71.5% for eyes and 89.3% for persons in this sample and the CSC was similar between the genders [Table 3]. The visual outcome after surgery with available correction was

Table 1: Age-gender adjusted prevalence of blindness and VI in study sample and in the population ≥ 50 years

Category	Study sample			Population		
	Males % (95% CI)	Females % (95% CI)	Total % (95% CI)	Males % (95% CI)	Females % (95% CI)	Total % (95% CI)
Blindness	2.3 (1.5-3.1)	2.1 (1.4-2.8)	2.2 (1.6-2.8)	2.5 (1.7-3.3)	2.4 (1.7-3.1)	2.4 (1.9-3.0)
SVI	3.8 (2.6-5.0)	3.1 (2.1-4.1)	3.4 (2.6-4.3)	3.4 (2.2-4.6)	3.5 (2.5-4.5)	3.5 (2.6-4.3)
MVI	19.6 (17.6-21.6)	17.4 (15.3-19.5)	18.3 (16.8-19.9)	18.2 (16.2-20.2)	18.6 (16.5-20.7)	18.4 (16.9-20.0)
EVI	17.4 (14.5-20.2)	16.6 (14.7-18.4)	16.9 (15.1-18.7)	17.0 (14.1-19.9)	16.8 (14.9-18.7)	16.9 (15.1-18.7)
Functional low vision	1.1 (0.5-1.7)	0.9 (0.5-1.4)	1.0 (0.6-1.4)	1.1 (0.5-1.6)	1.0 (0.6-1.5)	1.0 (0.6-1.4)

VI=Visual impairment; SVI=Severe VI; MVI=Moderate VI; EVI=Early VI; CI=Confidence interval

Table 2: Principal cause of blindness, SVI, MVI, and EVI in persons (PVA)

Eye disease/categories	Blindness		Severe VI		Moderate VI		Early VI	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Refractive error	0	0.0	1	0.9	77	13.2	385	71.4
Aphakia uncorrected	1	1.4	0	0.0	1	0.2	1	0.2
Cataract untreated	51	72.9	101	92.7	460	78.6	130	24.1
Cataract surgical complications	5	7.1	3	2.8	35	6.0	21	3.9
Trachomatous corneal opacity	0	0.0	0	0.0	0	0.0	1	0.2
Nontrachomatous corneal opacity	3	4.3	2	1.8	1	0.2	0	0.0
Phthisis	1	1.4	0	0.0	0	0.0	0	0.0
Glaucoma	1	1.4	0	0.0	0	0.0	0	0.0
Diabetic retinopathy	1	1.4	0	0.0	1	0.2	0	0.0
ARMD	0	0.0	1	0.9	2	0.3	0	0.0
Other posterior segment disease	5	7.1	1	0.9	6	1.0	1	0.2
All other globe/CNS abnormalities	2	2.9	0	0.0	2	0.3	0	0.0
Total	70	100.0	109	100.0	585	100.0	539	100.0

VI=Visual impairment; SVI=Severe VI; MVI=Moderate VI; EVI=Early VI; ARMD=Age-related macular degeneration; DR=Diabetic retinopathy; CNS=Central nervous system

very good (VA \geq 6/12) in 50.3%, good (VA \geq 6/18) in 19.1%, and 30.6% eyes had borderline to poor outcome (VA \leq 6/60). The most important reasons reported by the individual for not seeking cataract surgery include the "cost of treatment" ($n = 37$; 31.4%), "need not felt" ($n = 34$; 28.8%), "local reasons" ($n = 28$; 23.7%), and "fear of surgery" ($n = 5$; 4.2%).

The age and gender adjusted prevalence of diabetes was 6.3% (95% CI: 5.4–7.2) of which 33.3% were newly diagnosed during this study. The prevalence of diabetes among men and women were 7.3% (95% CI: 6.2–8.5) and 5.5% (95% CI: 4.3–6.7), respectively. Almost 79% of the prevalence was found in persons aged \leq 69 years. Among the known diabetes, 72.4% had a random blood sugar (RBS) value of >200 mg/dl and

approximately 80% of them were taking oral medication, 0.7% were on insulin, 2.2% were taking both oral medication and insulin. 10.4% of the persons with known diabetes were not taking any treatment for the control of diabetes and 64.9% ($n = 84$) reported that they had never undergone an eye examination in the past, while 23% ($n = 31$) had undergone an eye examination within the last 12 months [Table 4].

The prevalence of any DR among persons with diabetes in the sample was 14.9% (95% CI: 10.3–19.5) and any diabetic maculopathy was estimated at 12.4% (95% CI: 8.0–16.9) [Table 5]. Approximately, 3% (95% CI: 0.4–5.6) had proliferative DR and the overall prevalence of sight-threatening DR was 6.0% (95% CI: 2.6–9.4). The prevalence of DR was higher among males with 17.6% (95% CI: 11.3–24.0) compared to females with 9.1% (95% CI: 2.8–15.4).

The prevalence of blindness, SVI, and MVI among persons with diabetes were 2.0% (95% CI: 0.1–3.8), 2.5% (95% CI: 0.0–5.0), and 22.4% (95% CI: 16.0–28.8), respectively, while the same among persons without diabetes were 1.3% (95% CI: 0.9–1.7), 3.5% (95% CI: 2.6–4.3), and 18.1% (95% CI: 16.5–19.6), respectively. There was no significant difference in the prevalence of MVI and blindness among people with and without diabetes except in the SVI category.

Table 3: Percentage of cataract surgical coverage in eyes and person, by gender

Visual acuity	Males (%)		Females (%)		Total (%)	
	Eyes	Person	Eyes	Person	Eyes	Person
VA $<3/60$	71.0	89.2	72.0	89.4	71.5	89.3
VA $<6/60$	59.2	81.2	60.1	77.8	59.7	79.4
VA $<6/18$	37.6	56.9	38.4	56.4	38.0	56.6

VA=Visual acuity

Table 4: Previous DR examination status among persons with known diabetes, by gender

Period	Previous DR examination status					
	Males		Females		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Never had eye examination for DR	41	60.3	46	69.7	87	64.9
0-12 months ago	18	26.5	13	19.7	31	23.1
13-24 months ago	2	2.9	2	3.0	4	3.0
>24 months ago	7	10.3	5	7.6	12	9.0
Total	68	100.0	66	100.0	134	100.0

DR=Diabetic retinopathy

Table 5: Prevalence of DR among people with diabetes and the full sample population

	<i>n</i>	Persons with diabetes % (95% CI)	Full sample % (95% CI)
Retinopathy grade			
No retinopathy (R0)	162	80.6% (75.5-85.7)	5.1% (4.3-5.9)
Background DR - mild (R1)	3	1.5% (0.0-3.1)	0.1% (0.0-0.2)
Background DR - observable (R2)	4	2.0% (0.1-3.9)	0.1% (0.0-0.2)
Background DR - referable (R3)	10	5.0% (1.8-8.1)	0.3% (0.1-0.5)
Proliferative DR (R4)	6	3.0% (0.4-5.6)	0.2% (0.0-0.4)
Ungradable DR (R6)	7	3.5% (0.7-6.2)	0.2% (0.0-0.4)
Any retinopathy	30	14.9% (10.3-19.5)	0.9% (0.6-1.3)
Maculopathy grade			
No maculopathy (M0)	167	83.1% (77.8-88.4)	5.2% (4.5-6.0)
Maculopathy - observable (M1)	5	2.5% (0.4-4.6)	0.2% (0.0-0.3)
Maculopathy - referable (M2)	9	4.5% (1.7-7.3)	0.3% (0.1-0.5)
Any maculopathy	25	12.4% (8.0-16.9)	0.8% (0.5-1.1)
Any retinopathy and/or maculopathy	38	18.9% (13.7-24.1)	1.2% (0.8-1.6)
Sight threatening DR (R4 and/or M2)	12	6.0% (2.6-9.4)	0.4% (0.1-0.6)
Any laser scars	11	5.5% (2.3-8.6)	0.3% (0.1-0.5)

DR=Diabetes retinopathy

Discussion

This was the first study conducted in Bihar which used the RAAB 6 methodology, including DR. The prevalence of blindness and VI in adults aged 50 years and above was 2.2 and 23.6%, respectively, in this sample population. Untreated cataract was the leading cause of blindness, in approximately three-quarters of individuals (72.9%) and another 7.1% were blind due to complications after cataract surgery.

Most of the previous RAAB reports from India reported refractive error as the major cause for MVI, however, in this study cataract appears to be the most common cause for MVI. In this study uncorrected refractive error was responsible for MVI in 13.2% and in 71.4% for EVI in this population. The reasons for the lower prevalence of RE as a cause of VI in this population is not known, and one probability may be that the study participants had central media opacity and the subjective nature of PH improvement in VA as reported by the participants might have caused this underestimation of refractive error. To substantiate this, a detailed exploratory study focused on refractive errors in this age group is required.

The age and gender adjusted prevalence of diabetes was 6.3%, of which one-third was newly diagnosed diabetes. The prevalence of any DR among persons with diabetes was 14.9% and the DR prevalence was twice as high among males as compared to females in this study.

The estimated prevalence of blindness (2.2%) in this study was low compared to the available report, one from the state of Bihar (4.5%)^[3] and another recent publication from Haryana in North India (5%).^[9] The possible reason for the lower prevalence in this study may be due to availability and access to better eye care services in the study area given the presence of a tertiary eye care facility in the adjoining district. There are many RAAB surveys done in various parts of the country and the reported prevalence of blindness ranges from 1.87 to 5%^[9-11] while the national average was reported as 3.6%.^[3] Looking beyond our borders, our results are consistent with the prevalence of blindness findings reported from neighboring countries such as Bangladesh, Nepal, and Pakistan^[12-14] as well as some African countries such as Kenya and Tanzania.^[15,16]

As compared to RAAB studies from across the country,^[17] our study had a higher female participation rate while the prevalence of blindness was similar in both men and women. The increased participation rate among females may be due to their availability at home during the survey time, however, our study will not be able to explain the lower prevalence of blindness among females in this population compared to other studies. This aspect needs to be explored in more detail as insights from this region may help to address gender gaps in terms of access to and uptake of eye health services in other regions.

It is encouraging to witness that the CSC for persons at VA <3/60 and <6/60 was 89.3 and 78.1%, respectively, and there was no gender difference in CSC in this study. For the same VA cutoff, the previous RAAB survey (2007) conducted across India reported CSC as 82.3 and 66%, respectively, and comparatively the CSC was lower for women.^[3] As per a recent study the CSC (person) at VA <6/60 was 75.0% (80% for male and 75% for female), being highest in Gujarat (93.2%) and

lowest in Uttar Pradesh (47.1%).^[18] This increase in CSC may be attributed to better intervention strategies by government and NGOs in the recent past. However, even with CSC rates which are higher than the national average, cataract continues to be the leading cause of blindness in this population. This would suggest that interventions focusing on cataract are still required and may even need to be intensified further to address the situation. Financial constraints were identified as the major reason for not utilizing the cataract surgical services, and this is similar to earlier RAAB findings in the country.^[9-11] Although NGOs do not charge patients for cataract surgery, the opportunity cost in terms of loss of wages and other incidental expenses such as travel and food may have contributed to this. Consideration must be given to developing effective strategies to counter these barriers for effective blindness prevention programs in the future.

The inclusion of a DR module within RAAB 6 provides a dual opportunity to assess both the prevalence and causes of VI and blindness as well as the prevalence of diabetes and DR. Currently, India is battling with a rapid increase in the prevalence of diabetes in both urban and rural areas and along with this we are experiencing a resultant increase in diabetic eye diseases. DR has also been recognized as an emerging cause of blindness at the global level, prompting the WHO to list DR as a priority disease in the global VISION 2020 initiative for elimination of avoidable blindness.

The prevalence of diabetes and DR estimated in this study is comparatively lower than the previous population reports in the same age group.^[19-21] As cataract was identified as the major cause of blindness in this sample, it is quite likely that there was either no view or a hazy view to the fundus in these subjects which would make it difficult to determine whether a person with diabetes had DR or not. Moreover, the RAAB methodology requires the selection of more easily treatable cause of blindness in cases where there is more than one cause been identified. As cataract is more easily treatable than DR, DR may have been under-reported, hence leading to the lower prevalence of DR in this study.

It is important to note that almost one-third of the diabetes is newly diagnosed and around 72.3% of persons with known diabetes had uncontrolled blood sugar (RBS >200 mg/dl). Nearly 64% of the persons with known diabetes never had an eye examination in the past, suggesting a stronger need for strengthening primary screening, early detection and management of diabetes, and DR. Lack of adherence to diabetes vision care guidelines among persons with diabetes has been recognized as a persistent and complex health issues worldwide.^[22,23] Most importantly, much work is required to increase the general levels of awareness among the lay community as well as the network of healthcare providers involved in providing care to persons with diabetes.^[24] The importance of regular eye examinations and good diabetes control in preventing blindness due to DR needs to be adequately highlighted in all awareness generation activities.

The strength of this study was the use of the standardized RAAB 6 methodology to estimate the prevalence of blindness and DR in rural Bihar. This methodology has been validated globally and allows the results of this study to be compared with other RAAB surveys nationally and internationally. Findings from this study will be useful for planning a comprehensive

community eye health intervention for the region, i.e., Siwan and adjoining districts. There are few limitations in the methodology, including the selection of study area. The chosen study area was well covered by services from an NGO hospital, which might have affected the findings from this study. Hence the prevalence estimates obtained from this study may not be representative of the entire state of Bihar. Another major limitation was being very comprehensive and rapid nature of this study, the team may have sporadically missed the detailed exploration of the causative association. Further, RAAB cannot assess blindness or DR in younger population (<50 years) and RAAB is not a detailed blindness survey: it provides a reasonably accurate estimate of the prevalence of blindness, and the proportion that is avoidable in a geographic area. Also, both diabetes and DR may be underestimated in this study due to the use of RBG measurements as the criteria for case identification and the difficulty in evaluating the fundus in the community setting and with the presence of cataract.

Conclusion

To conclude, as compared to previous reports, the prevalence of blindness in Siwan district of Bihar was found to be lower and the CSC was higher. However, the problem of avoidable blindness and VI remains high and there is an urgent need for a more concerted, comprehensive effort in addressing the situation, with a particular focus on improving the quality of cataract surgeries and DR services in this region.

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Conflicts of interest

There are no conflicts of interest.

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