Prevalence of diabetic retinopathy in India: Results from the National Survey 2015-19

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Purpose: Diabetes mellitus (DM) and diabetic retinopathy (DR) contribute to ocular morbidity and are emerging as diseases with significant public health impact. Our aim was to assess the countrywide prevalence of DR and sight-threatening DR (STDR) among persons with diabetes and to evaluate the coverage of DR examinations among them. Methods: The present survey was planned to estimate the burden of DR in the population aged ≥50 years for assisting in the planning and prioritization of diabetic eye services. For this survey, 21 districts with a high prevalence of DM were selected among the 31 districts where the national blindness and visual impairment survey was conducted. The total sample size was 63,000 people aged 50 years and above. DR was assessed by dilated fundus examination with indirect ophthalmoscope and was graded according to Scottish DR grading. STDR included severe nonproliferative DR, proliferative DR, and clinically significant macular edema. Results: The prevalence of diabetes in the surveyed population was 11.8%. Among them, one-third were newly diagnosed DM, that is, diagnosed at the time of the survey. The study revealed that the prevalence of DR among persons with diabetes was 16.9%, the prevalence of STDR was 3.6%, and the prevalence of mild retinopathy was 11.8%. Risk factors for DR in the current study were duration of diabetes (>10 years, OR 4.8, 95% CI: 3.3–6.9), poor glycemic control (≥200 mg/dL, OR: 1.5, 95% CI: 1.2–1.7) and insulin treatment (OR: 2.6, 95% CI: 1.7–4.1). Conclusion: The current study highlights the substantial burden of DM and DR in India and the critical need to adopt a coordinated and multisectoral approach to reduce their prevalence. There is a need for early identification of persons with diabetes and their routine screening for DR along with availability of treatment facilities.

Key words: Blindness, diabetes, diabetic retinopathy, RAAB

Diabetes mellitus (DM) is a global epidemic. The World Health Organization (WHO) estimates revealed that the global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014.[1] The ninth edition of Diabetes Atlas by International Diabetes Federation released in 2019 estimates that there are 463 million persons with diabetes in the world and this figure will go up to 700 million by the year 2045;[2] the increase being disproportionately more in developing countries. This will result in a heavy burden on the health care system because of several DM-related complications. According to WHO, there were nearly 102.26 million cases of diabetes in India in 2016 with a prevalence of 7.8% (7.9% in males and 7.5% in females).[3]

Diabetes is a disease that is strongly associated with both microvascular and macrovascular complications, including retinopathy, nephropathy, neuropathy (microvascular), ischemic heart disease, peripheral vascular disease, and cerebrovascular disease (macrovascular), resulting in organ and tissue damage.[4] Diabetic Retinopathy (DR) is an important cause of visual impairment among persons with diabetes. The prevalence of diabetes is higher in urban areas (11.2%, 95% CI: 10.6–11.8) than in rural areas (5.2%, 95% CI: 4.9–5.4; P < 0.0001).[5] but DR does not show this variation.[6] DR accounted for 1.07% of blindness and 1.25% of moderate to severe visual impairment (MSVI) in 2015.[7] There are no recent studies on the prevalence of DR across all the geographical divisions of India. This makes it difficult to identify where DR screening and treatment programs are most needed. Most of the available estimates of DR are from diabetes clinics, which is subject to bias, limiting their use in planning ophthalmic services for persons with diabetes in the general population. Prevalence of DR has been included in the Rapid Assessment of Avoidable Blindness (RAAB + DR) survey by the International Center for Eye Health (ICEH), London as a relatively rapid and affordable method for estimating the burden of diabetes and DR in the population aged ≥50 years. This will help to plan and prioritize diabetic eye care services. The objectives of the current study were to assess the prevalence of total, known, and new diabetes and to assess the prevalence of DR and sight-threatening...
DR (STDR) among people with diabetes. Other objectives included evaluation of coverage of DR examinations among people with known diabetes (the proportion of people with known diabetes who have had an eye exam ever and in the past year) and/or to know the levels of glycemic control (random blood sugar <200 mg/dl) among them.

**Methods**

The current survey was done using the RAAB-6+DR module. RAAB survey methodology was developed in the context of Vision 2020: Right to Sight initiative as a rapid and cost-effective survey method for the assessment of avoidable blindness. The current RAAB protocol version-6 was utilized for this survey (taking Snellen visual acuity up to 6/12 as normal). Random blood sugar (RBS) ≥ 200 mg/dl was used as the criteria for diagnosing new persons with diabetes, and DR was classified according to Scottish Grading Scheme.

The survey protocol has been approved by the Institute Ethics Committee of the All India Institute of Medical Sciences, New Delhi, India. Approvals from state- and district-level health authorities were obtained before initiating survey activities. The survey was conducted as per the tenets of the Declaration of Helsinki. Written informed consent was obtained from each survey participant. Diabetes and DR assessments were carried out in 21 districts representing 18 states of India. Among the 31 randomly selected districts chosen for the national blindness and visual impairment survey, the selection of 21 districts for the current study was based on the higher prevalence of DM through the information available or based on the opinions of experts. Within the chosen districts, a list of all villages in rural areas and wards in urban areas along with their populations was obtained from Census 2011. The villages and wards varied in size from very small hamlets (population under 100) to large urban wards (population over 50,000). To achieve a self-weighing sample as per the rural-urban population distribution of the district, each large village/ward (having a population of more than 4,000) was split into smaller units of 4,000 population each. The smaller villages and wards were retained as-is. A village/ward could have multiple clusters. This process of splitting was done using Stata-13. This yielded the sampling frame for selection of clusters. The sampling frame included the following information: name, census ID, split number, and population of the unit after splitting. Using the PPS sampling procedure of the RAAB-6 software, 50 population units of size 400–4,000 were selected randomly from this sample frame and a district cluster list was generated. Information on the number of splits done for each village/urban ward was also added to the list. Selection of population sampling units and clusters was done at the central level in Dr. RP Center, AIIMS Delhi.

The sample size of 3000 was targeted in each district by enrolling 60 individuals per cluster in 50 clusters. The sample size was estimated considering 3.6% estimated prevalence of blindness (visual acuity <3/60) among ≥50 years population as per the 2007 national blindness survey of India, 25% relative precision, 5% probability of type-I error, design effect of 1.6, for multistage cluster random sampling with a cluster size of 60 as per RAAB recommendations, and response rate of 90%. The total sample size estimated for the survey was 63,000 people aged 50 years and above in 21 districts in India. Multistage cluster sampling without stratification was utilized. The ophthalmologists responsible for DR grading underwent inter-observer variation (IOV) by independently grading pregraded 40 slides of fundus photographs according to Scottish DR Classification. Each ophthalmologist marked their grading on a standard DR IOV form. These forms were then entered in special software and compared against the gold standard grading of the same slides. Ophthalmologists were permitted to participate in the survey only after an IOV of >0.60 was ensured on all parameters.

DR was assessed by dilated fundus examination with indirect ophthalmoscope and graded according to Scottish DR grading. The diagnosis of diabetes was made based on the participant having a history of diabetes, designated “Known Diabetes” (KD) or an elevated RBS (≥200 mg/dl) assigned as “New Diabetes” (ND) based on spot RBS testing. People with known history of diabetes were enquired regarding age of diagnosis, treatment taken (if any), and the last time retina examination was done for DR. All subjects who were diagnosed as having diabetes were explained about the need to undergo a dilated retina examination by the ophthalmologist. After consent for dilation, the participant was taken to a dark room inside the house. The pupil was dilated with a short-acting mydriatic (tropicamide 0.5%) eye drop. After a minimum time of 30–40 minutes, fundus was examined for presence of DR changes such as retinal hemorrhages, soft and hard exudates, and presence of any laser scars by using an indirect ophthalmoscope. The Scottish DR grading system was used for classification of retinopathy and maculopathy in each eye. Presence of laser scars was noted separately. Findings were recorded in diabetes and DR assessment forms in relevant sections. Fig 3 shows the clinical algorithm flow chart for DR examination.

The data were entered in the specially designed RAAB6+DR software package on the same day that the survey was done. The software has in-built validation and consistency checks to ensure accurate data entry. Transcription errors were minimized through a dual-data entry and comparison with
the initial field entered data. The second data entry was done by an independent operator in the center after the field survey in each district. The final corrected dataset was then analyzed using the inbuilt routines of the RAAB 6+DR software. Crude prevalence estimates for each district were obtained. By combining all datasets from the 21 districts, crude prevalence estimates for the full sample were obtained. Multivariate logistic regression analyses were performed to study the effect of various risk factors, keeping diabetes and DR as dependent variables using Stata (StataCorp, College Station, Texas). For all point estimates, 95% confidence intervals were calculated and the critical significance value was fixed as \( P < 0.05 \).

**Results**

The total enumerated sample size in 21 districts was 63,000 (28,019 males and 34,981 females) out of which 57,532 (91.3%) persons were enquired for history of diabetes (87.2% among males and 94.7% among females). The remaining 5,185 enumerated subjects were not available (8.2%), 147 refused examination (0.2%), and 136 could not be satisfactorily examined due to various reasons, such as deafness, muteness, and mental retardation. Three-fifths (58.2%) of the assessed participants were illiterate and 6.9% were aged 80 years and above [Table 1].

Out of the 57,532 participants enquired for diabetes, capillary RBS could be measured for 56,763 persons (98.7% RBS coverage); 769 persons refused to undergo RBS test, out of whom 8 were KDs, whereas 761 persons remained of unknown diabetic status. Refusal for RBS testing was higher in females than in males. Thus, 56,771 persons were assessed for presence of diabetes by history and/or by RBS test (98.7% coverage). Total diabetes prevalence was 11.8% among assessed participants (8.0% known diabetes and 3.8% new diabetes) and the prevalence increased with age [Table 1]. Prevalence of diabetes was higher in urban examined population at 18.3% (95% CI: 17.5–19.0) than in rural residents at 10.5% (95% CI: 10.2–10.8) [Table 1].

Out of 4522 KDs, the proportion of males and females was similar, but a significantly higher proportion of females with DM were illiterate [Table 2]. With regard to glycemic control,
39.5% of KDs had good control (<200 mg/dL); however, the proportion of males with diabetes taking medications was significantly less compared to females, whereas a significantly higher proportion of males were on insulin treatment. Among the KDs, only 6.3% had undergone a retinal examination in the last one year and a vast majority (89.9%) never underwent any retina examination [Table 2]. The risk factors for diabetes were gender, age, and literacy. The odds of being diagnosed with diabetes, either new or old, were 1.4 times higher for females than males (OR = 1.4; \( P < 0.001 \)). Risk of diabetes also significantly increased with age and literacy [Table 3].

Of the 6717 participants with diabetes, 5986 (89.1%) were assessed for evidence of DR by using dilated fundus examination by indirect ophthalmoscopy; among those not examined, 543 could not be assessed due to refusal and another 188 due to dense media opacity in both eyes. Dilated fundus examination coverage for known and new diabetes was 90.1% and 87.1%, respectively. Overall prevalence of any DR in those assessed was 16.9% (95% CI: 15.9–17.9) and that of any maculopathy was 7.0% (95% CI: 6.2–7.8) [Table 4 and Fig. 4]. Prevalence of DR in males was 17.0% (95% CI: 15.5–18.5) and in females was 16.7% (95% CI: 15.5–18.0). Highest prevalence of DR was observed in the 60–69-years age group at 18.6% and a similar prevalence in age groups of 70–79 years and >80 years age at 18.3% and 18.4%, respectively. Lowest prevalence of DR was 14.3% in the 50–59-years age group [Fig. 4]. Prevalence of DR was higher in the urban examined population than in the rural population at 20.7% (95% CI: 18.7–22.7) and 15.5% (95% CI: 14.5–16.6), respectively.

Risk factors for DR were duration of diabetes, glycemic control, and those on insulin treatment. Persons with 5–9 years of diabetes had 2.4 times and those with ≥10 years diabetes had 4.8 times higher odds of having DR (\( P < 0.001 \)). Odds of DR were 1.5 times more in those who had poor glycemic control. Persons who were on insulin treatment, either alone or with oral hypoglycemic agents, had 2.6 times higher odds of having DR [Table 5].

With regard to geographical variations, the prevalence of DR was highest in the Kadapa (now YSR) district of Andhra Pradesh (27.3%) and lowest in the Guna district of Madhya Pradesh (4.3%). In general, the prevalence was higher than the national average in Southern, Western, and Eastern states and lower in Northern and Central states [Fig. 5].

Out of 5986 persons with diabetes assessed, 214 were having STDR, a potentially blinding complication of diabetes. Prevalence of STDR, which included proliferative retinopathy (R4) and hard exudates within one-disc diopeter of the center of fovea (M2), was 3.6% in the population with diabetes assessed for DR changes by dilated fundus examination. There were only 29 persons with diabetes with laser coagulation marks seen on dilated examination by indirect ophthalmoscopy [Table 4]. In all the STDR cases, only 13.6% were treated with laser. Among the persons with known diabetes, 89.9% had never undergone fundus examination for evaluation of DR and only 6.3% of them had gone for an eye examination within the last one year.

The prevalence of blindness among persons with diabetes was 2.1% and that of moderate severe visual impairment (MSVI) was 11.6%; the difference was not significant as compared to normal persons who had prevalence of blindness and MSVI as 2.0% and 12.0%, respectively.

**Discussion**

This nationwide study funded by the National Program for Control of Blindness and Visual Impairment, India shows that the prevalence of DR in population aged 50 years and above was 16.9%. To date, no nationwide community-based studies on the prevalence of DR in India have been published, though some studies from Southern India reported the range of prevalence from 12.2% to 18.03% in the population with known DM.[12–14] The diagnosis of DR was made either clinically, using indirect ophthalmoscopy, or was made using fundus photographs. Regardless of the method used to detect DR,
### Table 1: Age, gender, and literacy wise prevalence of diabetes among participants assessed for diabetes (N=56,771)

| Age group | Total | Diabetes | 95% CI | Total | Diabetes | 95% CI | Total | Diabetes | 95% CI |
|-----------|-------|----------|--------|-------|----------|--------|-------|----------|--------|
| 50-59     | 9573  | 1008 (10.5) | 9.9-11.1 | 14944  | 1615 (10.8) | 10.3-11.3 | 24517  | 2623 (10.7) | 10.3-11.1 |
| 60-69     | 8703  | 1139 (13.9) | 12.4-13.8 | 10929  | 1428 (13.1) | 12.4-13.7 | 19632  | 2567 (13.1) | 12.6-13.5 |
| 70-79     | 4159  | 578 (13.9) | 12.8-14.9 | 4545  | 567 (12.5) | 11.5-13.4 | 8704  | 1145 (13.2) | 12.4-13.9 |
| ≥80       | 1775  | 172 (9.7) | 8.3-11.1 | 2143  | 210 (9.8) | 8.5-11.1 | 3918  | 382 (9.7) | 8.8-10.7 |
| **Total** | 24210 | 2897 (12.0) | 11.6-12.4 | 32561  | 3820 (11.7) | 11.4-12.1 | 56771  | 6717 (11.8) | 11.6-12.1 |

**Literacy**
- Illiterate: 9635, 653 (6.7) | 6.3-7.3 | 19.9-21.3 | 33013  | 2839 (8.6) | 8.3-8.9 |
- Up to 4<sup>th</sup> pass: 5808, 740 (12.7) | 11.9-13.6 | 15.6-17.6 | 10983  | 1600 (14.6) | 13.9-15.2 |
- 5<sup>th</sup>-9<sup>th</sup> pass: 572 (28.9) | 26.7-31.3 | 28.7-31.7 | 998  | 22.1 | 19.6-24.6 |
- ≥10<sup>th</sup> pass: 582 (29.4) | 26.7-31.3 | 28.7-31.7 | 791  | 17.5 | 15.0-20.0 |
| **Total** | 24210 | 2897 (12.0) | 11.6-12.4 | 32561  | 3820 (11.7) | 11.4-12.1 | 56771  | 6717 (11.8) | 11.6-12.1 |

### Table 2: Profile of persons with known diabetes (age, gender, literacy, duration, glycemic control, treatment, and last eye examination) (N=4522)

| Age group | Male | Female | Total | OR | P  |
|-----------|------|--------|-------|----|----|
| 50-59     | 694  | 1067   | 1761  | 0.747 | 0.000 |
| 60-69     | 812  | 995    | 1807  | 1.083 | 0.195 |
| 70-79     | 375  | 375    | 750   | 1.352 | 0.000 |
| ≥80       | 98   | 106    | 204   | 1.198 | 0.208 |
| **Total** | 1979 | 2543  | 4522  |  |  |

**Duration of diabetes**
- <1 year: 93 (4.7) | 145 (5.7) | 238 (5.3) | 0.815 | 0.134 |
- 1-4 years: 795 (40.2) | 1100 (43.3) | 1895 (41.9) | 0.880 | 0.037 |
- 5-9 years: 502 (25.4) | 707 (27.8) | 1209 (26.7) | 0.882 | 0.066 |
- 10 years or more: 589 (29.8) | 591 (23.2) | 1180 (26.1) | 1.400 | 0.000 |
| **Total** | 1979 | 2543  | 4522  |  |  |

**Glycemic control**
- <200 mg/dL (Good control): 780 (39.4) | 1005 (39.6) | 1785 (39.5) | 0.993 | 0.913 |
- ≥200 mg/dL (Poor control): 1197 (60.6) | 1532 (60.4) | 2729 (60.5) | 1.007 | 0.913 |
| **Total** | 1977 | 2537  | 4514  |  |  |

**Average blood sugar**: 240.4 mg% | 246.8 mg% | 244.0 mg%  |  |  |

**Type of Treatment**
- No treatment: 138 (7.0) | 127 (5.0) | 265 (5.9) | 1.426 | 0.005 |
- Diet only: 66 (3.3) | 63 (2.5) | 129 (2.9) | 1.358 | 0.085 |
- Tablets: 1646 (83.2) | 2230 (87.7) | 3876 (85.7) | 0.694 | 0.000 |
- Insulin with or without tablets: 129 (6.5) | 123 (4.8) | 252 (5.6) | 1.372 | 0.014 |
| **Total** | 1979 | 2543  | 4522  |  |  |

**Last retina examination**
- Not examined: 1741 (88.0) | 2322 (91.3) | 4063 (89.9) | 0.696 | 0.000 |
- 0-12 months ago: 155 (7.8) | 131 (5.1) | 286 (6.3) | 1.565 | 0.000 |
- 13-24 month ago: 41 (2.1) | 45 (1.8) | 86 (1.9) | 1.174 | 0.460 |
- ≥24 month ago: 42 (2.1) | 45 (1.8) | 87 (1.9) | 1.204 | 0.392 |
| **Total** | 1979 | 2543  | 4522  |  |  |

*8 patients who were known to have diabetes refused blood sugar test*
the prevalence of DR among persons with diabetes ranged from 10% to 30.4%. The current study reported a prevalence of 16.9%, which is comparable to other studies using plasma glucose as the criteria for DM; studies relying on self-report of DM had reported a higher prevalence of DR. This might be because persons self-reporting diabetes are usually in a more advanced stage of the disease with higher chances of complications. A recent meta-analysis concluded that among eight studies published in India, 14.8% (95% CI: 10.7–19.0) of persons with known diabetes aged ≥30 years and 18.1% (95% CI: 14.8–21.4) of those aged ≥50 years had DR.[15] The Sankara Nethralaya-Diabetic Retinopathy Epidemiology and Molecular Genetic Study-Phase 1 (SNDREAMS-I) reported 18.0% (95% CI: 16.0–20.1) prevalence of DR in an urban population with DM and SNDREAMS-3 reported 10.0% prevalence for the rural population aged >40 years.[16,17] In the Aravind Comprehensive Eye Study (ACES) conducted in a rural population in three districts of Tamil Nadu, the prevalence of DR was 10.5% in subjects with type II DM.[18] The Singapore India Eye Study (SINDI) reported an age-standardized prevalence of 30.4% (95% CI: 26.5–34.8) for DR among 3400 ethnic Indians living in Singapore.[19] Another pan-India DR Eye Screening Study utilizing nonrandom sampling conducted by All India Ophthalmological Society (AIOS) reported DR prevalence as 21.7% in diabetes clinics and camps involving more than 80% urban population.[20]

The current study reported a higher prevalence of DR among the urban population than in the rural population (20.7% vs. 15.5%). Very few previous studies have compared prevalence in urban and rural areas, and no difference was found when prevalence was adjusted for age and sex.[6]

STDR is a stage in DR that requires some form of intervention to arrest the vascular endothelial growth to prevent or reduce the risk of blindness. STDR includes severe nonproliferative DR, proliferative DR, and clinically significant macular edema.[21] The prevalence of STDR in the current study was 3.6%. Previous studies from South India reported the prevalence of referable STDR ranging from 4.6% to 6.8%.[6,14] SNDREAMS-2 had reported that incidences of STDR were higher in people with preexisting DR than in those without DR at baseline.[22]

Persons with known diabetes in the current study had poor awareness regarding the need for annual retina examination for diabetes complications such as DR. This was evident from our results in which 89.9% of KDs had never undergone fundus examination for evaluation of DR and only 6.3% of them had gone for an eye examination within the last one year. The ACES had reported that incidences of STDR were higher in people with previous ophthalmic examinations.[19] This result has far-reaching implications as unless a multidisciplinary effort on part of the clinical teams ranging from physician to endocrinologist refer any KD as per the guideline to eye care professionals, STDR will not be detected early to reverse the condition. There is a huge opportunity for communication strategies here, including personal education of KDs.

A South Indian study among paramedical workers had reported that over half of respondents were not aware of risk

### Table 3: Multivariate analysis for identifying risk factors of diabetes among those assessed (N=56,771)

| Gender | Total | Persons with Diabetes (N=6717) | Non-diabetics (N=50054) | OR (95%CI) | P |
|--------|-------|-------------------------------|-------------------------|------------|---|
| Male   | 24210 | 2897 (43.1)                   | 21313 (42.6)           | 1          |   |
| Female | 32561 | 3820 (56.9)                   | 28741 (57.4)           | 1.4 (1.3-1.5) | <0.001 |
| Age group |       |                               |                         |            |   |
| 50-59  | 24517 | 2623 (39.1)                   | 21894 (43.7)           | 1          |   |
| 60-69  | 19632 | 2567 (38.2)                   | 17065 (34.1)           | 1.4 (1.3-1.5) | <0.001 |
| 70-79  | 8704  | 1145 (17.0)                   | 7559 (15.1)            | 1.6 (1.5-1.7) | <0.001 |
| ≥80    | 3918  | 382 (5.7)                     | 3536 (7.1)             | 1.3 (1.1-1.4) | <0.001 |
| Literacy |       |                               |                         |            |   |
| Illiterate | 33013 | 2839 (42.3)                   | 30174 (60.3)           | 1          |   |
| Up to 4th pass | 10983 | 1600 (23.8)                   | 9383 (18.7)            | 2.1 (1.9-2.2) | <0.001 |
| 5th pass to 9th pass | 7917  | 1302 (19.4)                   | 6615 (13.2)            | 2.5 (2.3-2.7) | <0.001 |
| 10th pass or above | 4858  | 976 (14.5)                    | 3882 (7.8)             | 3.3 (3.1-3.6) | <0.001 |

The prevalence of STDR in the current study was 3.6%. Previous studies from South India reported the prevalence of referable STDR ranging from 4.6% to 6.8%.[6,14] SNDREAMS-2 had reported that incidences of STDR were higher in people with preexisting DR than in those without DR at baseline.[22]
Risk factors for DR in the current study were duration of diabetes, poor glycemic control, and insulin treatment. Gender was not significantly associated with increased risk of DR. However, previous studies have reported males having higher odds of DR than females; the exact reason for this male predominance has not been determined. Similarly, previous studies also demonstrated insulin treatment leading to higher odds of DR than females; the exact reason for this male predominance has not been determined.

Gender was not significantly associated with increased risk of DR. However, previous studies have reported males having higher odds of DR than females; the exact reason for this male predominance has not been determined. Similarly, previous studies also demonstrated insulin treatment leading to higher odds of DR than females; the exact reason for this male predominance has not been determined.

although it did show an increased prevalence in the sixth decade compared with the fifth decade of life, in the seventh and eighth decade, it leveled off. Similar trends also were observed in the SNDREAMS study. This pattern may be because many subjects with severe diabetes and secondary complications may not survive beyond the age of 70 due to other diabetic complications.

There is strong evidence that effective management of diabetes and associated systemic conditions postpones and reduces the incidence of STDR and improves prognosis. Periodic eye examinations by ophthalmologists, accompanied by standard treatment of DR, can postpone serious loss of vision. The current study highlights the critical need for India to adopt a coordinated and multisectoral approach to reduce the prevalence of diabetes and the onset of DR. There is an acute shortage of retina specialists in India, that is, 1 per 1.26 million population; thus, development of infrastructure and capacity building are of paramount importance. Early identification of diabetes and screening them for DR at the primary level using trained technicians at the diabetes clinics would help in covering a larger population. Knowledge attitude and practice (KAP) regarding DR needs to be enhanced, especially among persons with diabetes and the physicians treating them. A clear demarcation of referral pathways and a national registry for DM/DR are highly recommended.

### Strengths of the study

This is possibly the first nationwide community-based study from India that has estimated both the magnitude of DR and STDR among persons with diabetes across the country. The strength of this study is that it used WHO-approved standard survey methodology and grading techniques. Furthermore, the study is representative of a large population with good coverage, representative of diverse geographical populations, visual acuity, and blindness assessed in the same population. It randomly covered rural and urban populations and the results of the study were extrapolated for the entire country.

### Limitations of the study

It is a cross-sectional observational study and hence causal directions are not clear. Laboratory venous blood glucose
provides the most accurate blood sugar estimation and RBS measured with glucometer tends to overestimate or underestimate the blood sugar levels.[9] The current study employed the latter method as venous blood glucose was not feasible for such a large-scale survey and because the examinations were not hospital-based and were performed at the household level within the community. The study was conducted in individuals above 50 years of age and if there were individuals with diabetes and DR below 50 years, that would have possibly been missed. Secondly, in this study, the mode of detection of DR is by indirect ophthalmoscopy while the majority of the recent studies on DR prevalence use retinal color photography as the gold standard for detection of DR. The current study, being a large-scale community-based survey, color photography was not operationally feasible.

Conclusion

The current study showed that the prevalence of DR in population aged 50 years and above was 16.9% and that of STDR was 3.6%. It also reported a higher prevalence of DR among the urban population than in the rural population (20.7% vs. 15.5%). Persons with known diabetes in the current study had poor awareness regarding the need for annual retina examination for diabetes complications such as DR. This was evident from our results in which 89.9% of KDs had never undergone fundus examination for evaluation of DR and only 6.3% of them had gone for an eye examination within last one year. The current study highlights the critical need for India to adopt a coordinated and multi-sectoral approach to reduce the prevalence of diabetes and the onset of DR.

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Conflicts of interest

There are no conflicts of interest.

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