

**CAUSES OF VISUAL IMPAIRMENT AND BLINDNESS IN ADULTS OF TRIBAL AREAS OF GUJARAT AND MAHARASHTRA: A POPULATION-BASED SURVEY.****Dr. Vishwa Panchal***

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ABSTRACT **Background:** Tribal populations in South Gujarat and Maharashtra have limited access to eye-care due to geographic isolation, economic constraints and low awareness. These barriers delay diagnosis and treatment of avoidable conditions such as cataract and uncorrected refractive errors. **Objectives:** To determine the causes of visual impairment (VI) and blindness among adults in the tribal regions of South Gujarat and Maharashtra, using Rapid Assessment of Avoidable Blindness (RAAB) survey. **Methodology:** We conducted the RAAB 6 survey to assess VI and blindness among adults aged ≥ 50 years via the mobile-RAAB application. We examined 4,734 participants from 97 randomly selected clusters across tribal talukas in Gujarat and Maharashtra. Assessment of visual acuity, lens status and fundus were done and causes of VI and blindness were identified. **Results:** Survey achieved 97.6% response rate. Prevalence of blindness and VI was 2.05% and 23.76%, respectively. Untreated cataract was major cause of VI and blindness (65.2% and 81%, respectively). Refractive error accounted for 51.9% of early VI cases. Above 90% of blindness and most of the VI was due to avoidable causes. **Conclusions:** Avoidable blindness and VI remain highly prevalent among the tribals. Targeted interventions such as enhanced cataract surgical outreach and affordable refractive services are urgently needed.

KEYWORDS : RAAB, Tribal Population, Gujarat, Maharashtra, Visual Impairment, Blindness, Cataract**INTRODUCTION**

Restoring sight is not only a medical intervention but also a humanitarian priority, as vision is essential for experiencing daily life and maintaining social connection. More than 2.2 billion people worldwide live with visual impairment or blindness, and at least one billion of these cases are preventable or treatable. (Organization, 2020) In India, the burden is disproportionately high among older adults and socially or economically disadvantaged groups, particularly tribal communities who constitute over 10% of the rural population—more than 100 million people. Understanding where these populations are concentrated and the barriers they face in accessing eye-care services is critical for designing effective interventions.

Although national surveys (2015–19) have identified cataract and uncorrected refractive error as the leading causes of avoidable blindness, data focused specifically on tribal communities remain limited. (Vashist et al., 2022) In the tribal regions of South Gujarat and Maharashtra, geographic isolation, cultural diversity, economic hardship, and restricted healthcare access reduce both awareness and service uptake, leaving visual impairment frequently undetected and untreated.

This survey used the Rapid Assessment of Avoidable Blindness (RAAB) 6 methodology to evaluate the causes of visual impairment and blindness among adults aged 50 years and older in these tribal regions. By Analyzing age- and gender-specific patterns, the study identifies vulnerable groups and addresses key gaps in existing evidence.

OBJECTIVES

To determine the causes of visual impairment (VI) and blindness among adults in the tribal regions of South Gujarat and Maharashtra, using Rapid Assessment of Avoidable Blindness (RAAB) survey.

METHODOLOGY

A population-based, cross-sectional Rapid Assessment of Avoidable Blindness (RAAB) survey was conducted in March–April 2023 among adults aged ≥ 50 years in tribal regions of south Gujarat (Dang, Vansda, Dharampur, Kaprada) and Nashik (Surgana). Using compact cluster sampling with probability proportional to size (based on the 2011 census), we calculated sample size (via RAAB6 software) assuming a 2.23% blindness prevalence from prior local data (Tribal District and Taluka | About Us | Tribal Development Department, n.d.), 80% power, 95% confidence level, 20% precision, design effect 1.5 and a 90% response rate.

We enrolled 4,850 individuals from 97 clusters. In each cluster, one segment of approximately 50 eligible individuals aged ≥ 50 years was randomly selected. Starting from a random household in a randomly chosen direction, teams walked sequentially, enrolling adults ≥ 50 until 50 were examined. Eligible participants had resided in the household at least six months; those refusing consent or unable to participate were excluded.

Data were collected using the RAAB6 mobile application (mRAAB) following standard protocol. After informed consent, participants underwent structured interviews and standardized eye examinations. Presenting visual acuity (PVA) was measured (tumbling-E at 6 m) with spectacles if worn; pinhole acuity was tested if PVA was $< 6/12$. Lens status was assessed by torchlight (classified as normal, opacity, pseudophakia, aphakia, or no view); if the cause of vision loss was unclear, pupils were dilated (0.5% tropicamide) and the posterior segment examined with a direct ophthalmoscope.

The principal cause of vision loss for each eye was recorded in the application per RAAB definitions. (RAAB Instruction Manual, n.d.) If multiple conditions coexisted, the cause most easily treatable or preventable was assigned, as per RAAB protocol.; if both eyes had different causes, the more preventable or correctable condition (e.g. cataract over diabetic retinopathy) was used. Causes were classified as avoidable (treatable or preventable by basic or specialized care, e.g. refractive error, cataract, corneal disease, glaucoma, diabetic retinopathy, AMD) or non-avoidable (other posterior segment or central nervous system disorders). (GBD 2019 Blindness and Vision Impairment Collaborators & Vision Loss Expert Group of the Global Burden of Disease Study, 2021)

The data entered in the RAAB mobile application was then compiled into spreadsheet using Microsoft® Excel® 2019 MSO (Version 2505 Build 16.0.18827.20102) 64-bit and statistical analysis was done using the RAAB software.

RESULTS

In our survey, 4734 individuals were examined after excluding non-responders (response rate: 97.6%). Among these 2543 (53.72%) were females. The average age of the population under study was 61.49 years.

The sample prevalence of blindness and visual impairment was found to be 2.05% and 23.76%, respectively. The age group of 80 years and above showed highest prevalence of blindness (15.89%) and visual impairment (54.67%). While blindness was more prevalent among

females (2.28%), visual impairment was slightly more common in males (25.01%). (Table 1).

The odds ratio for blindness and severe visual impairment among females were found to be statistically higher; 1.28 [95% Confidence Interval: 0.85–1.94] and 1.52 [95% Confidence interval: 1.01 – 2.30] respectively.

Among treatable causes of blindness, untreated cataract was the most prevalent, accounting for 80.4% of total blindness in the sample population. Uncorrected refractive error was the leading cause of Early visual impairment (51.9%). The sample prevalence of visual impairment caused by uncorrected refractive error was found to be 7.54% (males: 3.9%, females: 3.64%). Corneal opacity caused 4.1% of total sample blindness which could have been prevented by primary health/eye care services. Blindness due to non-avoidable causes was found to be around 8%, resulting from posterior segment diseases and globe/central nervous system diseases. (Table 2).

Cataract accounted for a significant share of visual impairment and blindness, with 812 cases (17.15%) identified in the survey population. Of these, 65 individuals (8.0%) were bilaterally blind and 35 individuals (4.31%) were unilaterally blind due to cataract. The burden was higher among females (53.94%), who comprised 64.1% of cataract-related blindness, 65.6% of severe visual impairment cases, and 54.11% of moderate visual impairment cases. Conversely, early visual impairment due to cataract was slightly more prevalent among males; 52.49%. As expected, cataract predominantly affected older individuals, with 79.43% of cases occurring in those aged over 60 years, underscoring the age-related progression of the disease. (Table 3).

The survey identified 169 individuals with bilateral pseudophakia (i.e., operated for cataract in both eyes). The majority of these individuals achieved good visual outcomes, with presenting visual acuity of 6/12 or better in one or both eyes. Out of these, 33 individuals (19.5%) continued to experience bilateral visual impairment or blindness post-cataract surgery. Of the three who remained bilaterally blind, two cases were due to cataract surgical complications and one was attributed to a posterior segment disorder. Other causes of visual impairment in this group included posterior capsular opacification (PCO), uncorrected refractive error, retinal or optic nerve diseases.

Table 3: Age-wise and Gender-wise Distribution of Prevalence of Cataract. N = 812

Age group in years	Blindness		Severe VI		Moderate VI		Early VI		Total %	Prevalence in respective age groups
	Male %	Female %	Male %	Female %	Male %	Female %	Male %	Female %		
50-59	0.37	0.74	0.86	1.23	3.08	4.06	4.93	5.3	20.57	6.78%
60-69	1.6	0.99	1.35	2.22	8.49	10.1	9.97	7.14	41.87	22.86%
70-79	0.99	2.46	1.23	2.46	5.3	6.4	3.57	4.43	26.85	38.11%
≥ 80	0.49	1.97	0.49	1.6	2.34	2.1	0.99	0.74	10.71	40.65%
Total	3.45	6.16	3.94	7.51	19.21	22.66	19.46	17.61	100	17.15%

DISCUSSION

The tribal population faces unique challenges stemming from social diversity, geographic isolation, and economic hardships, limiting their access to education and essential healthcare. As a result, awareness about issues like visual impairment is often low, leading to limited access to eye care services. This study assessed the prevalence of causes of visual impairment and blindness in people aged 50 years and above, living in the tribal areas of South Gujarat and adjacent Maharashtra, highlighting age- and gender-specific trends. To the best of our knowledge such RAAB survey has been conducted for the first time in tribal population at boundary of South Gujarat and Maharashtra.

Our survey saw higher female participation, which was consistent with the findings of studies conducted in Navsari (54.6%), Karnataka (53%) and tribal areas of Andhra Pradesh (55.7%).(Murthy et al., 2010) (Guruprasad et al., 2013)(Singh et al., 2014) This may be due to men being outdoors during survey hours. The mean age of participants (61.49 years) was comparable to the national RAAB survey findings (61.6 years).(Vashist et al., 2022)

The prevalence of blindness in our survey was found to be comparable to the National Survey 2015-19 and conducted in the tribal areas of Andhra Pradesh and Siwan, Bihar (Singh et al., 2014; Vashist et al., 2022)(Poddar et al., 2020). The prevalence rate of blindness in urban underprivileged population of Pune, Maharashtra was less than that in our survey.(Kulkarni et al., 2019) The rate of visual impairment observed in the National Survey 2015-19 (26.68%) and that observed

Table 1: Age and Gender – Wise Prevalence of VI and Blindness

Age Groups (years)	Population surveyed	Blindness Prevalence (%)	Visual Impairment Prevalence (%)
50-59	2461	0.45	9.79
60-69	1487	1.21	32.08
70-79	572	5.94	50.7
>80	214	15.89	54.67
Gender			
Males	2191	1.78	25.01
Females	2543	2.28	22.68
Total	4734	2.05	23.76

Table 2: Causes of Visual Impairment and Blindness

Intervention Category	Cause	Blindness (%)	Severe VI (%)	Moderate VI (%)	Early VI (%)
Treatable	Untreated Cataract	80.4%	93.9%	94.18%	45.28%
	Refractive Error	0.0%	2.1%	2.77%	51.87%
	Pterygium	0	0	0.55%	0.45%
Preventable (by PHC/PEC services*)	Corneal Opacity (Non-Trachomatous)	4.1%	0.0%	0.3%	0.15%
	Phthisis Bulbi	3.1%	0.0%	0.0%	0.0%
Preventable (by Ophthalmic services)	Cataract Surgical Complications	3.1%	0.0%	0.55%	1.8%
	Glaucoma	1.0%	0.0%	0.55%	0.0%
	Age-Related Macular Degeneration	0.0%	0.0%	0.55%	0.0%
Non-Avoidable	Posterior Segment Disease (Other)	3.1%	3.0%	0.55%	0.45%
	All Globe/CNS Abnormalities	5.2%	1.0%	0.0%	0.0%
Total		100.0%	100.0%	100.0%	100.0%

* Primary health/eye care services

in the survey conducted in the neighbouring district of Surat (29.3%) was slightly more than in our survey.(Vashist et al., 2022)(Murthy et al., 2010) The variations in the prevalence rates of visual impairment and blindness could be due to geographic, economic and social differences in the population studied.

Similar to our survey, the national survey 2015-19 also showed the highest prevalence of blindness and visual impairment in the age group ≥ 80 years, 11.62% and 67.33% respectively.(Vashist et al., 2022) It seems increased life expectancy has resulted in elderly people living with ocular or systemic diseases causing visual impairment and blindness and therefore this age group reports higher prevalence in various studies.

The higher prevalence of blindness among females observed in our survey is consistent with findings from the national RAAB survey and the study conducted in Nandurbar, Maharashtra, both of which also reported higher rates of blindness among women. (Vashist et al., 2022)(Dhake et al., 2011) This trend reflects underlying societal dynamics, wherein male family members are more likely to seek timely eye care, while females may delay addressing ophthalmic issues until vision loss becomes severe or functionally limiting.

Untreated cataract emerged as the leading cause of blindness, severe visual impairment, and moderate visual impairment in the study population. This remains a concerning paradox given the high Cataract Surgical Coverage (CSC) of 99.2% reported by the National Survey (2015–19) in Gujarat.(Vashist et al., 2022) The continued burden of

cataract-related visual impairment in tribal areas can largely be attributed to limited awareness about the availability and importance of early surgical intervention, despite such services being provided free of cost at government facilities. Delays in seeking care until vision loss becomes disabling contribute significantly to preventable blindness. Additionally, we observed that older age and female gender were associated with higher rates of cataract-related severe visual impairment and blindness. This reflects underlying socio-cultural and logistical barriers to accessing eye care, particularly among women and the elderly. These findings are consistent with similar patterns reported in urban underprivileged populations of Pune; Mahabubnagar in Telangana, and Siwan in Bihar (Kulkarni et al., 2019) (Mactaggart et al., 2018; Poddar et al., 2020)

Uncorrected refractive error was found to be the leading cause of early VI in our survey. This was consistent with findings from other studies and the national survey (2015–19) (Murthy et al., 2010), (Guruprasad et al., 2013), (Dhake et al., 2011), (Singh et al., 2014), (Patil et al., 2014), (Vashist et al., 2022). This is largely because most people either do not get their vision tested for screening of refractive errors or don't have access to affordable corrective lenses.

Our survey shows around 7% of the VI and blindness is caused by

Table 4: Comparison Between Current Survey and Previous RAAB Surveys Done in India.

Parameter	Current tribal study (2023)	Murthy et al. (2010)	Guruprasad et al. (2011)	Chariwala et al. (2011)	Dhake et al. (2011)	Singh et al. (2014)	Patil et al. (2014)	Mactaggart et al. (2018)	Kulkarni et al. (2019)	Poddar et al. (2020)	Vashist et al. (2015–19)
Country	India	India	India	India	India	India	India	India	India	India	India
Region	S. Gujarat & Maharashtra	Gujarat	Kolar, Karnataka	Surat, Gujarat	Nandurbar, Maharashtra	Tribal Andhra Pradesh	Sindhudurg, Maharashtra	Mahabubnagar, Telangana	Urban Pune	Siwan, Bihar	National
Age Group	≥ 50 yrs	≥ 50 yrs	≥ 50 yrs	≥ 50 yrs	≥ 50 yrs	≥ 50 yrs	≥ 50 yrs	All Ages	≥ 50 yrs	≥ 50 yrs	≥ 50 yrs
No. Examined	4,734	4,738	2,907	2,137	2,005	7,281	2,737	3,574	3,221	3,189	85,135
Major Causes of VI & Blindness	Cataract, Globe/CNS disorders, CSC	Cataract, RE, Posterior segment disease	Cataract, RE, Aphakia	Cataract, RE, Corneal scars	Cataract, Globe abnormalities	Cataract, RE, Aphakia	Cataract, DR, Corneal scars	Cataract, RE, Glaucoma	Cataract, PSD	Cataract, RE, DR	Cataract, corneal opacity, CSC, PSD, glaucoma, RE
Cataract (% blindness)	80.4% blindness; 94% VI (est.)	82.6%	74.6% blindness; 73.3% SVI	67.3%	76%	70.3%	82.4%	75% (in ≥50 yrs)	45.7%	73% blindness; 93% SVI	66.2%
Avoidable Blindness (%)	91.8% blindness; 99.6% VI	High (implied)	91.2% blindness; 95.0% SVI	>90%	High (implied)	88.5%	95.3%	High (implied)	69.6%	High (implied)	92.9% blindness; 97.4% VI

CONCLUSIONS

This tribal survey highlights a substantial but preventable burden of vision loss, with untreated cataract and uncorrected refractive error emerging as the primary causes. Higher prevalence among women reflects enduring socio-cultural barriers to care. Geographic remoteness and limited health infrastructure further delay diagnosis and treatment. Most vision loss is avoidable through timely screening and cost-effective interventions, underscoring the need to integrate eye care into primary health services. Targeted, equitable strategies are essential to address disparities and improve outcomes in underserved populations.

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posterior segment diseases, lesser proportion of which might be due to masking of these conditions under avoidable conditions like cataract because as per our survey protocol “condition most readily treatable” was registered as primary cause of vision loss in an eye with more than one comorbidity.

The presence of blindness and visual impairment after cataract surgery in both eyes was proportionately low, it highlights the importance of comprehensive postoperative care, including regular follow-up, refractive error correction, and screening and management of treatable posterior segment complications; commonest being posterior capsular opacification. This will ensure optimal visual outcomes after cataract surgery.

Most studies indicated that the avoidable blindness accounted for majority of the total burden with cataract being the commonest cause in all the studies. (Table 4). To truly combat the burden of avoidable blindness, efforts must go beyond increasing surgical access: they must emphasize quality visual outcomes, ensure gender equity in access to eye care services, integrate comprehensive post-operative care (including patient counselling, refractive follow-up, and complication monitoring), and strengthen community-based programmes that support adherence and long-term follow-up.

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