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Barriers to Uptake of Eye Care Services in South India: The Rapid Assessment of Visual Impairment (RAVI) Project

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ABSTRACT

Aim: To assess the barriers to uptake of eye care services among those with visual impairment (VI) due to cataract or uncorrected refractive errors in an urban and rural population aged ≥40 years in South India state of Andhra Pradesh.

Methods: A population based cross-sectional study was conducted in which 7800 subjects were randomly selected from three districts. Eye examinations were conducted using a rapid assessment protocol. VI was defined as presenting visual acuity <6/18 in the better eye. A questionnaire was used to collect information on barriers for uptake of services among those who had avoidable VI.

Results: The prevalence of avoidable VI was 11.8% (95%:11.0–12.5). Among these 868 individuals, 71.1% (n=617) individuals reported 'person related' barriers while 28.9% (n=251) individuals reported 'service related' barriers for uptake of services. Among the 'person related' barriers, the leading barrier was 'lack of perceived need' (61.1%; n=377) for reasons such as old age, good vision in other eye. This was followed by 'no one to accompany' (20.3%; n=125) and 'fear of surgery or consultation' (6.6%; n=41). Of the 251 individuals who had 'service related' barriers, lack of affordability was the major barrier (76.1%; n=191) followed by lack of accessibility (12.7%; n=32). Over 11% (n=28) of the individuals were advised to wait for cataract surgery.

Conclusions: Person related barriers are more common than service related barriers In Andhra Pradesh. An eye care service delivery that can address these barriers by influencing an individual attitudinal change is required to address this challenge.

ARTICLE SUMMARY

Article focus

- Visual impairment is common in south Indian state of Andhra Pradesh.
- Despite availability of services, barriers limit the uptake of eye care services
- Understanding and addressing the barriers is essential to tackle the challenge of visual impairment

Key messages

- 'Person related' barrier are more common than 'service related' barriers in our study population
- There is trend towards 'person related' barriers compared to 'service related' barriers compared to earlier studies
- Lack of 'perceived need' and affordability are the leading barriers that prevent the uptake of services in the study region

Strengths and limitations

- Large representative sample from three districts, a good response rate and sound methodology are the strengths of the study
- The division of barriers into 'person related' and 'service related' is arbitrary and subject to discussion.

With over 285 million visually impaired people worldwide, visual impairment is a major global public health challenge.[1] Over 80% of the blindness is due to cataract and uncorrected refractive errors, both of which have cost-effective solutions.[1, 2] While technological advances have rendered cataract surgery safe, resulting in excellent outcomes, this technology needs to be accessible to people in remote rural areas in developing nations where visual impairment is more prevalent.[1] Making services available is only a part of the larger solution to the global problem of visual impairment. Even in places where services are available and accessible,[3] the uptake of services is determined by several factors or barriers that must be addressed if we are to improve the uptake of services and thereby reduce the prevalence of visual impairment. Research shows that the barriers that determine uptake of services tend to change over time are due to several factors and hence current research on trends should guide service delivery to impact the prevalence of avoidable visual impairment in the community.[4, 5]

Andhra Pradesh is one of the largest states in India with an estimated population of 84 million in 2011.[6] It is administratively divided into twenty three districts which are further divided into sub-districts (mandals which are rural) and municipalities (urban).[6] The literacy rate is around 68% and nearly one third of the population resides in urban areas as per Census 2011.[6] Similar to other parts of the country, eye care services are provided by several non-government organizations, private hospitals and clinics, especially in urban areas and by government hospitals.[7] In rural areas, several non-government organizations conduct outreach screening programmes to identify people with cataract who are then

transported to a base eye hospital where cataract surgery is performed at 'no cost' to the people and expenses are reimbursed by national programme for control of blindness, India.

We recently conducted a large population-based cross sectional study among adults 40 years and older in three locations (one urban and two rural) in Andhra Pradesh and reported an age and gender adjusted prevalence of visual impairment of 14.3% (95% CI: 13.5 - 15.0) including a blindness prevalence of 5.5% (95% CI: 5.0 – 6.0).[8] Refractive errors were the leading cause of visual impairment accounting for 47.6% followed by cataract (43.7%).[8] In this paper, we report the reasons for poor uptake of eye care services among those who are visually impaired due to cataract or refractive errors in this study cohort and suggest strategies to address these barriers.

METHODS

Ethics Approval

The study protocol was reviewed and approved by Institutional Review Board (IRB) of Hyderabad Eye Research Foundation, L V Prasad Eye Institute, Hyderabad, India. This study adhered to the tenets of the Declaration of Helsinki. Verbal informed consent was obtained from each subject after explaining the study procedures and before starting the eye examination. The studies were carried out during 2011 and 2012.

Data Collection

The sampling process and the study protocol are described in detail elsewhere.[8] In brief, a two stage cluster random sampling was used to select 7800 subjects from 156 study clusters

across three districts, Krishna (urban area), Khammam (rural) and Warangal (rural) in Andhra Pradesh. In each randomly selected cluster, the study teams comprising of a vision technician and a community eye health worker visited the selected households and conducted eye examinations that included visual acuity assessment. Those with visual impairment, defined as presenting visual acuity worse than 6/18 in the better eye were identified. The investigators asked the question: 'why were services not sought despite having visual impairment?' It was an open ended question and was asked in the local language. The response given by the participants was matched with the responses that were pre-listed on the data collection form and the response that was the closest was marked. If a subject gave a response that was different to those listed, then it was fully documented in the forms as 'others'. If the subject gave multiple responses, then a follow-up questioning was asked to prioritize the response and the most important one was documented. The responses used in the form were based on the questionnaire used in the previous studies in India and were available in the local language. [3, 9, 10] To suggest strategies to increase uptake of services, the responses were further categorized into two groups; a) Person related barriers and b) Service related barriers. The proportion of visual impairment caused due to cataract and refractive errors was considered as avoidable visual impairment in this study.

Data analysis was done using STATA statistical software version 12.[11] Chi square tests were conducted to assess the association between the barriers quoted by the individuals and socio-demographic variables. The point prevalence estimate for prevalence of avoidable

blindness was calculated and reported along with 95% confidence intervals (CI). A p value of 0.05 (two-tailed) was considered as statistically significant for all the estimates.

RESULTS

Among the 7800 enumerated from the three districts, 7378 (95%) individuals were available for examination. Of those examined, 46.4% (n=3421) were male, 62% (n=4562) had no education and 66.7% (n=4923) were from rural location. The mean age of those examined (51.7 years; standard deviation 10.9 years) was similar to those not examined (52.8; standard deviation 9.9 years) (p=0.05). Women were more likely to be examined compared to men (95.6%versus 93.5%; p<0.01).[8]

The overall prevalence of avoidable visual impairment was 11.8% (95% CI: 11.0 – 12.5; n=868). It was 9.5% (95% CI: 8.4 – 10.8) and 12.9% (95% CI: 12.0 – 13.8) in urban and rural areas respectively. The most common reason quoted for not seeking eye care services were 'Old age need not felt' (29.6%; n=257) followed by 'unable to afford the cost of services' (22.0%; n=191) and no one to accompany (14.4%) followed by aware of the problem, but can manage (11.2%) (Table 1). 'No one to accompany' was quoted by 15.9% of the subjects in the rural area compared to 10.3% in the urban area (p=0.04). 'Unaware of the problem' and 'no time available / other priorities' was quoted more frequently by urban participants compared to their rural peers (p<0.01). Other health reasons were significantly higher among rural residents (p<0.01). The other reasons for not seeking eye care services were similar between the groups (Table 1).

Table 1: Reasons for not seeking eye care services (n=868)

Responses	Category	Urban (n=234)	Rural (n=634)	Total (n=868)	p values
		%	%	%	
Old age and need not felt	P	29.9	29.5	29.6	0.130
Cannot afford	S	20.5	22.6	22.0	0.520
Aware of the problem, but can manage	P	10.7	11.4	11.2	0.780
No one to accompany	P	10.3	15.9	14.4	**0.04**
Unaware of the problem	P	9.0	0.6	2.9	**<0.01**
No time available / other priorities	P	6.4	0.9	2.4	**<0.01**
Services not available or very far	S	4.7	3.3	3.7	0.340
Waiting for cataract to mature	S	4.3	2.8	3.2	0.290
Fear of losing eyesight / operation / consultation	P	2.6	5.5	4.7	0.070
One eye adequate vision / need not felt	P	1.3	3.2	2.6	0.130
Other health reasons	P	0.4	4.3	3.2	**<0.01**

P=Personal related barriers; S=Service related barrier

When the above quoted reasons for not seeking eye care services were categorized into person related and service related barriers, of 868 individuals who had avoidable visual impairment, 71.1% (n=617) individuals reported 'person related' barriers while 28.9% (n=251) individuals reported 'service related' barriers for uptake of services. Among the 'person related' barriers, the leading barrier was 'lack of perceived need' (61.1%;n=377) for reasons such as old age, good vision in other eye. This was followed by 'no one to accompany' (20.3%;n=125) and 'fear of surgery or consultation' (6.6%;n=41). Of the 251 individuals who had 'service related' barriers, lack of affordability was the major barrier (76.1%; n=191) followed by lack of accessibility (12.7%; n=32). Over 11% (n=28) of the

individuals were advised to wait for cataract surgery or waiting for cataract to mature (Figure 1). Other than the age group, the service related and person related barriers were similar between the gender, education, area of residence, level and causes of visual impairment (Table 2).

Table 2: Categories of reasons for not utilizing eye care services stratified by socio-demographic variables and causes of visual impairment

	Total in the group with avoidable Visual impairment	**Service related barriers (n=251)**		**Person related barriers (n=617)**		**p#**
	n	**n**	**%***	**n**	**%***	
Age group (years)						***<0.01***
40 - 49	55	25	10.0	30	4.9	
50 - 59	181	69	27.5	112	18.2	
60 - 69	330	97	38.6	233	37.8	
70 & above	302	60	23.9	242	39.2	
Gender						*0.63*
Male	381	107	42.6	275	44.6	
Female	487	144	57.4	343	55.6	
Education						*0.58*
No Education	720	211	84.1	509	82.5	
Educated	148	40	15.9	108	17.5	
Area of residence						*0.82*
Urban	234	69	27.5	165	26.7	
Rural	634	182	72.5	452	73.3	
Categories of visual impairment (VI)						*0.44*
<6/18 - 6/60	553	155	61.8	398	64.5	
<6/60	315	96	38.2	219	35.5	
Cause of VI						*0.54*
Cataract	401	120	47.8	281	45.5	
Refractive error	467	131	52.2	336	54.5	
Total	**868**	**251**	100.0	**617**	100.0	

** Column percentages presented*

 # p values comparing the service related and person related barriers

DISCUSSION

We found an overwhelming predominance of 'person related' barriers compared to 'service related' barriers compared to previous studies suggestive of a clear change in trends in barriers over time.[4, 9, 10, 13-15] Earlier studies that were conducted about two decades ago, revealed 'service related' barriers such as availability, accessibility, and affordability in sharp contrast to 'person related' barriers found in this study. [4, 9, 10, 13-15] In 1995, Gupta and colleagues reported distance as the leading barrier for uptake of services followed by economic and other reasons whereas accessibility was not a major barrier in the current study.[15]

In the last few decades, the availability of services has increased significantly due to efforts of several non-government agencies and the national programme for prevention of blindness. Despite this, lack of affordability continues to remains a concern and still is a leading barrier. Recent studies from Andhra Pradesh also reported economic reasons one of the leading barriers for uptake of services.[5, 12] Affordability was a leading barrier (41%), similar to that found in Tamil Nadu [16] (78.2%) and another study from an urban area Andhra Pradesh.[9] However in the rural component of this study, it was not an important barrier.[10] Though some services are provided at no cost, the indirect expenses such as lost wages, travel and other incidental expenses may be posing an economic hurdle for uptake of services.[16, 17] The service delivery programmes need to consider ways to address the issues related to 'indirect costs' by providing transport facilities.

Lack of escort was quoted more commonly in Karnataka (21.6%) and Tamil Nadu (58.2%) compared to 14.4% in the present study. [4, 16] However, 'waiting or was told to wait for cataract surgery' was the leading reasons in the Karnataka study whereas it was reported only by 3% of the respondents in our study.[4] These differences are indicative of the changing trends in barriers for uptake of services over time. Similarly, the 'fear of surgery or visual outcome after surgery' was more commonly reported from Tamil Nadu [17] and Karnataka[4], compared to less than 5% of the participants in present study, again suggestive of a changing trend.

The reasons such as fear of surgery, waiting or was told to wait for cataract to mature for surgery are reminiscent of the days when ICCE (Intra capsular cataract extraction) was the commonly performed procedure in the camp settings. In fact population-based studies that were conducted over a decade ago in several parts of India revealed poor outcomes after cataract surgery.[18, 19] However technological advances and increase in availability of cataract surgical services support by National Programme for Control of Blindness (NPCB) are resulting in better outcomes as evidenced by recent publications.[20, 21] However, efforts are needed to pass this information on to the communities using effective information, education and communication tools so that these barriers are addressed. Similar is the case with those reporting about 'other commitments' that prevent them from undergoing cataract surgery and 'old age' and 'need not felt'; there appears to be perception in the community on the need for long period of rest after cataract surgery that will keep them away from active work engagements a considerable periods of time. The

quick visual rehabilitation that is now possible with better surgical techniques at a low cost even in small towns in India should be propagated more actively.

Availability was reported by less than 5% of those with avoidable visual impairment in both urban and rural areas in the present study suggesting increased availability of services. 'Old age and need not felt' was reported by more nearly 30% of the respondents which relates to individual attitudes. A significantly higher proportion of rural residents reported 'no one to accompany' compared to their urban counterparts and overall it accounted for nearly 15 percent of the responses. This could be attributed to availability of services at much closer distance or better conveyance in urban locations compared to rural locations.

The individuals who are aware of their visual impairment but do not perceive the need for consultations owing to several reasons which are more challenging for service providers to deal with as it is related to attitude. This finding was also reported in earlier studies in different parts of India.[3, 10] Only effective IEC methods focused on relative ease and safety of cataract surgery that can be undertaken now compared to the strenuous planning and efforts of yester years may induce a proportion of these people to utilize the services. The same holds true for those who don't perceive any eye problem despite having visual impairment.

Our study is not free from limitations. As the participants were aware of the affiliation of the study teams, the responses may have been biased (courtesy bias). Moreover, the earlier studies were focused on cataract compared to avoidable visual impairment in our study,

though we found no difference in barriers with the avoidable causes of visual impairment. Our data present the pointers that can help service providers plan strategies to address them but by no means provide in-depth analysis on health seeking behaviors.

In conclusion, as the barriers trend more towards 'person related' phenomenon such as person's attitude and 'felt need' to improve vision, newer and much intensive awareness campaigns are needed to bring about an attitudinal / behavioral change among individuals to improve the uptake of services. Only such focused and innovative approaches can improve uptake of services through which the goal of eliminating avoidable visual impairment can be achieved.[22-24]

FUNDING SUPPORT AND CONTRIBUTORSHIP STATEMENT

The financial support for this study was provided by Hyderabad Eye Research Foundation, India. SM conceived the idea, designed and conducted the study and wrote the manuscript. KS assisted in data collection and supervised the field activities. RCK and GNR reviewed the earlier version of the manuscripts and provide the intellectual inputs.

DATA SHARING STATEMENT

No additional data available

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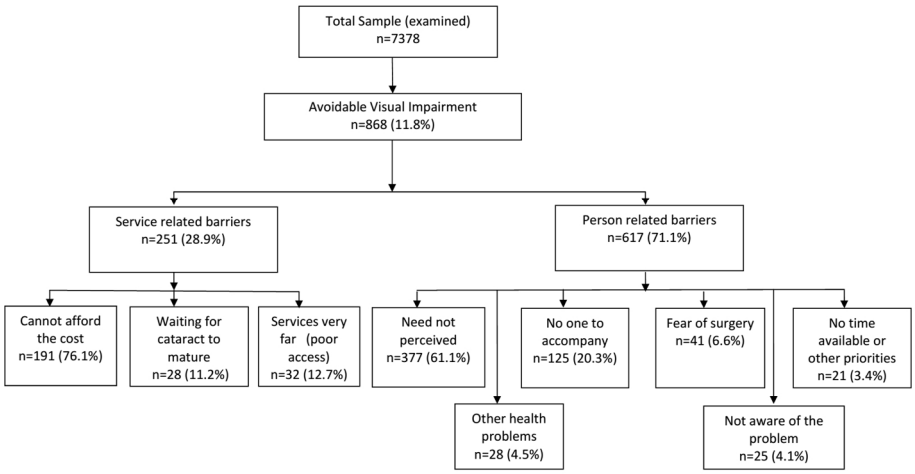
Figure 1: Flow chart showing the classification of reasons for not seeking eye care services among those with avoidable visual impairment



630x309mm (72 x 72 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4,5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4,5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4,5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	9,10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11,12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11,12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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A population based Cross sectional Study of Barriers to Uptake of Eye Care Services in South India: The Rapid Assessment of Visual Impairment (RAVI) Project

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Running Head: Barriers to uptake of eye care services in Andhra Pradesh, India

Key words: Visual Impairment; Cataract; Refractive errors; Barriers; Rapid assessment

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ABSTRACT

Objective: To assess the barriers to uptake of eye care services among those with avoidable impairment in the population aged ≥40 years in South India state of Andhra Pradesh.

Design: Cross-sectional study

Setting: Community Setting

Participants: Of 7800 subjects were enumerated from an urban and two rural locations using a two stage cluster random sampling methodology, 7378 (95%) were examined. Eye examinations were conducted using a rapid assessment protocol. Visual Impairment (VI) was defined as presenting visual acuity <6/18 in the better eye. For the purpose of this study, VI caused due to cataract or uncorrected refractive error was considered avoidable VI. A validated questionnaire was used to collect information on barriers for uptake of services among those who had avoidable VI.

Primary Outcome: Barriers to uptake of services among those with avoidable VI

Results: The prevalence of avoidable VI was 11.8% (95%:11.0–12.5; n=868). Among these, 71.1% (n=617) individuals reported 'person related' barriers while 28.9% (n=251) individuals reported 'service related' barriers to uptake of services. Among the 'person related' barriers, the leading barrier was 'lack of perceived need' (61.1%; n=377) for reasons such as old age, good vision in other eye. This was followed by 'no one to accompany' (20.3%; n=125). Of the 251 individuals who had 'service related' barriers, lack of affordability was the major barrier (76.1%; n=191) followed by lack of accessibility (12.7%; n=32). Over 11% (n=28) of the individuals were advised to wait for cataract surgery.

Conclusions: Person related barriers are more common than service related barriers in Andhra Pradesh. As the barriers trend more towards 'person related' phenomenon such as

person's attitude and 'felt need' to improve vision, newer and much intensive awareness campaigns are needed to bring about an attitudinal / behavioral change among individuals to improve the uptake of services.

ARTICLE SUMMARY

Article focus

- Avoidable visual impairment is common in south Indian state of Andhra Pradesh.
- Despite availability of services, several barriers limit the uptake of eye care services
- Understanding and addressing the barriers is essential to tackle the challenge of visual impairment

Key messages

- 'Person related' barriers are more common than 'service related' barriers in our study population
- Compared to earlier studies, there is trend towards 'person related' barriers compared to 'service related' barriers
- Lack of 'perceived need' and affordability are the leading barriers that prevent the uptake of services in the study region

Strengths and limitations

- Large representative sample from three districts, a good response rate and sound methodology are the strengths of the study
- The division of barriers into 'person related' and 'service related' is arbitrary and subject to discussion.

With over 285 million visually impaired people worldwide, visual impairment is a major global public health challenge.[1] Over 80% of the blindness is due to cataract and uncorrected refractive errors, both of which have cost-effective solutions.[1, 2] While technological advances have rendered cataract surgery safe, resulting in excellent outcomes, this technology needs to be accessible to people in remote rural areas in developing nations where visual impairment is more prevalent.[1] Making services available is only a part of the larger solution to the global problem of visual impairment. Even in places where services are available and accessible,[3] the uptake of services is determined by several factors or barriers that must be addressed if we are to improve the uptake of services and thereby reduce the prevalence of visual impairment. Research has shown that the barriers to uptake of services tend to change over time due to several factors. [4, 5] Hence research on changing trends is necessary to guide service delivery programmes for planning strategies to address avoidable visual impairment in the community.

Andhra Pradesh is one of the largest states in India with an estimated population of 84 million in 2011.[6] It is administratively divided into twenty three districts which are further divided into sub-districts (mandals which are rural) and municipalities (urban).[6] The literacy rate is around 68% and nearly one third of the population resides in urban areas as per Census 2011.[6] Similar to other parts of the country, eye care services are provided by several non-government organizations, private hospitals and clinics, especially in urban areas and by government hospitals.[7] In rural areas, several non-government organizations conduct outreach screening programmes to identify people with cataract who are then

transported to a base eye hospital where cataract surgery is performed at 'no cost' to the people and expenses are reimbursed by national programme for control of blindness, India.

We recently conducted a large population-based cross sectional study among adults 40 years and older in three locations (one urban and two rural) in Andhra Pradesh and reported an age and gender adjusted prevalence of visual impairment of 14.3% (95% CI: 13.5 - 15.0) including a blindness prevalence of 5.5% (95% CI: 5.0 – 6.0).[8] Refractive errors were the leading cause of visual impairment accounting for 47.6% followed by cataract (43.7%).[8] In this paper, we report the reasons for poor uptake of eye care services among those who are visually impaired due to cataract or refractive errors in this study cohort and suggest strategies to address these barriers.

METHODS

Ethics Approval

The study protocol was reviewed and approved by Institutional Review Board (IRB) of Hyderabad Eye Research Foundation, L V Prasad Eye Institute, Hyderabad, India. This study adhered to the tenets of the Declaration of Helsinki. Verbal informed consent was obtained from each subject after explaining the study procedures and before starting the eye examination. The studies were carried out during 2011 and 2012.

Data Collection

The sampling process and the study protocol are described in detail elsewhere.[8] In brief, a two stage cluster random sampling was used to select 7800 subjects from 156 study clusters

across three districts, Krishna (urban area), Khammam (rural) and Warangal (rural) in Andhra Pradesh. In each randomly selected cluster, the study teams comprising of a vision technician and a community eye health worker visited the selected households and conducted eye examinations that included visual acuity assessment. Those with visual impairment, defined as presenting visual acuity worse than 6/18 in the better eye were identified. The investigators asked the question: 'why were services not sought despite having visual impairment?' It was an open ended question and was asked in the local language. The response given by the participants was matched with the responses that were pre-listed on the data collection form and the response that was the closest was marked. If a subject gave a response that was different to those listed, then it was fully documented in the forms as 'others'. If the subject gave multiple responses, then a follow-up questioning was asked to prioritize the response and the most important one was documented. The responses used in the form were based on the questionnaire used in the previous studies in India and were available in the local language. [3, 9, 10] To suggest strategies to increase uptake of services, the responses were further categorized into two groups; a) Person related barriers and b) Service related barriers. The proportion of visual impairment caused due to cataract and refractive errors was considered as avoidable visual impairment in this study.

Data analysis was done using STATA statistical software version 12.[11] Chi square tests were conducted to assess the association between the barriers quoted by the individuals and socio-demographic variables. The point prevalence estimate for prevalence of avoidable

blindness was calculated and reported along with 95% confidence intervals (CI). A p value of 0.05 (two-tailed) was considered as statistically significant for all the estimates.

RESULTS

Among the 7800 enumerated from the three districts, 7378 (95%) individuals were available for examination. Of those examined, 46.4% (n=3421) were male, 62% (n=4562) had no education and 66.7% (n=4923) were from rural location. The mean age of those examined was 51.7 years (standard deviation 10.9 years) compared to 52.8 years (standard deviation 9.9 years) of those not examined. The mean difference in age among those examined and not examined was of borderline statistical significance (p=0.05). Women were more likely to be examined compared to men (95.6% versus 93.5%; p<0.01).[8]

The overall prevalence of avoidable visual impairment was 11.8% (95% CI: 11.0 – 12.5; n=868). It was 9.5% (95% CI: 8.4 – 10.8) and 12.9% (95% CI: 12.0 – 13.8) in urban and rural areas respectively. The most common reason quoted for not seeking eye care services were 'Old age need not felt' (29.6%; n=257) followed by 'unable to afford the cost of services' (22.0%; n=191) and no one to accompany (14.4%) followed by 'aware of the problem, but can manage '(11.2%) (Table 1). 'No one to accompany' was quoted by 15.9% of the subjects in the rural area compared to 10.3% in the urban area (p=0.04). 'Unaware of the problem' and 'no time available / other priorities' was quoted more frequently by urban participants compared to their rural peers (p<0.01). Other health reasons were significantly higher among rural residents (p<0.01). The other reasons for not seeking eye care services were similar between the groups (Table 1).

Table 1: Reasons for not utilizing care services (n=868)

Responses	Category	Urban (n=234)	Rural (n=634)	Total (n=868)	Statistical significance
		n (%)	n (%)	n (%)	
Old age and need not felt	P	70 (29.9)	187 (29.5)	257 (29.6)	0.13
Cannot afford	S	48 (20.5)	143 (22.6)	191 (22.0)	0.52
No one to accompany	P	24 (10.3)	101 (15.9)	125 (14.4)	**0.04**
Aware of the problem, but can manage	P	25 (10.7)	72 (11.4)	97 (11.2)	0.78
Fear of losing eyesight / operation / Consultation	P	6 (2.6)	35 (5.5)	41 (4.7)	0.07
Services not available or very far	S	11 (4.7)	21 (3.3)	32 (3.7)	0.34
Waiting for cataract to mature	S	10 (4.3)	18 (2.8)	28 (3.2)	0.29
Other health reasons	P	1 (0.4)	27 (4.3)	28 (3.2)	**<0.01**
Unaware of the problem	P	21 (9.0)	4 (0.6)	25 (2.9)	**<0.01**
No time available / other priorities	P	15 (6.4)	6 (0.9)	21 (2.9)	**<0.01**
One eye adequate vision / need not felt	P	3 (1.3)	20 (3.2)	23 (2.6)	0.13
Total		**234 (100)**	**634 (100)**	**868 (100)**	

P=Person related barrier; S=Service related barrier

When the above quoted reasons for not seeking eye care services were categorized into 'person related' and 'service related' barriers, of 868 individuals who had avoidable visual impairment, 71.1% (n=617) individuals reported 'person related' barriers while 28.9% (n=251) individuals reported 'service related' barriers for uptake of services. Among the 'person related' barriers, the leading barrier was 'lack of perceived need' (61.1%;n=377) for reasons such as old age, good vision in other eye. This was followed by 'no one to accompany' (20.3%;n=125) and 'fear of surgery or consultation' (6.6%;n=41).

Of the 251 individuals who had 'service related' barriers, lack of affordability was the major barrier (76.1%; n=191) followed by lack of accessibility (12.7%; n=32). Over 11% (n=28) of the individuals were advised by an eye care service provider to 'wait for cataract surgery' or 'waiting for cataract to mature' (Figure 1). Except for age groups, the service related and person related barriers were similar with respect to all other characteristics such as gender, education, area of residence, level and causes of visual impairment (Table 2).

Table 2: Categories of reasons for not utilizing eye care services stratified by socio-demographic variables and causes of visual impairment

	Total in the group with avoidable Visual impairment	**Service related barriers (n=251)**		**Person related barriers (n=617)**		**p#**
	n	**n**	**%***	**n**	**%***	
Age group (years)						***<0.01***
40 - 49	55	25	10.0	30	4.9	
50 - 59	181	69	27.5	112	18.2	
60 - 69	330	97	38.6	233	37.8	
70 & above	302	60	23.9	242	39.2	
Gender						*0.63*
Male	381	107	42.6	275	44.6	
Female	487	144	57.4	343	55.6	
Education						*0.58*
No Education	720	211	84.1	509	82.5	
Educated	148	40	15.9	108	17.5	
Area of residence						*0.82*
Urban	234	69	27.5	165	26.7	
Rural	634	182	72.5	452	73.3	
Categories of visual impairment (VI)						*0.44*
<6/18 - 6/60	553	155	61.8	398	64.5	
<6/60	315	96	38.2	219	35.5	
Cause of VI						*0.54*
Cataract	401	120	47.8	281	45.5	

Refractive error	467	131	52.2	336	54.5	
Total	**868**	**251**	100.0	**617**	100.0	

** Column percentages presented*

 # p values comparing the service related and person related barriers

DISCUSSION

We found an overwhelming predominance of 'person related' barriers compared to 'service related' barriers compared to previous studies suggestive of a clear change in trends in barriers over time.[4, 9, 10, 12-14] Earlier studies that were conducted about two decades ago, revealed 'service related' barriers such as availability, accessibility, and affordability in sharp contrast to 'person related' barriers found in this study. [4, 9, 10, 12-14] In 1995, Gupta and colleagues reported distance as the leading barrier for uptake of services followed by economic and other reasons whereas accessibility was not a major barrier in the current study.[14]

In the last few decades, the availability of services has increased significantly due to efforts of several non-government agencies and the national programme for prevention of blindness. Despite this, lack of affordability continues to remains a concern and still is a leading barrier. Recent studies from Andhra Pradesh also reported economic reasons one of the leading barriers for uptake of services.[5, 15] Affordability was a leading barrier (41%), similar to that found in Tamil Nadu [16] (78.2%) and another study from an urban area Andhra Pradesh.[9] However in the rural component of this study, it was not an important barrier.[10] Though some services are provided at no cost, the indirect expenses such as lost wages, travel and other incidental expenses may be posing an economic hurdle for uptake

of services.[16, 17] The service delivery programmes need to consider ways to address the issues related to 'indirect costs' by providing transport facilities.

Lack of escort was quoted more commonly in Karnataka (21.6%) and Tamil Nadu (58.2%) compared to 14.4% in the present study. [4, 16] However, 'waiting or was told to wait for cataract surgery' was the leading reasons in the Karnataka study whereas it was reported only by 3% of the respondents in our study.[4] These differences are indicative of the changing trends in barriers for uptake of services over time. Similarly, the 'fear of surgery or visual outcome after surgery' was more commonly reported from Tamil Nadu [17] and Karnataka[4], compared to less than 5% of the participants in present study, again suggestive of a changing trend.

The reasons such as fear of surgery, waiting or was told to wait for cataract to mature for surgery are reminiscent of the days when ICCE (Intra capsular cataract extraction) was the commonly performed procedure in the camp settings. In fact population-based studies that were conducted over a decade ago in several parts of India revealed poor outcomes after cataract surgery.[18, 19] However technological advances and increase in availability of cataract surgical services support by National Programme for Control of Blindness (NPCB) are resulting in better outcomes as evidenced by recent publications.[20, 21] However, efforts are needed to pass this information on to the communities using effective information, education and communication tools so that these barriers are addressed. Similar is the case with those reporting about 'other commitments' that prevent them from

undergoing cataract surgery and 'old age' and 'need not felt'; there appears to be perception in the community on the need for long period of rest after cataract surgery that will keep them away from active work engagements a considerable periods of time. The quick visual rehabilitation that is now possible with better surgical techniques at a low cost even in small towns in India should be propagated more actively.

Availability was reported by less than 5% of those with avoidable visual impairment in both urban and rural areas in the present study suggesting increased availability of services. 'Old age and need not felt' was reported by more nearly 30% of the respondents which relates to individual attitudes. A significantly higher proportion of rural residents reported 'no one to accompany' compared to their urban counterparts and overall it accounted for nearly 15 percent of the responses. This could be attributed to availability of services at much closer distance or better conveyance in urban locations compared to rural locations.

The individuals who are aware of their visual impairment but do not perceive the need for consultations owing to several reasons which are more challenging for service providers to deal with as it is related to attitude. This finding was also reported in earlier studies in different parts of India.[3, 10] Only effective IEC methods focused on relative ease and safety of cataract surgery that can be undertaken now compared to the strenuous planning and efforts of yester years may induce a proportion of these people to utilize the services. The same holds true for those who don't perceive any eye problem despite having visual impairment.

We did not find any difference in 'person related' and 'service related' barriers among those with cataract and uncorrected refractive errors though they require a very different intervention. This could be possible as the barriers question was asked to all those with avoidable visual impairment and not specific to a cause. It is possible that a significant proportion of people may not have known the cause of their visual impairment. It is also possible that some of those who were visually impaired due to uncorrected refractive errors felt that their visual impairment was due to cataract and not refractive errors and vice-versa.

Our study is not free from limitations. As the participants were aware of the affiliation of the study teams, the responses may have been biased (courtesy bias). Moreover, the earlier studies were focused on cataract compared to avoidable visual impairment in our study, though we found no difference in barriers with the avoidable causes of visual impairment. Our data present the pointers that can help service providers plan strategies to address them but by no means provide in-depth analysis on health seeking behaviors.

In conclusion, as the barriers trend more towards 'person related' phenomenon such as person's attitude and 'felt need' to improve vision, newer and much intensive awareness campaigns are needed to bring about an attitudinal / behavioral change among individuals to improve the uptake of services. Only such focused and innovative approaches can improve uptake of services through which the goal of eliminating avoidable visual impairment can be achieved.[22-24]

FUNDING SUPPORT AND CONTRIBUTORSHIP STATEMENT

The financial support for this study was provided by Hyderabad Eye Research Foundation, India. SM conceived the idea, designed and conducted the study and wrote the manuscript. KS assisted in data collection and supervised the field activities. RCK and GNR reviewed the earlier version of the manuscripts and provide the intellectual inputs.

DATA SHARING STATEMENT

No additional data available

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Competing Interests: None

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Figure 1: Classification of barriers reasons for not utilizing eye care services among those with avoidable visual impairment

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Data Collection

The sampling process and the study protocol are described in detail elsewhere.[8] In brief, a two stage cluster random sampling was used to select 7800 subjects from 156 study clusters

across three districts, Krishna (urban area), Khammam (rural) and Warangal (rural) in Andhra Pradesh. In each randomly selected cluster, the study teams comprising of a vision technician and a community eye health worker visited the selected households and conducted eye examinations that included visual acuity assessment. Those with visual impairment, defined as presenting visual acuity worse than 6/18 in the better eye were identified. The investigators asked the question: 'why were services not sought despite having visual impairment?' It was an open ended question and was asked in the local language. The response given by the participants was matched with the responses that were pre-listed on the data collection form and the response that was the closest was marked. If a subject gave a response that was different to those listed, then it was fully documented in the forms as 'others'. If the subject gave multiple responses, then a follow-up questioning was asked to prioritize the response and the most important one was documented. The responses used in the form were based on the questionnaire used in the previous studies in India and were available in the local language. [3, 9, 10] To suggest strategies to increase uptake of services, the responses were further categorized into two groups; a) Person related barriers and b) Service related barriers. The proportion of visual impairment caused due to cataract and refractive errors was considered as avoidable visual impairment in this study.

Data analysis was done using STATA statistical software version 12.[11] Chi square tests were conducted to assess the association between the barriers quoted by the individuals and socio-demographic variables. The point prevalence estimate for prevalence of avoidable

blindness was calculated and reported along with 95% confidence intervals (CI). A p value of 0.05 (two-tailed) was considered as statistically significant for all the estimates.

RESULTS

Among the 7800 enumerated from the three districts, 7378 (95%) individuals were available for examination. Of those examined, 46.4% (n=3421) were male, 62% (n=4562) had no education and 66.7% (n=4923) were from rural location. The mean age of those examined was 51.7 years (standard deviation 10.9 years) compared to 52.8 years (standard deviation 9.9 years) of those not examined. The mean difference in age among those examined and not examined was of borderline statistical significance (p=0.05). Women were more likely to be examined compared to men (95.6% versus 93.5%; p<0.01).[8]

The overall prevalence of avoidable visual impairment was 11.8% (95% CI: 11.0 – 12.5; n=868). It was 9.5% (95% CI: 8.4 – 10.8) and 12.9% (95% CI: 12.0 – 13.8) in urban and rural areas respectively. The most common reason quoted for not seeking eye care services were 'Old age need not felt' (29.6%; n=257) followed by 'unable to afford the cost of services' (22.0%; n=191) and no one to accompany (14.4%) followed by 'aware of the problem, but can manage '(11.2%) (Table 1). 'No one to accompany' was quoted by 15.9% of the subjects in the rural area compared to 10.3% in the urban area (p=0.04). 'Unaware of the problem' and 'no time available / other priorities' was quoted more frequently by urban participants compared to their rural peers (p<0.01). Other health reasons were significantly higher among rural residents (p<0.01). The other reasons for not seeking eye care services were similar between the groups (Table 1).

Table 1: Reasons for not utilizing care services (n=868)

Responses	Category	Urban (n=234)	Rural (n=634)	Total (n=868)	Statistical significance
		n (%)	n (%)	n (%)	
Old age and need not felt	P	70 (29.9)	187 (29.5)	257 (29.6)	0.13
Cannot afford	S	48 (20.5)	143 (22.6)	191 (22.0)	0.52
No one to accompany	P	24 (10.3)	101 (15.9)	125 (14.4)	**0.04**
Aware of the problem, but can manage	P	25 (10.7)	72 (11.4)	97 (11.2)	0.78
Fear of losing eyesight / operation / Consultation	P	6 (2.6)	35 (5.5)	41 (4.7)	0.07
Services not available or very far	S	11 (4.7)	21 (3.3)	32 (3.7)	0.34
Waiting for cataract to mature	S	10 (4.3)	18 (2.8)	28 (3.2)	0.29
Other health reasons	P	1 (0.4)	27 (4.3)	28 (3.2)	**<0.01**
Unaware of the problem	P	21 (9.0)	4 (0.6)	25 (2.9)	**<0.01**
No time available / other priorities	P	15 (6.4)	6 (0.9)	21 (2.9)	**<0.01**
One eye adequate vision / need not felt	P	3 (1.3)	20 (3.2)	23 (2.6)	0.13
Total		**234 (100)**	**634 (100)**	**868 (100)**	

P=Person related barrier; S=Service related barrier

When the above quoted reasons for not seeking eye care services were categorized into 'person related' and 'service related' barriers, of 868 individuals who had avoidable visual impairment, 71.1% (n=617) individuals reported 'person related' barriers while 28.9% (n=251) individuals reported 'service related' barriers for uptake of services. Among the 'person related' barriers, the leading barrier was 'lack of perceived need' (61.1%;n=377) for reasons such as old age, good vision in other eye. This was followed by 'no one to accompany' (20.3%;n=125) and 'fear of surgery or consultation' (6.6%;n=41).

Of the 251 individuals who had 'service related' barriers, lack of affordability was the major barrier (76.1%; n=191) followed by lack of accessibility (12.7%; n=32). Over 11% (n=28) of the individuals were advised by an eye care service provider to 'wait for cataract surgery' or 'waiting for cataract to mature' (Figure 1). Except for age groups, the service related and person related barriers were similar with respect to all other characteristics such as gender, education, area of residence, level and causes of visual impairment (Table 2).

Table 2: Categories of reasons for not utilizing eye care services stratified by socio-demographic variables and causes of visual impairment

	Total in the group with avoidable Visual impairment	**Service related barriers (n=251)**		**Person related barriers (n=617)**		**p#**
	n	**n**	**%***	**n**	**%***	
Age group (years)						***<0.01***
40 - 49	55	25	10.0	30	4.9	
50 - 59	181	69	27.5	112	18.2	
60 - 69	330	97	38.6	233	37.8	
70 & above	302	60	23.9	242	39.2	
Gender						*0.63*
Male	381	107	42.6	275	44.6	
Female	487	144	57.4	343	55.6	
Education						*0.58*
No Education	720	211	84.1	509	82.5	
Educated	148	40	15.9	108	17.5	
Area of residence						*0.82*
Urban	234	69	27.5	165	26.7	
Rural	634	182	72.5	452	73.3	
Categories of visual impairment (VI)						*0.44*
<6/18 - 6/60	553	155	61.8	398	64.5	
<6/60	315	96	38.2	219	35.5	
Cause of VI						*0.54*
Cataract	401	120	47.8	281	45.5	

Refractive error	467	131	52.2	336	54.5	
Total	**868**	**251**	100.0	**617**	100.0	

** Column percentages presented*

 # p values comparing the service related and person related barriers

DISCUSSION

We found an overwhelming predominance of 'person related' barriers compared to 'service related' barriers compared to previous studies suggestive of a clear change in trends in barriers over time.[4, 9, 10, 12-14] Earlier studies that were conducted about two decades ago, revealed 'service related' barriers such as availability, accessibility, and affordability in sharp contrast to 'person related' barriers found in this study. [4, 9, 10, 12-14] In 1995, Gupta and colleagues reported distance as the leading barrier for uptake of services followed by economic and other reasons whereas accessibility was not a major barrier in the current study.[14]

In the last few decades, the availability of services has increased significantly due to efforts of several non-government agencies and the national programme for prevention of blindness. Despite this, lack of affordability continues to remains a concern and still is a leading barrier. Recent studies from Andhra Pradesh also reported economic reasons one of the leading barriers for uptake of services.[5, 15] Affordability was a leading barrier (41%), similar to that found in Tamil Nadu [16] (78.2%) and another study from an urban area Andhra Pradesh.[9] However in the rural component of this study, it was not an important barrier.[10] Though some services are provided at no cost, the indirect expenses such as lost wages, travel and other incidental expenses may be posing an economic hurdle for uptake

of services.[16, 17] The service delivery programmes need to consider ways to address the issues related to 'indirect costs' by providing transport facilities.

Lack of escort was quoted more commonly in Karnataka (21.6%) and Tamil Nadu (58.2%) compared to 14.4% in the present study. [4, 16] However, 'waiting or was told to wait for cataract surgery' was the leading reasons in the Karnataka study whereas it was reported only by 3% of the respondents in our study.[4] These differences are indicative of the changing trends in barriers for uptake of services over time. Similarly, the 'fear of surgery or visual outcome after surgery' was more commonly reported from Tamil Nadu [17] and Karnataka[4], compared to less than 5% of the participants in present study, again suggestive of a changing trend.

The reasons such as fear of surgery, waiting or was told to wait for cataract to mature for surgery are reminiscent of the days when ICCE (Intra capsular cataract extraction) was the commonly performed procedure in the camp settings. In fact population-based studies that were conducted over a decade ago in several parts of India revealed poor outcomes after cataract surgery.[18, 19] However technological advances and increase in availability of cataract surgical services support by National Programme for Control of Blindness (NPCB) are resulting in better outcomes as evidenced by recent publications.[20, 21] However, efforts are needed to pass this information on to the communities using effective information, education and communication tools so that these barriers are addressed. Similar is the case with those reporting about 'other commitments' that prevent them from

undergoing cataract surgery and 'old age' and 'need not felt'; there appears to be perception in the community on the need for long period of rest after cataract surgery that will keep them away from active work engagements a considerable periods of time. The quick visual rehabilitation that is now possible with better surgical techniques at a low cost even in small towns in India should be propagated more actively.

Availability was reported by less than 5% of those with avoidable visual impairment in both urban and rural areas in the present study suggesting increased availability of services. 'Old age and need not felt' was reported by more nearly 30% of the respondents which relates to individual attitudes. A significantly higher proportion of rural residents reported 'no one to accompany' compared to their urban counterparts and overall it accounted for nearly 15 percent of the responses. This could be attributed to availability of services at much closer distance or better conveyance in urban locations compared to rural locations.

The individuals who are aware of their visual impairment but do not perceive the need for consultations owing to several reasons which are more challenging for service providers to deal with as it is related to attitude. This finding was also reported in earlier studies in different parts of India.[3, 10] Only effective IEC methods focused on relative ease and safety of cataract surgery that can be undertaken now compared to the strenuous planning and efforts of yester years may induce a proportion of these people to utilize the services. The same holds true for those who don't perceive any eye problem despite having visual impairment.

We did not find any difference in 'person related' and 'service related' barriers among those with cataract and uncorrected refractive errors though they require a very different intervention. This could be possible as the barriers question was asked to all those with avoidable visual impairment and not specific to a cause. It is possible that a significant proportion of people may not have known the cause of their visual impairment. It is also possible that some of those who were visually impaired due to uncorrected refractive errors felt that their visual impairment was due to cataract and not refractive errors and vice-versa.

Our study is not free from limitations. As the participants were aware of the affiliation of the study teams, the responses may have been biased (courtesy bias). Moreover, the earlier studies were focused on cataract compared to avoidable visual impairment in our study, though we found no difference in barriers with the avoidable causes of visual impairment. Our data present the pointers that can help service providers plan strategies to address them but by no means provide in-depth analysis on health seeking behaviors.

In conclusion, as the barriers trend more towards 'person related' phenomenon such as person's attitude and 'felt need' to improve vision, newer and much intensive awareness campaigns are needed to bring about an attitudinal / behavioral change among individuals to improve the uptake of services. Only such focused and innovative approaches can improve uptake of services through which the goal of eliminating avoidable visual impairment can be achieved.[22-24]

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The financial support for this study was provided by Hyderabad Eye Research Foundation, India. SM conceived the idea, designed and conducted the study and wrote the manuscript. KS assisted in data collection and supervised the field activities. RCK and GNR reviewed the earlier version of the manuscripts and provide the intellectual inputs.

DATA SHARING STATEMENT

No additional data available

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Competing Interests: None

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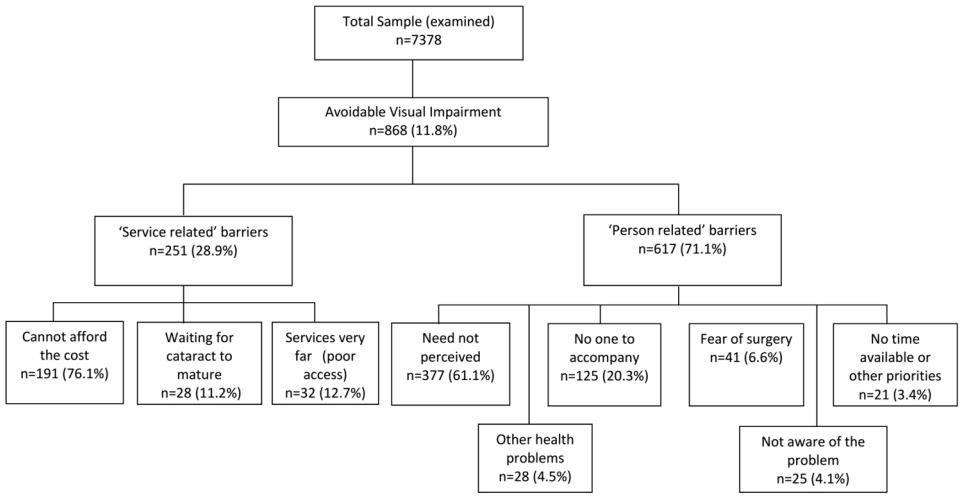
Figure 1: Classification of barriers reasons for not utilizing eye care services among those with avoidable visual impairment



Classification of barriers for not utilizing eye care services among those with avoidable visual impairment
178x90mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4,5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4,5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4,5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	9,10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11,12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11,12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.