Rapid Assessment of Refractive Error (RARE) in Kasganj District, Uttar Pradesh

2.5 new VISION generation™
An EssilorLuxottica initiative

Sightsavers India

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Abbreviations

CI	Confidence Interval
CSC	Cataract Surgical Coverage
DDO	Distant Direct Ophthalmoscopy
EVI	Early visual impairment
ICD	International Classification of Disease
MVI	Moderate visual impairment
PPS	Proportional Probability to Sample Size
PSU	Primary Sampling Unit
RAAB	Rapid Assessment of Avoidable Blindness
RARE	Rapid Assessment of Refractive Error
RE	Refractive Error
REC	Refractive Error Coverage
SVI	Severe visual impairment
URE	Uncorrected Refractive Error
VA	Visual Acuity
VI	Visual impairment
WHO	World Health Organisation

Executive Summary

Over two billion individuals globally face vision impairment, with one billion having preventable or unresolved conditions, primarily attributed to uncorrected refractive error (URE). URE is a critical public health challenge, affecting productivity and quality of life, especially in low and middle-income countries. Despite cost-effective interventions, the Global Action Plan 2014-2019 emphasizes the need to address URE, with a focus on effective service delivery models.

This study aims to assess barriers to refraction service uptake in Kasganj, Uttar Pradesh, for individuals aged 15-49. Specific objectives include determining the prevalence of visual impairment due to URE and presbyopia, spectacle coverage, and identifying barriers/enablers to obtaining spectacles. A population-based cross-sectional study was conducted, involving a sample of 3250 respondents selected through cluster random sampling methodology. Data collection took place in June and July 2023, utilizing non-invasive methods and a structured questionnaire. A team comprising a trained vision technician and a field worker visited the households and conducted the eye examination. Presenting, pinhole and aided visual acuity were assessed. Anterior segment was examined using a torchlight. Lens was examined using distant direct ophthalmoscopy.

A total of 3167 participants (97.5%) underwent examination. Although the number of women examined was lower than men (1557 vs. 1610), the response rate was higher among women at 98.4% compared to males at 96.52% (p = 0.002). The mean age of participants in the sample was 29.9 years. The prevalence of spectacle use was 3.56%, with a higher proportion in the 40-49 age group and those with higher education. Females in the 15-29 age group showed higher spectacle use. The age and sex-adjusted prevalence of visual impairment was 1.9%, higher in those above 40 years. Uncorrected refractive error accounted for 78% of cases, followed by cataracts and corneal opacity. URE was the principal cause of visual impairment in 78.08% of cases. The age and sex-adjusted prevalence of URE was 3.33%, with a higher prevalence among females. Among people above 35 years, 42.65% had presbyopia, and only 14.66% had access to near glasses. Spectacle coverage for females was notably lower than for males. REC was calculated as 30.38%, and effective refractive error coverage (eREC) as 27.85%, indicating a gap in meeting the population's refractive needs. The primary reported barrier to accessing refractive error services was the distance from these services. Approximately 33% of females cited social reasons as the next most common obstacle. Among men with uncorrected refractive error (URE), about 25% did not feel the need for glasses. However, approximately 15% of males and 7% of females reported that they could not afford glasses.

In conclusion, the survey provided crucial insights into visual impairment, uncorrected refractive errors, and spectacle use. Uncorrected refractive errors, especially in individuals above 40, emerged as a significant cause of visual impairment (78%). Despite relatively low spectacle coverage, barriers to accessing refractive error services, like distance, were identified. Addressing these issues and enhancing access to eye care services, particularly for uncorrected refractive errors, is vital to alleviate the burden of visual impairment. Additionally, interventions targeting improved spectacle coverage and access, especially for those with presbyopia, could enhance overall eye health and quality of life in the community.

Introduction

At least 2.2 billion individuals worldwide are experiencing some form of vision impairment, and out of this population, approximately 1 billion people are affected by conditions that could have been prevented or remain unresolved.[1] The primary contributor to these vision impairments is uncorrected refractive error. Research indicates that the prevalence of vision impairments is notably higher in low and middle-income countries compared to high-income nations. Furthermore, refractive error has a substantial impact on the quality of life within society.[2,3] According to a national survey conducted in India between 2016 and 2019, refractive error was identified as the leading cause of visual impairment in individuals under the age of fifty, affecting 29.6% of this population.[4]

The WHO's recent report on 'Universal Eye Health: A global action plan 2014–2019'highlights the need for regional surveys to generate evidence on the magnitude and causes of VI.[5] It also recommends that the member states target 25% reduction in the prevalence of VI from 2010 baseline.[5] This underscores the importance of periodic regional surveys as a mechanism to understand both the burden and the trends in the prevalence of VI over time and to plan strategies to address it. Grams RC described prevalence of the uncorrected refractive error was 2.7% (95% CI, 2.1-3.2) among the 15-49 years of population in India, the Survey was based on the Rapid Assessment of Refractive Error (RARE) strategy. [6]

Refractive error (RE) is one of the most common ocular conditions affecting all age groups and a priority under the VISION 2020 initiative. Most REs can be easily corrected at the primary care level with spectacles. Despite the availability of a cost-effective intervention to address this problem, uncorrected refractive error (URE) is a major public health challenge Unaddressed refractive errors (including unaddressed Presbyopia) are increasingly being recognized as a public health priority. Vision 2020 priorities and key strategies of the Global Action Plan 2014 to 2019 continue counsel on reducing uncorrected refractive error and emphasize the effective service delivery models.[5,7] Primary care services can correct refractive errors through an effective service delivery model for spectacle correction.[7] The Rapid Assessment of Refractive Error (RARE) Survey collects data on uncorrected refractive error and presbyopia in the young population, which can help in addressing the issue and improving service delivery and the methodology was tested in India in 2009. [8,9]

Rationale

Few research studies have noticed regional variability in the prevalence of visual impairment and others also supported uncorrected refractive error rose the problem of life and livelihood and the effect of productivity. Rapid assessment have proven to be invaluable tools in this aspect.[8] Rapid data collection at low cost, using local resources, and high repeatability at regular intervals to study trends have been the strengths of rapid assessment methods.[8] Rapid Assessment of Refractive Errors (RARE) in a methodology that focuses on younger age groups. It is used to assess the prevalence of uncorrected refractive errors. [9] This study will help to understand the eye magnitude of the refractive error and barriers among those unable to uptake spectacles among who's aged below fifty years in the district Kasganj, Uttar Pradesh.

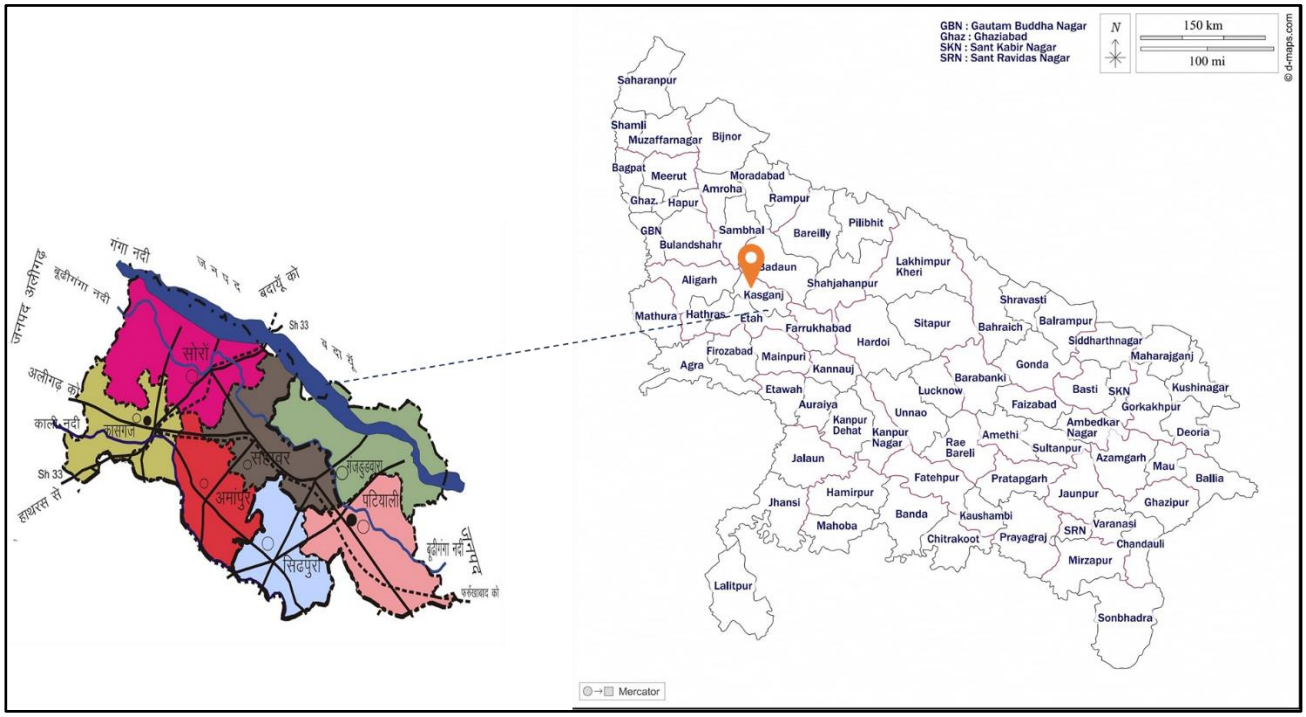
This study will be the first study which is looking at the prevalence of refractive error, effective spectacle coverage and barriers to update spectacles (distance and near) in the district Kasgnaj.

Study Location

Kasganj is one of the North Indian districts in the state of Uttar Pradesh. Kasganj is formerly called as Kanshi Ram Nagar and formed in the year 2008. The district spread across area of 1955 sq.km, with 715 villages with a sex ratio of 880. As per 2011 census, the total population size was 14,36,719/- and 237,311 households.[10] The district has 7 administrative blocks Sahawar, Kasganj, Patiyali, Soron, Gunjdundwara, Amanpur and Sidhpura. With regard to health infrastructure, a district hospital, 7 community health centres, 29 Primary Health Centres and 170 Sub Centres are there in Kasganj. Sightsavers India is being implementing Rural Eye Health Programme in the district of Kasganj partner with Christian Mission Hospital.

Sightsavers India had conducted a Rapid assessment of avoidable blindness (RAAB) survey in 2022 in the district targeting people 50 years and above. Age and gender adjusted analysis estimated that the prevalence of blindness amongst this age group was 3.5% (95% CI, 2.8 – 4.3%). Prevalence of Severe VI, Moderate VI and Early VI were 1.9%, 9.1% and 7.7% respectively. These values were considerably higher than the national average values (Blindness 1.99%). [11]

Figure 1- Kasganj District Map



Aim and Objectives

The prime objective of this study is to assess the barriers to the uptake of refraction services in the age group of 15 to 49 years in Kasganj district of Uttar Pradesh. Further this assessment assessed the prevalence of visual impairment due to uncorrected refractive error.

Specific objectives

1. To determine the prevalence of visual impairment due to Uncorrected Refractive Error (URE) and Presbyopia among those aged between 15 to 49 years in the district Kasganj, Uttar Pradesh-India.
2. To determine the spectacle coverage among those aged between 15 to 49 years of population in the study district of Kasganj, Uttar Pradesh-India.
3. To determine the barriers and enablers to obtaining spectacles among those aged between 15 to 49 years in the study district of Kasganj, Uttar Pradesh-India

Methodology

We conducted a descriptive cross-sectional population-based survey in Kasganj district, Uttar Pradesh, India, to evaluate the prevalence of visual impairment caused by uncorrected refractive error (URE) among individuals aged 15 to 49 as per the International Classification of Disease 11 (ICD-11). Our survey teams employed non-invasive methods consistent with recommended approaches for similar epidemiological studies to assess the overall eye health of the participants. This evaluation encompassed the determination of visual acuity (both for distance and near vision) and the identification of any significant eye conditions, such as cataracts, that might be responsible for any observed visual impairments. Additionally, we utilized a pre-tested structured questionnaire to gather information from the respondents regarding their use of eyeglasses and the barriers and facilitators influencing their access to refractive error services.

Sample size

In this research, we utilized the RAAB (Rapid Assessment of Avoidable Blindness) toolkit to calculate the sample size. We considered an estimated prevalence of blindness at 3.30%, with the goal of achieving a 20% level of precision, 90% confidence intervals, while also factoring in a design effect of 1.5. This calculation led to a sample size of 3250, based on a cluster size of 50. As a result, we proceeded to randomly select a total of 66 study clusters, with each cluster comprising 50 individuals in the age range of 15 to 49 years. Following parameters have been used to select the sample size.

Parameters		Cluster Sampling with confidence 95% and interval Random Sampling			
		Cluster size	Design effect	Sample Size	No. of cluster
Population Size	2000000				
Expected Frequency	3.30	**50**	**1.5**	**3250**	**66**
Acceptable Variation of Frequency	20%				
Non-Compliance	10%				

Note: RAAB-Software used W.G Cochran formula for sample size calculation

$$N = \frac{P(1-P)Z^2}{d^2}$$

N = Sample size

P = Proportion (if not known, use 0.5)

Z= Represent confidence; the value is from Z-score table.

- If the confidence at 95% , Z=1.96
- **If the confidence at 90%, Z= 1.64**

d= Acceptable Error

Sampling Procedure

We used a two-stage sampling approach, starting by randomly selecting primary sampling units (PSUs), which were villages, based on the probability proportionate to size (PPS) method. Subsequently, 66 villages were chosen using the PPS principle through the RAAB6 software. Each selected village was subdivided into segments, each containing a minimum of 250 households. One segment was randomly chosen, and all households within it were surveyed until we reached the target cluster size of 50 eligible participants, following the Compact segment sampling method. After establishing village and segment boundaries, the cluster informer informed the study team and provided a map. The team initiated the survey within the chosen segment, recording the number of eligible respondents in each household as reported by the head. All eligible household members were included in the study, regardless of their availability at the time of the survey.

Inclusion and Exclusion Criteria

Inclusion Criteria

1. Age 15-49 years and willing to participate in the study.
2. Permanent resident of the selected household* and cluster for a minimum of 6 months

Exclusion Criteria

1. Age less than 15 and above 49 years
2. Temporary visitors of non-household members
3. If the person is not well/having any health problem
4. Not willing to be involved in the study.

Ethical consideration

The study protocol received approval from the Institutional Review Board at Sigma Research and Consulting Private Limited in Delhi, India. When conducting the survey, the following key considerations were considered with care:

- The survey's purpose and nature were clearly communicated to the respondents. We dedicated the initial moments to establishing a rapport with the participants and addressing any concerns they had about the data requirements.
- Consent was obtained from every respondent before initiating the data collection process. For respondents aged 15-17 years, guardian consent was also sought.
- Confidentiality of the information shared was ensured and the same and conveyed to the respondents.
- All COVID-19 related precautionary measures were taken by the field team during data collection phase, including maintaining distance from the respondents, wearing mask and sanitization of hands regularly.

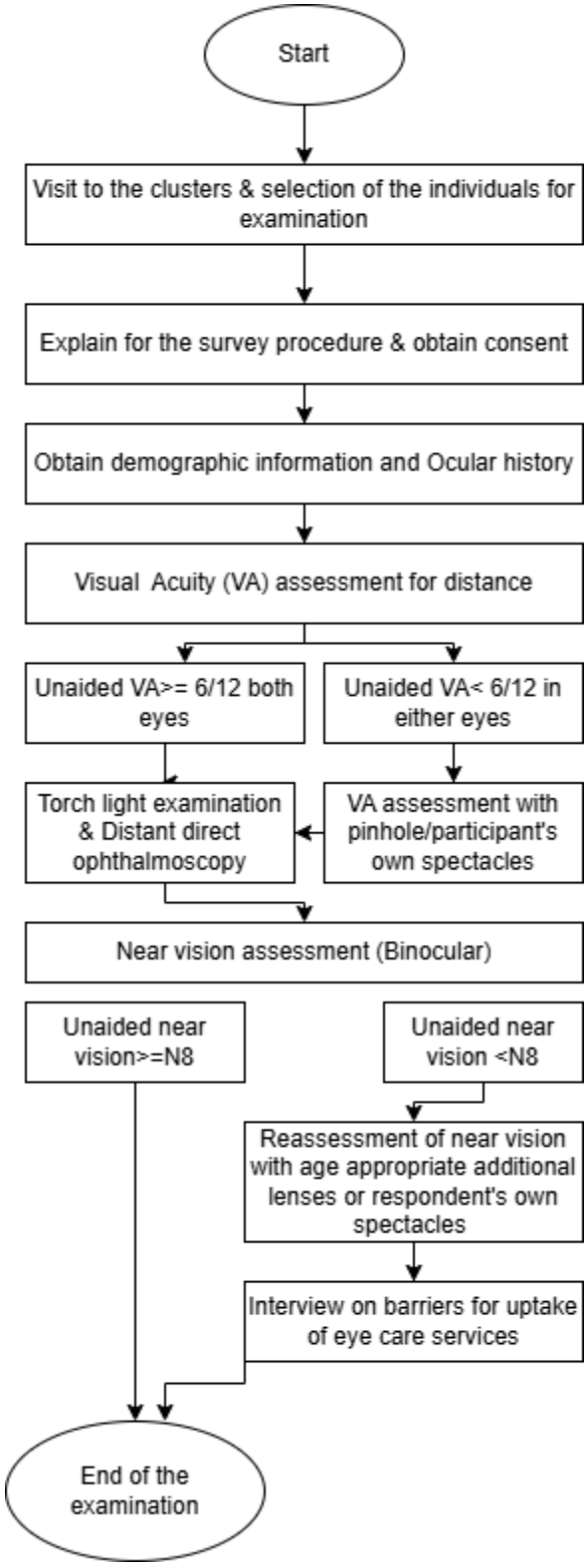
Eye Examination protocol

A standardized pre-tested protocol was used for assessment of eye health status for the eligible participants. This involved, measurement of unaided and aided visual acuity (VA) in each eye using a Snellen chart with tumbling "E" optotypes at 6 meters. Participants with VA less than 6/12 in either eye, were re-assessed using a multiple pinhole.

Near vision was assessed binocularly using the N notation chart at a fixed distance of 40 cm used for individual 35 years and older. Torchlight examination was performed to assess the anterior segment of the eye. Lens status was assessed by using torchlight and distant direct ophthalmoscopy (DDO) in a shaded environment without pupillary dilatation.

Demographic information, including current and previous used of spectacles was collected through questionnaire method. A question on barriers to the uptake of eye care services was administered to all participants with visual impairment.

Figure 2 – Flowchart showing study procedures.



Definitions

- **Visual Impairment (VI)** was defined as presenting visual acuity worse than 6/12 in the better eye. VI was subdivided into blindness (worse than 3/60), severe visual impairment (worse than 6/60 to 3/60), moderate visual impairment (worse than 6/18 to 6/60), and mild visual impairment (worse than 6/18 to 6/12).
- **Uncorrected Refractive Error (URE)** was defined as presenting visual acuity worse than 6/12 that has improved to 6/12 or better with pinhole.
- **Presbyopia** was defined as binocular, near vision <N8 at the participant's customary working distance for participants aged over 35 years and those who had binocular distance visual acuity of 6/12 or better.
- **Refractive Error Coverage (%)** was defined according to McCormick and colleagues.13-15 'Met need' was defined as unaided VA worse than 6/12 that improved to 6/12 or better with their current spectacles. 'Unmet need' was defined as unaided VA worse than 6/12 that improved to 6/12 with pinhole among those without spectacles. 'Under-met need' was defined as aided VA worse than 6/12 that improved with pinhole to 6/12 or better. The sum of 'met need,' 'unmet need,' and 'under-met need' was considered as 'total need.'
- **Effective Refractive Error Coverage (e-REC)** is calculated as follows: e-REC (%) = ((met need)/(total need)) X100.
- **Refractive Error Coverage (%)** was calculated as: REC (%) = (met need + under-met need)/(total need) X100. REC (%) is similar to Spectacle Coverage (%) reported in other studies.
- **Relative gap between REC (%)** and e-REC (%) was calculated as follows: Relative Quality gap (%) = 1-(e-REC/REC) X100.

Training

The survey team was trained on the survey protocol including non-invasive eye tests like visual acuity assessment and torchlight examination. Optometrists and Community Health Workers were trained for a period of 2 days and undergo an inter-observer agreement (IOV) test to ensure high level of agreement between the teams and thus high data quality.

Pilot Study

The pilot study was conducted in 2 clusters before the launch of the main study for validating data collection instruments and fine-tuning the workflow including.

- Visual Acuity measurement
- Identification of cause of visual impairment

Data collection, management, and analysis

The survey was conducted during June and July 2023. In total, 3,250 participants were surveyed during this study. Inclusion criteria were all the participants aged 15-49 years who were permanent residents of the household and a cluster for minimum of 6 months and who were willing and consented to participate. The participants who were less than 15 years old

and above 49 years, temporary visitors of non-household members, were sick at the time of recruitment or who refused to participate following a short explanation about the study purpose were excluded from participating in the survey. The visits to the clusters were made during the time when most of the people were likely to be available, i.e., early mornings and evenings. At least two attempts were made for those who were not available at first visit. The participants who were not available after multiple visits were marked as 'non-available' participants and were not substituted.

Surveys were conducted using a pre-tested, structured questionnaire. Local investigators were recruited and trained to conduct informed consent and administer the survey via Commcare application, a web-based application. Quality checks (skip patterns, relevance, and constraints) were developed in the application and surveys reviewed to ensure quality and accuracy. Investigators provided a paper copy of the consent form for reference and verbally read the entire form to each potential study participant prior to enrolment. Participants who agreed to participate in the study were then verbally consented by the investigator and their consent noted within the web-based survey application prior to starting the survey. All surveys were conducted in person in the most private setting available and each survey took approximately 45 minutes.

The data quality was monitored through supportive supervision and back-checks. Any discrepancies were resolved through discussion with the respective field investigators. Regular debriefing sessions by the supervisor/site coordinator allowed identifying and resolving any emerging issue(s) in data collection.

Data analysis was conducted using STATA Statistical software for windows, version 12.

Results

The survey enrolled 3250 participants from the selected 66 clusters. Of these 3167 (97.5%) were available and willing to participate for data collection. While the number of women examined was lower than men (1557 vs 1610), the response rate was higher amongst women 98.4% compared to males 96.52 (p= 0.002).

Table-1 Eligible persons, coverage, absentees, and refusals

	Examined		Not Available		Refused		No Response		Total
Male	1610	96.52%	31	1.86%	21	1.26%	6	0.36%	1668
Female	1557	98.42%	9	0.67%	15	0.95%	1	0.06%	1582
Total	3167	97.45%	40	1.23%	36	1.11%	7	0.22%	3250

The mean age of participants in the sample was 29.9 years. Men in the age group of 20-29 years formed the largest group (16.07%) while 15–19-year-old men were least represented (9.8%). Compared to the population distribution (based on extrapolation form the 2011 census data), there was significant under-representation of 15–19-year-old males (sample 9.8%, population 13.4%) and over-representation of both males and females in the 40-49 years age group (Males in sample 13.4% vs 10.1% in population and females 12.0% in sample vs 8.7% in

population). This may have led to over-estimation of the prevalence of visual impairment and URE but the results were adjusted using direct standardization.

Majority of examined cases were either illiterate (31.5%) or educated up to high school only (39.2%). Most of the men in the group reported to be employed as unskilled laborers (57.6%) while almost 80% women were housewives. Students constituted 19.1% of the sample.

Table- 2 Demographic information of participants

	N	%
Age Group		
15-29	1644	51.91
30-39	717	22.64
40-49	806	25.45
Gender		
Male	1610	50.84
Female	1557	49.16
Spectacle use		
Using Glasses	132	4.17
No Glasses	3035	95.83
Education		
No Education	997	31.43
Primary school	413	13.04
High school	848	26.78
Intermediate & above	909	28.7
Occupation		
Student	607	19.17
Unskilled lab	946	29.87
Skilled lab/Small business	333	10.51
Unemployed/Homemaker	1281	40.45

Spectacle use

At the time of examination, 132 subjects were using spectacles. Age and gender adjusted prevalence of spectacle use was 3.56%, 95% CI 2.71- 4.41%.

Sixty-nine (52%) cases were wearing single vision near glasses whereas 47 (35%) were using single vision distance glasses. Only 16 (12%) subjects were using bifocal spectacles. Most cases (84%) received their glasses from an optical shop or a private clinic (14%) and nearly all (98%) were purchased against out-of-pocket payment.

While there was no significant difference in spectacle use amongst men and women, it was observed that in the 15-29 years age group, a higher proportion of females were using spectacles as compared to men (2.43% females and 0.98% males). Inversely, in the 40- 49 years age group, more men were observed to be using eyeglasses (12% men and 9.48% women).

Table- 3 Association of spectacle wear and demographic variables (n=132)

	N	%	Odds	95% CI
Age Group				
15-29	28	21.21	1.00	
30-39	17	12.88	1.09	0.76-2.58
40-49	87	65.91	8.76	4.52-10.79
Gender				
Male	68	51.52	1.00	
Female	64	48.48	0.97	0.68-1.38
Education				
No Education	28	21.21	1.00	
Primary school	16	12.12	1.39	0.75-2.61
High school	50	37.88	2.17	1.35-3.48
Intermediate & above	38	28.79	1.51	0.92-2.48
Occupation				
Student	16	12.12	1.00	
Unskilled lab.	51	38.64	2.10	1.19-3.73
Skilled lab./Small business	29	21.97	3.52	1.88-6.59
Unemployed/Homemaker	36	27.27	1.01	0.59-1.94

Logistic regression showed that the OR of using spectacles was higher for the individuals in the age group 40 - 49 years of age and those with high-school or above education. While there was some association with occupation (OR for 'Skilled labourer / small business', 3.52, 95% CI 1.88 - 6.59), this was largely due to the influence of education and age. Also, while the OR for females was lower, the association was not statistically significant.

When asked if they used glasses in the past, five subjects (4 females and 1 male) responded that they had stopped using spectacles recently. Most of them (40%) reported poor quality of glasses that got broken or scratched as the reason for discounting use.

Visual Impairment (based on better eye Presenting Va)

Seventy-three (73) cases had presenting vision less than 6/12 in the better eye. Of these 36 (49%) were males and 37 (51%) were females.

Age and Sex adjusted prevalence of visual impairment was 1.9% (95% CI 1.29 – 2.52). This was slightly higher amongst females (1.97% vs 1.84%) but the difference was not statistically significant (p= 0.715). People above 40 years age had a significantly higher prevalence of visual impairment compared to those below 40 years (7.06%, 95% CI 5.36 – 9.24 in above 40yrs vs 0.71% in under 40)

Uncorrected refractive error was the most common cause of VI accounting for 78% of cases. Others were cataract (16.5%) and corneal opacity (2.7%). Since posterior segment examination was not included in the survey design, those with no anterior segment cause for VI were reported as other posterior segment disease. These accounted for about 3% cases in the sample.

Refractive error (based on UCVA and BCVA either eye)

URE was the principal cause of visual impairment in 78.08% (57/73) subjects.

One hundred and twenty-one (121) subjects had an uncorrected distance VA less than 6/12 that improved to 6/12 with correction or pinhole in either eye. Of these 71 (58.68%) had refractive error in both eyes and 50 (41.32%) had it in one eye only. Of those with URE, only 34 (28%) were corrected with glasses and 87 (72%) were not using distance glasses.

Age and sex adjusted prevalence of URE (either eye) was 3.33% (95% CI 2.50 - 4.15%). URE amongst females was higher than that amongst males (3.7% females vs 3.0% males) but the difference was not statistically significant.

On univariate logistic regression age above 40 years was found to be significantly associated with considerably higher odds of having URE.

Table-4 Association of URE and demographic variables

	N	%	OR	96% CI	P Value
Age Group					
15-29	28	1.7	1		
30-39	17	2.37	1.38	0.79 - 2.43	
40-49	76	9.43	5.89	3.57 - 9.74	p<0.05
Gender					
Male	56	3.48	1		
Female	65	4.17	1.24	0.87 - 1.77	p = 0.235
Education					
No Education	53	5.32	1		
Primary school	16	3.87	0.72	0.42 - 1.24	
High school	36	4.25	0.84	0.48 - 1.46	
Intermediate & above	16	1.76	0.34	0.17 - 0.67	p=0.014
Occupation					
Student	13	2.14	1		
Unskilled lab	38	4.02	1.69	0.89 - 3.19	
Skilled lab/Small business	16	4.8	2.06	0.94 - 4.55	
Unemployed/Homemaker	54	4.22	1.78	1.00 - 3.16	p=0.22

Presbyopia

Of the 1088 people above 35 years of age, 464 were unable to read N8 at presentation (42.65%, 95% CI 39.7 – 45.59). While the prevalence in females (44.57%) was slightly higher than men (40.91%), this was not statistically significant. However only 68 (14.66%) of the cases had access to near glasses and spectacle coverage was considerably lower for females (9.57%) compared to males (19.66%).

Table- 5 Refractive error coverage (REC) and effective refractive error coverage

Need		n
Met Need	a	22
Under met need	b	2
Unmet need	c	55
Spectacle coverage (REC%)	(a+b)/ (a+b+c)*100	30.38%
Effective Refractive error coverage (eREC)	a/ (a+b+c) *100	27.85%
Quality gap	1- (eREC/ REC)	8.3%

Refractive error coverage

While 66 people were using distance glasses at presentation, 41 of them had uncorrected vision better than 6/12. There were 22 cases who had access to spectacles and corrected vision with glasses was improving to 6/12 or better (met need), In 55 other cases the vision with pinhole improved to 6/12 but they did not have spectacles (unmet need).

Thus, using the formula proposed by McCormick et all, refractive error coverage (REC) was calculated as 30.38% and effective refractive error coverage (e REC) as 27.85%.

Figure 3 – Flowcharts showing Effective Refractive Error Coverage

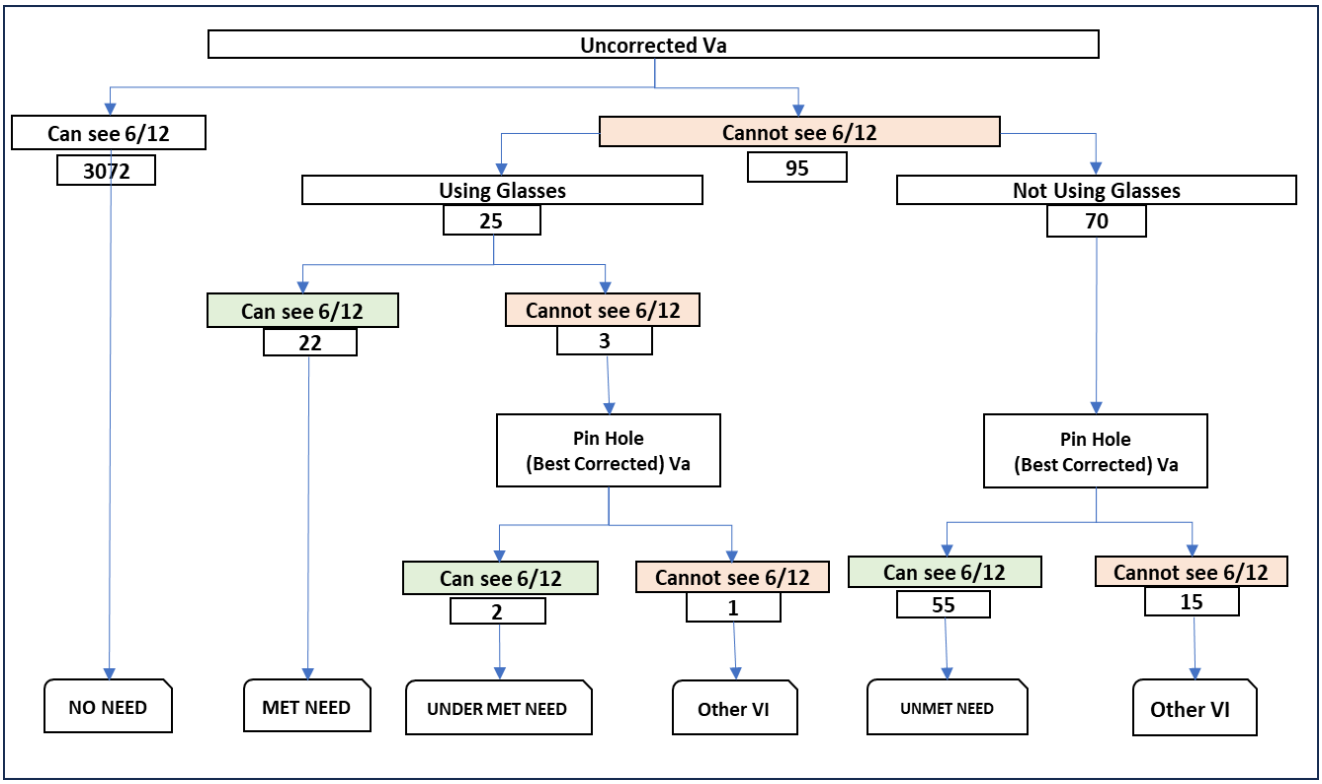


Table 6 Barriers to uptake of refractive services

	Male	Female	Total
Need not felt	25%	20%	22%
Service too far	40%	40%	40%
Cannot afford	15%	6.67%	10%
Social reasons	20%	33.34%	28%

Distance from RE services was reported as the most prominent reason for not being able to access these by both men and women. While females reported 'Social reasons' and the next most common barrier, 25% of men with URE didn't feel the 'need for glasses. Most didn't think the cost of the glasses itself was a key barrier.

Conclusion

Uncorrected refractive errors have been recognised as a significant public health problem with wide spanning impacts ranging from education to livelihood and even social development of individuals. It has also been acknowledged that URE pose considerable economic burden on the society by way of reduced productivity especially since it involves a large proportion of the working age population.

Most of the current literature on URE is based on either school age children or people above age 40- 50years. The working age group is responsible for most of the economic productivity of the society and understanding their status with respect to visual impairment and URE would be most useful to design services to suite them.

This survey indicated that while the overall prevalence of URE was only 3.3%, the coverage to services was still very low (~30%). This indicates a massive need to identify and remove the bottleneck/ barriers that are preventing individuals from accessing these services. While the relationship with level of education and occupation was not statistically strong, there is a hint that the uptake for RE services improves with higher level of literacy and job requirements. Also, gap between the coverage levels amongst the sexes, indicates a need for gendered approach of developing these services.

In conclusion, the survey provided critical insights into the prevalence of visual impairment, uncorrected refractive errors, and spectacle use within the population. The findings suggest that uncorrected refractive errors, particularly among those above 40 years of age, are a significant cause of visual impairment, accounting for 78% of cases. While spectacle coverage was relatively low, there were barriers to accessing refractive error services, including distance from service providers. Addressing these barriers and improving access to eye care services, especially for uncorrected refractive errors, is crucial to reducing the burden of visual impairment in the population. Additionally, interventions aimed at improving spectacle coverage and access, particularly for those with presbyopia, should be considered to enhance eye health and overall quality of life in the community.

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Appendices

Appendix-1: Institutional Review Board Approval

Sigma-IRB (Institutional Review Board)
(A Division of Sigma Research and Consulting Pvt Ltd)
C 23, South Extension I, First Floor
New Delhi-110049
t (+ 91 11) 41063450
www.sigma-india.in
CIN No: U74140DL2008PTC182567
IRB REG No : IORG0008260

APPROVAL DOCUMENT

Date: 19.06.2023

Name of Applicant : Dr. Sandeep Buttan

Name of Organisation : Sightsavers India

Study Title : Prevalence of Refractive Error among aged 15 to 49 years of population in district Kasganj, Uttar Pradesh-India

IRB Number: 10015/IRB/23-24

Thank you for submitting the protocol, study tools, and consent forms of the above study.

I am pleased to inform you that the above mentioned study has been approved by the Committee..

All research activities must be conducted in accordance with the approved submission. It is your responsibility to fulfil the **following requirements of approval**:

1. Changes, amendments, and addenda to the protocol, informed consent, or other study materials must be submitted to the Sigma-IRB for re-review and approval **prior** to implementation.

2. Any unanticipated problems, adverse events, protocol violations, social harm, or any new information becoming available which could change the risk/benefit ratio must be reported to the Sigma-IRB.

The Sigma-IRB concluded that the Principal Investigator has taken sufficient safeguards to carry out the study. The Sigma-IRB approves the proposal for conducting the aforesaid study. This approval is based on your revised submission of application, study protocol, tools and consent forms and any deviation from this protocol would require further approval of IRB. This is valid for one year from the date of approval, mentioned geographical location and presented sample. After the completion of the study, please submit the study report to Sigma-IRB

Signature:
Dr U V Somayajulu (Member Secretary of Sigma-IRB) Date: **19.06.2023**

Signature:
Dr. Sandeep Buttan Date: **19.06.2023**

Appendix 2- Consent form for Adults

Respondent ID |__| |__| |__| |__| |__| |__|

(To be read to participant prior to the survey)

Study title: Rapid Assessment of Refractive errors (RARE) survey in Kasganj District (Uttar Pradesh)

Introduction and Propose of the study: Hello. My name is _____. I work for Sightsavers India, and we are providing eye care services in your area. Sightsavers India is conducting this survey to assess the assess the barriers to the uptake of refraction services in the age group of 15 to 49 years in Kasganj district of Uttar Pradesh. About 3300 persons are expected to take part of this study. This result of the survey will help to implement comprehensive universal eye care in your area. Further this assessment will assess the prevalence of visual impairment due to uncorrected refractive errors, presbyopia, and spectacle coverage of your area.

Procedure: I request for your permission to be a part in the study, and you may deny if you decide not to participate. The interview will be conducted at day time (between 9.30 a.m. to 2 p.m.) as per your convenience in a private place and will take approximately 15-30 minutes. You will undergo visual acuity screening during the survey which is a harmless and non-invasive procedure. If significant refractive error is identified, we will advise formal consultation with suitable eye health services in your region. There is no monetary benefits/compensation you received if you participate this study.

Privacy and confidentiality: The information you provide during this survey will be kept confidential and used only for the specific purpose of this study. Your name or the location of your house and other information that could reveal your identity will be removed before the results of the study are made public or shared between people other than the main researchers working on the project. Your data will be transferred to computers protected by passwords. We will not speak about anything that you personally have said unless you indicate that there is a real risk to your own health. The information you tell us is strictly confidential and will not be shared with others.

Risks and benefits of participation: Before you decide whether you want to participate, it is important to listen to the following information carefully and discuss it with others if you wish. If you chose to answer these questions, there will not be a direct benefit to you but you will help us to understand how to improve the eye care services in your locality. The findings of this survey will be disseminated to relevant policy makers and health partners of your area so they can be used to inform planning of services to tackle avoidable blindness, disability, gender, and economic disparity of eye health access. Please ask me if there is anything that is not clear or if you would like more information.

Withdrawal: Participation in this study is completely voluntary. Choosing not to take part will not disadvantage you in any way. It is up to you to decide whether to take part or not. If you decide to take part, you are free to withdraw at any time and without giving a reason. You are also free to not answer any question that you do not wish to answer.

Questions and contacts: If you have any questions or concerns at a later time, you may contact the RARE investigator, Dr Sandeep Buttan at +91.11. 65955511/33.

If you have questions about the study, you can ask me now or anytime during the study. If you have any questions about your rights as a participant in this research or if you feel you have been placed at risk, you can contact the IRB Office: Sigma Research and Consulting Private Limited at Telephone number- Tel : 91.11.41063450 /email- irb.sigma@sigma-india.in

Would you like to participate? ☐Yes ☐No

Appendix 3- Consent form for Parents

Respondent ID |__| |__| |__| |__| |__| |__|

(To be read to participant prior to the survey)

Study title: Rapid Assessment of Refractive errors (RARE) survey in Kasganj District (Uttar Pradesh)

Introduction and Propose of the study: Hello. My name is _____. I work for Sightsavers India, and we are providing eye care services in your area. Sightsavers India is conducting this survey to assess the assess the barriers to the uptake of refraction services in the age group of 15 to 49 years in Kasganj district of Uttar Pradesh. About 3300 persons are expected to take part of this study. This result of the survey will help to implement comprehensive universal eye care in your area. Further this assessment will assess the prevalence of visual impairment due to uncorrected refractive errors, presbyopia, and spectacle coverage of your area.

Procedure: I request for your permission to be a part in the study, and you may deny if you decide not to participate. The interview will be conducted at day time (between 9.30 a.m. to 2 p.m.) as per your convenience in a private place and will take approximately 15-30 minutes. You will undergo visual acuity screening during the survey which is a harmless and non-invasive procedure. If significant refractive error is identified, we will advise formal consultation with suitable eye health services in your region. There is no monetary benefits/compensation you received if you participate this study.

Privacy and confidentiality: The information you provide during this survey will be kept confidential and used only for the specific purpose of this study. Your name or the location of your house and other information that could reveal your identity will be removed before the results of the study are made public or shared between people other than the main researchers working on the project. Your data will be transferred to computers protected by passwords. We will not speak about anything that you personally have said unless you indicate that there is a real risk to your own health. The information you tell us is strictly confidential and will not be shared with others.

Risks and benefits of participation: Before you decide whether you want to participate, it is important to listen to the following information carefully and discuss it with others if you wish. If you chose to answer these questions, there will not be a direct benefit to you but you will help us to understand how to improve the eye care services in your locality. The findings of this survey will be disseminated to relevant policy makers and health partners of your area so they can be used to inform planning of services to tackle avoidable blindness, disability, gender, and economic disparity of eye health access. Please ask me if there is anything that is not clear or if you would like more information.

Withdrawal: Your child's participation in this study is voluntary. Your child may decline participation at any time. You may also withdraw your child from the study at any time; there will be no penalty. Likewise, if your child chooses not to participate or to withdraw from the study at any time, and without giving a reason. You are also free to not answer any question that you do not wish to answer.

Questions and contacts: If you have any questions or concerns at a later time, you may contact the RARE investigator, Dr Sandeep Buttan at +91.11. 65955511/33.

If you have any questions about your child's rights as a participant in this research or if you feel your child has been placed at risk, you can contact the IRB Office - : Sigma Research and Consulting Private Limited at Telephone number- Tel : 91.11.41063450 /email- **irb.sigma@sigma-india.in**

Would you like to give your consent for your child to participate in the above study?

☐Yes ☐No

Appendix- 4 Child Assent form

Respondent ID |__| |__| |__| |__| |__| |__|

(To be read to participant prior to the survey)

Study title: Rapid Assessment of Refractive errors (RARE) survey in Kasganj District (Uttar Pradesh)

Introduction and Propose of the study: Hello. My name is _____. I work for Sightsavers India, and we are providing eye care services in your area. Sightsavers India is conducting this survey to assess the assess the barriers to the uptake of refraction services in the age group of 15 to 49 years in Kasganj district of Uttar Pradesh. About 3300 persons are expected to take part of this study. This result of the survey will help to implement comprehensive universal eye care in your area. Further this assessment will assess the prevalence of visual impairment due to uncorrected refractive errors, presbyopia, and spectacle coverage of your area.

Procedure: I request for your permission to be a part in the study, and you may deny if you decide not to participate. The interview will be conducted at day time (between 9.30 a.m. to 2 p.m.) as per your convenience in a private place and will take approximately 15-30 minutes. You will undergo visual acuity screening during the survey which is a harmless and non-invasive procedure. If significant refractive error is identified, we will advise formal consultation with suitable eye health services in your region. There is no monetary benefits/compensation you received if you participate this study.

Privacy and confidentiality: The information you provide during this survey will be kept confidential and used only for the specific purpose of this study. Your name or the location of your house and other information that could reveal your identity will be removed before the results of the study are made public or shared between people other than the main researchers working on the project. Your data will be transferred to computers protected by passwords. We will not speak about anything that you personally have said unless you indicate that there is a real risk to your own health. The information you tell us is strictly confidential and will not be shared with others

Risks and benefits of participation: Before you decide whether you want to participate, it is important to listen to the following information carefully and discuss it with others if you wish. If you chose to answer these questions, there will not be a direct benefit to you but you will help us to understand how to improve the eye care services in your locality. The findings of this survey will be disseminated to relevant policy makers and health partners of your area so they can be used to inform planning of services to tackle avoidable blindness, disability, gender, and economic disparity of eye health access. Please ask me if there is anything that is not clear or if you would like more information.

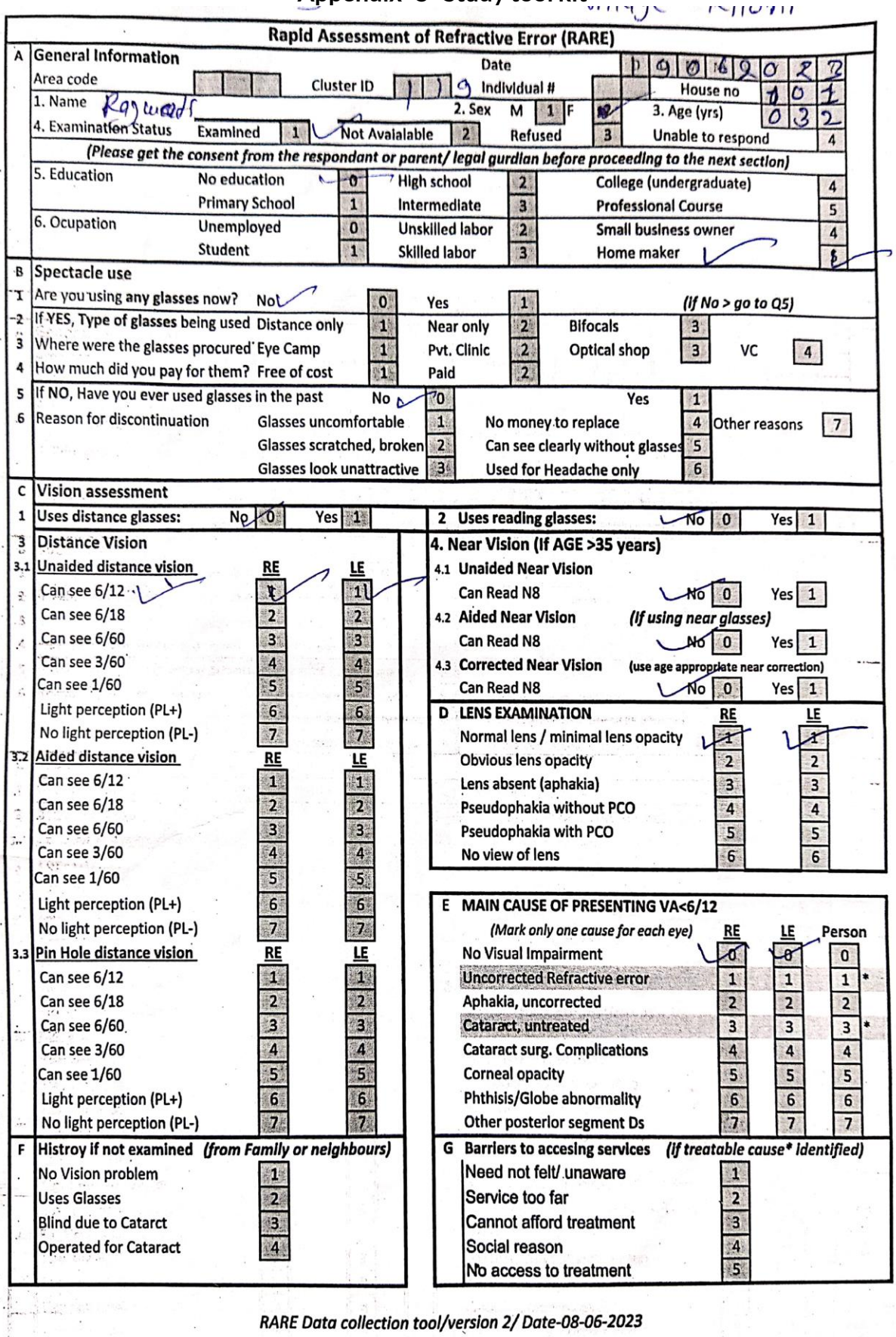
Withdrawal: Your participation in this study is completely voluntary. No one will get angry or upset if you don't want to do this. And you can change your mind anytime if you decide you don't want to be in the study anymore. You are also free to not answer any question that you do not wish to answer.

Questions and contacts: If you have any questions or concerns at a later time, you may contact the RARE investigator, Dr Sandeep Buttan at +91.11. 65955511/33

If you have questions about the study, you can ask me now or anytime during the study. If you have any questions about your rights as a participant in this research or if you feel you have been placed at risk, you can contact the IRB Office: Sigma Research and Consulting Private Limited at Telephone number- Tel : 91.11.41063450 /email- irb.sigma@sigma-india.in

Would you like to participate? ☐Yes ☐No

Appendix- 5- Study tool kit



Rapid Assessment of Refractive Error (RARE)

A General Information

Area code | Cluster ID | Date 09/06/2023 | Individual # | House no 101 | 1. Name Rajwadi | 2. Sex M 1 F 2 | 3. Age (yrs) 032 | 4. Examination Status: Examined 1 | Not Available 2 | Refused 3 | Unable to respond 4

(Please get the consent from the respondant or parent/ legal gurdian before proceeding to the next section)

5. Education: No education 0 | Primary School 1 | High school 2 | Intermediate 3 | College (undergraduate) 4 | Professional Course 5

6. Ocupation: Unemployed 0 | Student 1 | Unskilled labor 2 | Skilled labor 3 | Small business owner 4 | Home maker 5

B Spectacle use

1 Are you using any glasses now? No 0 | Yes 1 *(If No > go to Q5)*

2 If YES, Type of glasses being used: Distance only 1 | Near only 2 | Bifocals 3

3 Where were the glasses procured: Eye Camp 1 | Pvt. Clinic 2 | Optical shop 3 | VC 4

4 How much did you pay for them? Free of cost 1 | Paid 2

5 If NO, Have you ever used glasses in the past: No 0 | Yes 1

6 Reason for discontinuation: Glasses uncomfortable 1 | Glasses scratched, broken 2 | Glasses look unattractive 3 | No money to replace 4 | Can see clearly without glasses 5 | Used for Headache only 6 | Other reasons 7

C Vision assessment

1 Uses distance glasses: No 0 | Yes 1

2 Uses reading glasses: No 0 | Yes 1

3 Distance Vision

	3.1 Unaided distance vision	RE	LE
	Can see 6/12	1	1
	Can see 6/18	2	2
	Can see 6/60	3	3
	Can see 3/60	4	4
	Can see 1/60	5	5
	Light perception (PL+)	6	6
	No light perception (PL-)	7	7

	3.2 Aided distance vision	RE	LE
	Can see 6/12	1	1
	Can see 6/18	2	2
	Can see 6/60	3	3
	Can see 3/60	4	4
	Can see 1/60	5	5
	Light perception (PL+)	6	6
	No light perception (PL-)	7	7

	3.3 Pin Hole distance vision	RE	LE
	Can see 6/12	1	1
	Can see 6/18	2	2
	Can see 6/60	3	3
	Can see 3/60	4	4
	Can see 1/60	5	5
	Light perception (PL+)	6	6
	No light perception (PL-)	7	7

4. Near Vision (If AGE >35 years)

4.1 Unaided Near Vision — Can Read N8: No 0 | Yes 1

4.2 Aided Near Vision *(If using near glasses)* — Can Read N8: No 0 | Yes 1

4.3 Corrected Near Vision (use age appropriate near correction) — Can Read N8: No 0 | Yes 1

D LENS EXAMINATION

	RE	LE
Normal lens / minimal lens opacity	1	1
Obvious lens opacity	2	2
Lens absent (aphakia)	3	3
Pseudophakia without PCO	4	4
Pseudophakia with PCO	5	5
No view of lens	6	6

E MAIN CAUSE OF PRESENTING VA<6/12

(Mark only one cause for each eye)

	RE	LE	Person
No Visual Impairment	0	0	0
Uncorrected Refractive error	1	1	1 *
Aphakia, uncorrected	2	2	2
Cataract, untreated	3	3	3 *
Cataract surg. Complications	4	4	4
Corneal opacity	5	5	5
Phthisis/Globe abnormality	6	6	6
Other posterior segment Ds	7	7	7

F Histroy if not examined *(from Family or neighbours)*

No Vision problem 1 | Uses Glasses 2 | Blind due to Catarct 3 | Operated for Cataract 4

G Barriers to accesing services *(If treatable cause* identified)*

Need not felt/ unaware 1 | Service too far 2 | Cannot afford treatment 3 | Social reason 4 | No access to treatment 5

RARE Data collection tool/version 2/ Date-08-06-2023

Notes

 Share **SightsaversIndia**

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 Watch **SightsaversIN**

 Follow **@SightsaversIN**

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Sightsavers India is registered as "Royal Commonwealth Society for the Blind" under Bombay Public Trust Act 1950 vide registration number E4330.

Sightsavers India