

Utilization of eye care services among those with unilateral visual impairment in rural South India: Andhra Pradesh Eye Disease Study (APEDS)

Srinivas Marmamula^{1,2,3,4,5}, Giridhar Pyda¹, Rohit C Khanna^{1,2,4}

¹Allen Foster Community Eye Health Research Centre, Gullapalli Pratibha Rao, International Centre for Advancement of Rural Eye Care, L V Prasad Eye Institute, Hyderabad 500034, India

²Brien Holden Eye Research Centre, L V Prasad Eye Institute, Hyderabad 500034, India

³Wellcome Trust/DBT India Alliance Fellow, L V Prasad Eye Institute, Hyderabad 500034, India

⁴School of Optometry & Vision Science, University of New South Wales, Sydney NSW 2052, Australia

⁵Brien Holden Institute of Optometry and Vision Science, L V Prasad Eye Institute, Hyderabad 500034, India

Correspondence to: Srinivas Marmamula. Allen Foster Community Eye Health Research Centre, GPR ICARE, L V Prasad Eye Institute, Road # 2, Banjara Hills, Hyderabad 500034, India. sriptom@lvpei.org

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Abstract

• **AIM:** To report on the utilization of eye care services and its associated factors among those with unilateral visual impairment (VI) in a rural South Indian population.

• **METHODS:** A population based cross-sectional study was conducted in three districts (Adilabad, Mahbubnagar and West Godavari) in the state of Andhra Pradesh, India. A detailed interview and a comprehensive eye examination were conducted. Those with unilateral VI were asked questions about noticing any change in vision and on utilization of eye care services. The most important reason reported by the participant for not utilizing the services was used for the analysis. Multiple logistic regression models were used to examine the association between noticing a change in vision and socio-demographic variables such as age, gender, education and area of residence, severity and causes of VI.

• **RESULTS:** Among the 4456 participants aged ≥ 16 y who were administered the questionnaire, 53.2% were women, and 54.7% had no education. Of the 489 (11%; 95% CI: 10.1-11.9) people with unilateral VI, 399 (81.6%) participants reported noticing a change in their vision over the last five years but only 136 (34.1%) participants had sought

eye care consultation. Those who had any education (OR: 1.9; 95% CI: 1.1-3.2), had blindness (OR: 2.7; 95% CI: 1.4-5.2), and cataract (OR: 2.1; 95% CI: 1.0-4.3) as a cause of unilateral VI were more like to seek eye care consultations. The most commonly reported reasons for not seeking eye care services were “do not have money for eye checkup” in 30.7% of the participants followed by “do not have a serious problem” (30.0%).

• **CONCLUSION:** A large proportion of rural population though noticed a change in their vision did not seek eye care due to financial and person-related reasons. Eye care service providers need to address these barriers to enhance the uptake of eye care services among those with unilateral VI.

• **KEYWORDS:** unilateral visual impairment; socio-demographic variables; Andhra Pradesh Eye Disease Study; India

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INTRODUCTION

Visual impairment (VI) affects ten out of every hundred people in the South Indian state of Andhra Pradesh^[1-2]. Similar to several other regions of the world, uncorrected refractive errors and cataract are the leading causes of visual impairment in India^[1-2]. Both these conditions can be addressed effectively at primary and secondary levels of eye care respectively. Population based epidemiological data on the prevalence and causes of VI, on patterns of utilization and barriers for uptake of eye care services have now become a cornerstone for any eye care service delivery model to address VI.

Conventionally, VI is defined on the basis of visual acuity in the better eye and consequently most literature on utilization and barriers for uptake of eye care services are mostly reported from this group. Research studies have shown that unilateral VI is common and it impacts the visual functions and quality of life as it affects binocularity^[3]. Studies have also shown the benefit of second eye cataract surgery^[4-5]. Most studies on

barriers to utilization of eye care service are restricted to that of bilateral VI and/or specifically focused on visual impairment due to cataract^[6-17]. While Vaidyanathan *et al*^[17], Brilliant *et al*^[14] and Finger^[8] have studied barriers for uptake of cataract surgery, Marmamula *et al*^[9-10] and Nirmalan *et al*^[16] reported on uptake of eye care services in general not restricting to cataract alone in India.

The Andhra Pradesh Eye Disease Study (APEDS) I was a population based study that was undertaken in the South Indian state of Andhra Pradesh which is now divided into two states, Telangana and Andhra Pradesh^[18]. This study involved detailed in-depth interviews and comprehensive clinical examination of over 10 000 participants from one urban (Hyderabad) and three rural areas (West Godavari district in Andhra Pradesh, and Adilabad and Mahbubnagar districts now in Telangana)^[18]. The sample was selected in such a way that it represented the population on the state and hence the results can be extrapolated to the entire state. The study was conducted by L V Prasad Eye Institute, Hyderabad which is located in south India. A feasibility study (APEDS II) was conducted during years 2009-2010 to understand the availability and survival status of the participants examined in APEDS I. This study was possible only in three rural areas. Nearly 70% of the participants were available and willing to participate in a follow-up study, based on which the follow-up study (APEDS III) was started in 2012 and currently being conducted in the last location. The study methodology of the APEDS III is published^[19]. The APEDS I has provided this vital information and led to development of pyramidal eye care service delivery model in the state and APEDS III is intended to provide insights on incidence and progression of common causes of visual impairment^[20].

Patterns in utilization of eye care services in an urban area and barriers for uptake of eye care services in rural area from APEDS I are reported^[21-22], but these reports included only those with bilateral VI. In this paper, we report on utilization of eye care services among those with unilateral VI in three rural areas in the state of Andhra Pradesh.

SUBJECTS AND METHODS

The study protocol was reviewed and approved by the Institutional Review Board of L V Prasad Eye Institute, Hyderabad, India. The study followed the tenets of the Declaration of Helsinki. All the participants provided written informed consent for participating in the study. The rural data collection was accomplished from 1997 to 2000.

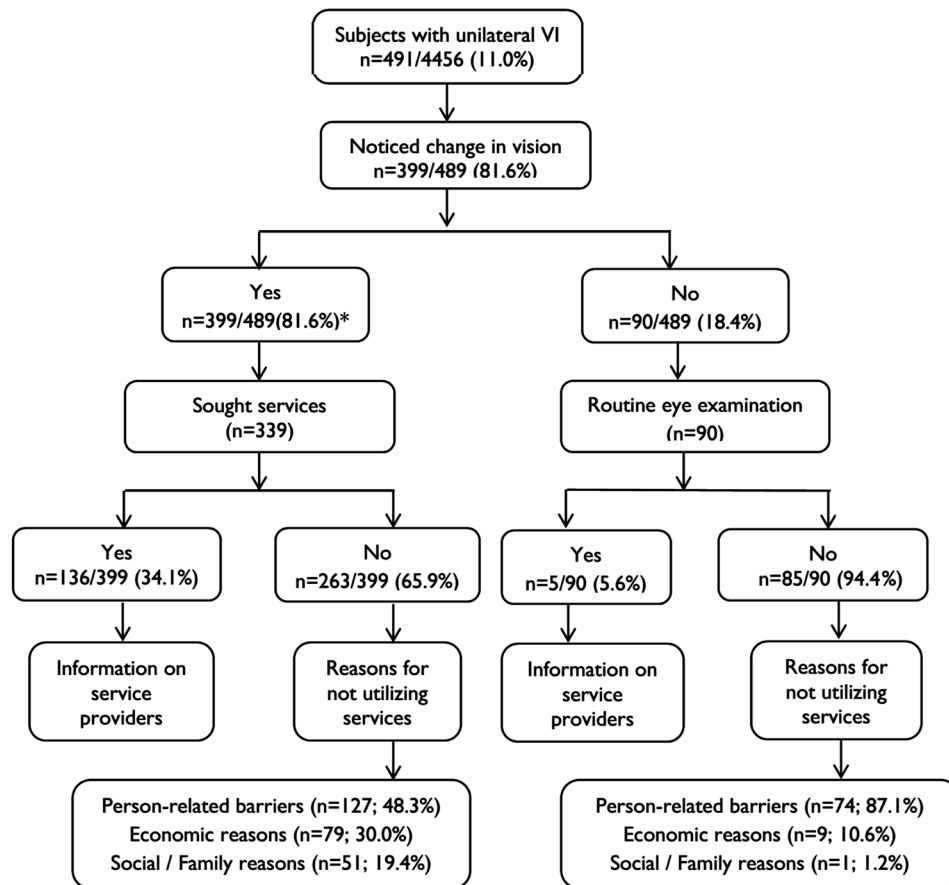
The detailed clinical and non-clinical protocol and the findings of the APEDS I were reported elsewhere^[18]. In short, a stratified cluster random sampling design was used to select 7771 participants from three rural locations. Definitions of urban and rural population were based on census data. All the selected subjects were transported to a clinic that was

specifically set-up for the study. Presenting and best corrected visual acuity after refraction was assessed using a logarithm of minimum angle of resolution (logMAR) chart under standard testing conditions for both distance and near. Detailed anterior segment examination was conducted using a slit lamp biomicroscope. Fundus examination through dilated pupils was done on all participants unless contraindicated.

All the subjects who were aged ≥ 16 y were administered a questionnaire on eye care utilization patterns and barriers to seeking eye care. The details of this questionnaire and utilization of eye care services by those with bilateral VI have been published^[21-22]. All the participants were asked if they had noticed a change in their vision in the last five years. If the subjects reported noticing a change, they were asked if they had sought consultation for their condition. If yes, then they were asked to provide details on the service provider they had visited. If a participant responded that they had not consulted a service provider despite noticing a change in their vision, they were asked for the reasons for not consulting the service provider. The questionnaire had a list of responses and the response given by the participant was marked by the field investigator against the one that was listed. If a participant gave a response that was not listed, then it was documented fully in the "others" column. If a respondent gave more than one reason, then he/she was asked to specify the most important reason and that was documented. The reasons were further classified into "personal", if they were related self and self-perceptions, "social/family", if they were related to family and "economic" reasons, if they were related to financial issues.

Unilateral VI was defined as presenting visual acuity worse than 6/18 in one eye but better than 6/18 in other eye. Those with bilateral VI were excluded from analysis. Unilateral VI is further classified as moderate VI ($<6/18$ to $6/60$) and blindness ($<6/60$). The cause of unilateral VI was classified into uncorrected refractive errors, cataract and others. These definitions are based on Indian definitions and were used in previous studies^[11-23-24].

Statistical Analysis Data were analyzed using Stata statistical software version 12^[25]. The prevalence estimates were calculated and presented along with 95% confidence intervals (CI) after excluding those with bilateral VI. A Chi-square test was used to test for difference in proportions. The most important reason reported by the participant for not utilizing the services was used for the analysis. Multiple logistic regression models were used to examine the association between noticing a change in vision and socio-demographic variables such as age, gender, education and area of residence, severity and causes of VI. Similar models were also used to examine the factors associated with seeking consultation. Hosmer-Lemeshow goodness of fit tests was used to assess the goodness of the model fit. The odds ratio (OR) with 95% CI and *P* values are presented.



* Two participants who had unilateral visual impairment since early children are excluded as the question in noticing a change in last five years is not applicable for them

Figure 1 Flowchart showing the questions and responses sequence for utilization on eye care services among those with unilateral visual impairment.

RESULTS

A total of 7771 participants were examined from three rural locations. After excluding 1136 participants with bilateral VI and 2179 participants aged ≤ 15 y, the final sample of 4456 participants aged ≥ 16 y on whom the questionnaire was administered was used for analysis. The mean age of the participants in this group was 37.1y (standard deviation 13.5y), 53.2% ($n=2371$) were women, 54.7% ($n=2439$) had no education. Figure 1 shows the sequence of study procedures that was followed.

Unilateral VI was present in 491 individuals (11.0%; 95% CI: 10.1-11.9), which included blindness in 144 participants (3.2%; 95% CI: 2.5-3.6) and moderate VI in 347 participants (7.8%; 95% CI: 7.0-8.6). Of these 491 individuals, two participants were blind since childhood and hence excluded from the remaining analysis. The causes of unilateral VI were uncorrected refractive errors (62.3%; $n=306$), cataract (17.9%; $n=88$) and others (19.8%; $n=97$).

Table 1 shows the univariate associations between the unilateral VI and other factors for noticing a change in vision and seeking consultation. Of the 489 people with unilateral VI, 399 (81.6%) participants reported noticing a change in their vision in the last five years. While participants in the older age group

were associated with noticing a change in vision ($P<0.001$), gender, level of education and level of visual impairment were not associated. Compared to West Godavari, a higher proportion of participants in Mahbubnagar and Adilabad district noticed a change in vision ($P=0.01$). Those with cataract as a cause of unilateral VI noticed were more likely to notice a change in their vision compared to those with uncorrected refractive errors and other conditions (Table 2).

With multiple regression analysis, noticing a change was associated with older age group, those aged 50 years had higher odds compared to those younger than 50y (OR: 2.8; 95% CI: 1.7-4.6). Compared to those from west Godavari district, the residents of Adilabad (OR: 2.0; 95% CI: 1.1-3.6; $P=0.02$) and Mahbubnagar (OR: 2.7; 95% CI: 1.5-5.1; $P=0.002$) were more likely to notice a change in their vision. Other covariates in the model such as gender, education, severity of VI and cause of VI were not associated with noticing a change in vision (Table 2). Among the 399 who noticed a change in their vision, only 136 (34.1%) people sought a consultation (Figure 1). Table 2 shows that results of multiple logistic regression analysis for association between unilateral VI and factors associated with noticing a change and seeking consultation. Those who were educated were more likely to seek consultation after noticing

Table 1 Characteristics of the participants for noticing a change in their vision and for seeking consultation

Characteristics	Total participants with unilateral VI (n=491) n (%) ^a	Noticed changed in vision (n=399) ¹		Sought treatment (n=136)	
		n (%) ^b	P	n (%) ^b	P
Age groups (a)			<0.01		<0.01
<50	214 (43.6)	155 (72.4)		50 (32.3)	
≥50	277 (56.4)	244 (88.1)		86 (35.2)	
Gender			0.60		0.31
M	245 (49.9)	196 (80.0)		62 (31.6)	
F	246 (50.1)	203 (82.5)		74 (36.5)	
Education			0.27		0.01
No education	303 (61.7)	251 (82.8)		73 (29.1)	
Any education	188 (38.3)	148 (78.7)		63 (42.6)	
Area			0.01		<0.01
West Godavari	186 (37.9)	138 (74.2)		60 (43.5)	
Adilabad	162 (33.0)	136 (84.0)		47 (34.6)	
Mahbubnagar	143 (29.1)	125 (87.4)		29 (23.2)	
Level of unilateral VI			0.77		<0.01
Moderate VI	347 (70.7)	282 (81.3)		70 (24.8)	
Blind	144 (29.3)	117 (81.3)		66 (56.4)	
Cause of VI			0.02		<0.01
Refractive error	306 (62.3)	251 (82.0)		60 (23.9)	
Cataract	88 (17.9)	77 (87.5)		43 (55.8)	
Others	97 (19.8)	71 (73.2)		33 (46.5)	
Total	491 (100.0)	399 (81.3)		136 (34.1)	

¹Two cases where the participants had unilateral visual impairment since childhood are excluded as the question on noticing a change in last five years was not applicable. ^aColumn percentage (%) presented; ^bRow percentage (%) presented.

Table 2 Effect of demographic variables, severity and causes of unilateral visual impairment on noticing and change in their vision in last five years and on seeking consultation (multiple logistic regression analysis)

Variables	Noticed changed in vision (n=399)			Sought consultation (n=136)		
	Odds ratio	95% CI	P	Odds ratio	95% CI	P
Age groups (a)						
<50	1.0			1.0		
≥50	2.8	1.7-4.6	<0.001	1.1	0.7-1.7	0.802
Gender						
M	1.0			1.0		
F	1.2	0.7-2.0	0.498	1.6	1.0-2.5	0.07
Education						
No education	1.0			1.0		
Any education	0.9	0.6-1.6	0.783	1.9	1.1-3.2	0.013
Area						
West Godavari	1.0			1.0		
Adilabad	2.0	1.1-3.5	0.02	0.7	0.4-1.1	0.139
Mahbubnagar	2.7	1.5-5.1	0.002	0.4	0.2-0.7	0.001
Level of unilateral VI						
Moderate VI				1.0		
Blind	1.1	0.5	0.832	2.7	1.4-5.2	0.002
Cause of VI						
Refractive error	1.0			1.0		
Cataract	1.5	0.6-3.8	0.355	2.1	1.0-4.3	0.043
Others	0.6	0.3-1.3	0.232	1.7	0.8-3.4	0.151

Table 3 Reasons for not utilizing eye care services despite noticing a change in their vision in the last five years

No.	Reason	Category	Number	%
1	Do not have money to pay for the checkup	Economic	79	30.7
2	Do not have a serious problem	Personal	77	30.0
3	Family/harvest/Business obligations	Social	40	15.6
4	Able to see adequately	Personal	15	5.8
5	Eye disease/decrease in vision natural with old age	Personal	9	3.5
6	Eye checkup not a priority due to other medical problems	Personal	9	3.5
7	Afraid that seeing someone for eye checkup will reveal vision loss and therefore cause worry	Personal	7	2.7
8	No one willing to escort for eye checkup	Social	7	2.7
9	Dominant person in the family do not feel the need to seek healthcare	Social	4	1.6
10	Would like eye checkup but other medical problems prevent me from going	Personal	4	1.6
11	Have to travel for eye checkup	Personal	3	1.2
12	Don't know where to go for eye checkup	Personal	2	0.8
13	Do not feel comfortable with eye doctor/general medical practioners I have access to	Personal	1	0.4
Total			257	100

a change in their vision compared those without any education (OR: 1.9; 95% CI: 1.1-3.2; $P=0.013$). The participants belonging to Mahbubnagar district had lower odds of seeking consultation compared to their counterparts in West Godavari district (0.4; 95% CI:0.2-0.7; $P=0.001$), those from Adilabad district also had lower odds but it did not reach the statistical significance. Those who were blind (OR: 2.7; 95% CI: 1.4-5.2; $P=0.002$) and those who had cataract as a cause of VI were more likely to seek consultation (OR: 2.1; 95% CI: 1.0-4.3; $P=0.043$) but not significant for noticing a change (Table 2). Among 339/489 (65.9%) people who did not seek consultation despite noticing a change in their vision, “do not have a serious problem” and “do not have money for eye checkup” were the most commonly reported reasons for not seeking services. These accounted for 60.7% ($n=156$) of the responses and this was followed by “other family/harvest/business obligations” in 15.6% ($n=40$) participants. The responses were not available from 6 (2.3%) participants (Table 3). The persons-related barriers ($n=127$; 49.4%) were more common followed by economic reasons ($n=79$; 30.7%) and social/family reasons ($n=51$; 19.8%).

In total, 90/489 participants did not notice a change in their vision. Of these, only 5/90 (5.6%) participants had a routine eye exam with an ophthalmologist. Among the remaining 85 participants, 65 (76.5%) participants reported that they were able see adequately, 9 (10.6%) participants responded that they did not consider that they had a serious problem and the other 9 (10.6%) responded that they had no money for eye checkup.

DISCUSSION

We reported on utilization of eye care services among those with unilateral VI in three rural areas in the state of Andhra Pradesh from a large cross sectional study with a representative sample. Barriers for the uptake of eye care services in older people were also reported by other researchers but most of the

literature on this subject was limited to those with bilateral VI or focused on cataract and cataract surgeries and conducted in older age groups^[6-8,10,16,21-22,26-31]. These studies reveal either “lack of felt need” or financial issues as the important reasons for not utilizing the eye care services^[6-8,16,27-31]. Studies also reported on changing trends in barriers for utilization of eye care services^[8,32].

In our study, a large number of people with unilateral VI noticed a change in their vision in the last five years but only a third of them visited an eye care provider for a consultation. This is similar to that reported for those with bilateral VI from the same study^[22]. About 34% of those who noticed a change in their vision sought a consultation in this study compared to 30% of those who had bilateral VI as reported earlier^[22]. We found that those who were older were more likely to notice a change in their vision however seeking a consultation was similar across the age groups. We did not find any association between gender with both noticing a change in vision and seeking a consultation. Only about a third of those who noticed a change sought consultation. This finding was similar to that reported among those with bilateral VI^[22]. We found no association between the education and noticing a change in vision but those who had any education were more likely to seek a consultation. This can be attributed to more awareness, access to eye care services, affordability and informed decision making due to their better education. We found a lower prevalence of unilateral VI among those belonging to the poorer regions of the state (Mahbubnagar and Adilabad) compared to the relatively well-off West Godavari district. Both Mabubnagar and Adilabad are designated as backward districts and are being funded backward regions grant fund from Government of India (<http://panchayat.nic.in/brgf/>; accessed 8th July 2016). Though a very high proportion of people noticed a change in their vision in these two poor areas,

a smaller proportion of them sought consultation compared to those in West Godavari district. This could partly be explained by the difference in socio-economic situations and awareness levels between the regions.

Severity of VI was not associated with noticing a change in their vision, this is probably because of good vision in the other eye. However, after noticing a change in vision, those with unilateral blindness were more likely to seek eye care compared to those with moderate VI. It is possible that once vision deteriorates to a certain level even in one eye, people tend to seek consultation as starts affecting their daily chores. Those with cataract were more likely to seek consultation when compared to uncorrected refractive errors and other conditions which is suggestive of the nature of VI caused due to cataract is more disabling than that of uncorrected refractive errors^[33-34]. Previous studies have also shown that quality of life and visual functions are severely affected by cataract compared to that of uncorrected refractive errors^[33-34]. Even though uncorrected refractive errors disable people from doing their daily tasks, acceptance of spectacles in rural population is not well understood. It is also possible that cataract being more visible compared to uncorrected refractive errors, social and family pressure may result in comparatively higher utilization of services.

Similar to several studies that reported economic reasons, both direct and indirect expenses limit the uptake of services, we also found that this was an important issue in our study population^[9-10]. This underlines the importance of unilateral VI and program planners need to consider the burden of unilateral VI in addition to bilateral VI in planning eye care services. "Do not have a serious problem" was another frequently reported reason, almost as common as economic reasons which describes the attitude and eye health seeking behavior of the rural populations.

When we categorized the reasons into personal, economic and social/family related, we found a predominance of personal reasons compared to the other two reasons. Most of the personal reasons are related to "self-perception" and influencing an attitudinal change is a challenge to the service providers. Economic reasons were also important reasons for not seeking eye care services. Though we categorized the reasons in three categories, personal, economic and social/family related, these reasons are likely to be interdependent and interlinked and hence cannot be seen in isolation^[21].

The practice of routine eye examination seems to be virtually absent in these rural populations. Even after noticing a change in vision only a third sought consultation. This calls for wider public health strategies to bring about an attitudinal change in eye health seeking behavior of the people. With emerging diseases such as diabetic retinopathy and glaucoma, routine eye examination has become far more relevant now than

ever before for early detection and management to prevent irreversible visual impairment.

While we had a large, randomly chosen representative sample with a good response rate that lends to the generalizability of our results, the data dates back to over a decade and considerable changes may have occurred since then. The follow-up study (APEDS III) which is in underway will be able to provide the trends for which this paper would serve as a baseline^[19]. The urban area was not reported as the APEDS III is restricted to rural areas only and was not possible in urban area due to significant infrastructural changes in the recent years.

In conclusion, we have explored a less researched but important area (unilateral VI) in eye care which has implications in eye care service delivery planning in rural communities. Systematic in-depth interviews by well trained and experienced field investigators, comprehensive ocular health assessment and a large population-based sample representative of the rural Andhra Pradesh renders our findings to be extrapolated to the larger rural populations. Equipped with population-based epidemiological data on unilateral and bilateral VI will enable program planners to work on strategies to achieve the goal of global VISION 2020 initiative in line with "The Universal Eye Health: The Global Action Plan 2014-2019".

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REFERENCES

- 1 Dandona L, Dandona R, Srinivas M, Giridhar P, Vilas K, Prasad MN, John RK, McCarty CA, Rao GN. Blindness in the Indian state of Andhra Pradesh. *Invest Ophthalmol Vis Sci* 2001;42(5):908-916.
- 2 Dandona R, Dandona L, Srinivas M, Giridhar P, Prasad MN, Vilas K, McCarty CA, Rao GN. Moderate visual impairment in India: the Andhra Pradesh Eye Disease Study. *Br J Ophthalmol* 2002;86(4):373-377.
- 3 Chia EM, Mitchell P, Rochtchina E, Foran S, Wang JJ. Unilateral visual impairment and health related quality of life: the Blue Mountains Eye Study. *Br J Ophthalmol* 2003;87(4):392-395.
- 4 Tan AC, Tay WT, Zheng YF, Tan AG, Wang JJ, Mitchell P, Wong TY, Lamoureux EL. The impact of bilateral or unilateral cataract surgery

- on visual functioning: when does second eye cataract surgery benefit patients? *Br J Ophthalmol* 2012;96(6):846-851.
- 5 Vu HT, Keffe JE, McCarty CA, Taylor HR. Impact of unilateral and bilateral vision loss on quality of life. *Br J Ophthalmol* 2005;89(3):360-363.
- 6 Bekibele CO, Murthy GV. Barriers to cataract surgery of persons screened at camps in Ibadan, Nigeria. *Afr J Med Med Sci* 2012;41(3):257-264.
- 7 Brian G, Maher L, Ramke J, Palagyi A. Eye care in Fiji: a population-based study of use and barriers. *Ophthalmic Epidemiol* 2012;19(2):43-51.
- 8 Finger RP. Cataracts in India: current situation, access, and barriers to services over time. *Ophthalmic Epidemiol* 2007;14(3):112-118.
- 9 Marmamula S, Keffe JE, Raman U, Rao GN. Population-based cross-sectional study of barriers to utilisation of refraction services in South India: Rapid Assessment of Refractive Errors (RARE) Study. *BMJ Open* 2011;1(1):e000172.
- 10 Marmamula S, Khanna RC, Shekhar K, Rao GN. 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. *BMJ Open* 2014;4(6):e005125.
- 11 Palagyi A, Ramke J, du Toit R, Brian G. Eye care in Timor-Leste: a population-based study of utilization and barriers. *Clin Experiment Ophthalmol* 2008;36(1):47-53.
- 12 Sapkota YD, Pokharel GP, Dulal S, Byanju RN, Maharjan IM. Barriers to up take cataract surgery in Gandaki Zone, Nepal. *Kathmandu Univ Med J (KUMJ)* 2004;2(2):103-112.
- 13 Arinze OC, Eze BI, Ude NN, Onwubiko SN, Ezisi CN, Chuka-Okosa CM. Determinants of eye care utilization in rural south-eastern Nigeria. *J Community Health* 2015;40(5):881-890.
- 14 Brilliant GE, Lepkowski JM, Zurita B, Thulasiraj RD. Social determinants of cataract surgery utilization in south India. The Operations Research Group. *Arch Ophthalmol* 1991;109(4):584-589.
- 15 Keffe JE, Weih LM, McCarty CA, Taylor HR. Utilisation of eye care services by urban and rural Australians. *Br J Ophthalmol* 2002;86(1):24-27.
- 16 Nirmalan PK, Katz J, Robin AL, Krishnadas R, Ramakrishnan R, Thulasiraj RD, Tielsch J. Utilisation of eye care services in rural south India: the Aravind Comprehensive Eye Survey. *Br J Ophthalmol* 2004;88(10):1237-1241.
- 17 Vaidyanathan K, Limburg H, Foster A, Pandey RM. Changing trends in barriers to cataract surgery in India. *Bull World Health Organ* 1999;77(2):104-109.
- 18 Dandona R, Dandona L, Naduvilath TJ, Nanda A, McCarty CA. Design of a population-based study of visual impairment in India: The Andhra Pradesh Eye Disease Study. *Indian J Ophthalmol* 1997;45(4):251-257.
- 19 Khanna RC, Murthy GV, Marmamula S, Mettla AL, Giridhar P, Banerjee S, Shekhar K, Chakrabarti S, Gilbert C, Rao GN; Andhra Pradesh Eye Disease Study Group. Longitudinal Andhra Pradesh Eye Disease Study: rationale, study design and research methodology. *Clin Exp Ophthalmol* 2016;44(2):95-105.
- 20 Rao GN. An infrastructure model for the implementation of VISION 2020: the right to sight. *Can J Ophthalmol* 2004;39(6):589-590, 593-594.
- 21 Dandona R, Dandona L, Naduvilath TJ, McCarty CA, Rao GN. Utilisation of eyecare services in an urban population in southern India: the Andhra Pradesh eye disease study. *Br J Ophthalmol* 2000;84(1):22-27.
- 22 Kovai V, Krishnaiah S, Shamanna BR, Thomas R, Rao GN. Barriers to accessing eye care services among visually impaired populations in rural Andhra Pradesh, South India. *Indian J Ophthalmol* 2007;55(5):365-371.
- 23 Marmamula S, Khanna RC, Rao GN. Unilateral visual impairment in rural south India-Andhra Pradesh Eye Disease Study (APEDS). *Int J Ophthalmol* 2016;9(5):763-767.
- 24 Marmamula S, Shekhar K, Banerjee S, Khanna RC, Rao GN. Population-based assessment of unilateral visual impairment in the south Indian State of Andhra Pradesh: Rapid Assessment of Visual Impairment (RAVI) Project. *Ophthalmic Epidemiol* 2016;23(3):171-175.
- 25 StataCorp.: Stata Statistical Software: Release 12. In. College Station, TX: StataCorp LP; 2011.
- 26 Marmamula S, Madala SR, Rao GN. Rapid assessment of visual impairment (RAVI) in marine fishing communities in South India--study protocol and main findings. *BMC Ophthalmol* 2011;11:26.
- 27 Ahmad K, Zwi AB, Tarantola DJ, Chaudhry TA. Self-perceived barriers to eye care in a hard-to-reach population: the Karachi Marine Fishing Communities Eye and General Health Survey. *Invest Ophthalmol Vis Sci* 2015;56(2):1023-1032.
- 28 Finger RP, Ali M, Earnest J, Nirmalan PK. Cataract surgery in Andhra Pradesh state, India: an investigation into uptake following outreach screening camps. *Ophthalmic Epidemiol* 2007;14(6):327-332.
- 29 Kovai V, Prasadarao BV, Paudel P, Stapleton F, Wilson D. Reasons for refusing cataract surgery in illiterate individuals in a tribal area of Andhra Pradesh, India. *Ophthalmic Epidemiol* 2014;21(3):144-152.
- 30 Mitsuhiro MH, Berezovsky A, Belfort R Jr, Ellwein LB, Salomao SR. Uptake, barriers and outcomes in the follow-up of patients referred for free-of-cost cataract surgery in the Sao Paulo Eye Study. *Ophthalmic Epidemiol* 2015;22(4):253-259.
- 31 Li Z, Song Z, Wu S, Xu K, Jin D, Wang H, Liu P. Outcomes and barriers to uptake of cataract surgery in rural northern China: the Heilongjiang Eye Study. *Ophthalmic Epidemiol* 2014;21(3):161-168.
- 32 Lee L, Ramke J, Blignault I, Casson RJ. Changing barriers to use of eye care services in Timor-Leste: 2005 to 2010. *Ophthalmic Epidemiol* 2013;20(1):45-51.
- 33 Nutheti R, Keffe JE, Shamanna BR, Nirmalan PK, Krishnaiah S, Thomas R. Relationship between visual impairment and eye diseases and visual function in Andhra Pradesh. *Ophthalmology* 2007;114(8):1552-1557.
- 34 Nutheti R, Shamanna BR, Nirmalan PK, Keffe JE, Krishnaiah S, Rao GN, Thomas R. Impact of impaired vision and eye disease on quality of life in Andhra Pradesh. *Invest Ophthalmol Vis Sci* 2006;47(11):4742-4748.