Gender differences in blindness, cataract blindness and cataract surgical coverage in India: a systematic review and meta-analysis

Manya Prasad,[1] Sumit Malhotra,[1] Mani Kalaivani,[2] Praveen Vashist,[3] Sanjeev K Gupta[4]

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[1]Community Medicine, All India Institute of Medical Sciences, Delhi, India
[2]Biostatistics, All India Institute of Medical Sciences, Delhi, India
[3]Dr. R. P. Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, Delhi, India
[4]Community Medicine, All India Institute of Medical Sciences, Delhi, India

Correspondence to
Dr Sumit Malhotra, Community Medicine, All India Institute of Medical Sciences, Delhi 110029, India; drsumitaiims@gmail.com

MP and SM contributed equally.

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ABSTRACT

Background The magnitude of blindness is unevenly distributed worldwide. This systematic review aimed to study gender differences in the prevalence of blindness, cataract blindness and cataract surgical coverage in India among persons aged 50 years and above.

Methods Literature search was carried out in the Medline, Web of Science, Google Scholar, EMBASE and Trip databases. Data were abstracted and risk of bias was assessed for the selected full-text articles. Pooled prevalence, ORs and risk differences were synthesised by meta-analyses.

Results 22 studies were included in the systematic review. The pooled prevalence of blindness obtained for men was 4.17% and that for women was 5.68%. Women had 35% higher odds of being blind (OR 1.35, 95% CI 1.08 to 1.62) and 69% higher odds of being cataract blind (OR 1.69, 95% CI 1.44 to 1.95). Women had a 27% lower odds of getting cataract surgery (OR 0.73, 95% CI 0.45 to 1.01). In women, around 35% of the prevalence of blindness and 33% of the prevalence of cataract blindness are attributable to their gender.

Conclusion Marked gender differences in blindness, cataract blindness and cataract surgical coverage were seen in India, with the odds being unfavourable for women. Interventions implemented for reduction of blindness, including cataract blindness, need to consider these gender differentials in the Indian context. Further research is needed to ascertain the reasons for these differences and devise interventions to reduce these differences in order to tackle the magnitude of avoidable blindness in India.

INTRODUCTION

From the current figure of 36 million blind persons globally, it is estimated that over 114 million will be blind by 2050 if effective preventive measures are not implemented.[1] Low-income and middle-income countries (LMICs) bear the greater proportion of this burden. Moreover, 81% of people who are blind or have moderate or severe vision impairment are aged more than 50 years.[1]

Previous studies have suggested that this disease prevalence is not gender-equal.[2] It is imperative to quantify the gender difference in the magnitude of blindness and to investigate causes for its existence in order to guide future policies.

It has been demonstrated that the overall magnitude of disease morbidity is higher for women in India.[3] It is imperative to bridge this difference and address its determinants in all spheres of health if the aim of universal health coverage is to be achieved in the near future.

Public health policy in India has aimed to give due importance to blindness prevention and treatment. Cataract is the most common cause of blindness in India.[4] It is postulated that the gender difference in the *magnitude* of blindness in India may be due to differences in access and uptake of cataract surgeries.

To quantify the gender difference in the magnitude of this disease, and to assess a possible cause thereof, we undertook a systematic review and meta-analysis to investigate gender differences in the prevalence of blindness, cataract blindness and cataract surgical coverage (CSC).

METHODOLOGY

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-analyses and the Meta-analysis Of Observational Studies in Epidemiology statements were adhered to in the present report.[5 6]

Inclusion criteria

The following inclusion criteria were used for eligibility:

- Population-based studies/surveys.
- Study conducted in India.
- Published between year 1990 and 2018.
- Gender-wise prevalence of blindness/cataract blindness/CSC estimates reported for persons aged 50 years or more.

Editorials, letters, news, reviews, expert opinions, case report and studies without original data were excluded.

If data were duplicated or shared in more than one study, the study published later or the more comprehensive report was included in the analysis.

Studies on specific disease groups (eg, patients with leprosy or diabetes) and those reporting prevalence of blindness only due to specific causes were also excluded.

Data sources and searches

Medline, Web of Science, EMBASE, Google Scholar and Turning Research Into Practice (TRIP)

Selection of studies

Titles and abstracts were screened in duplicate by two reviewers independently (MP and SM), and

full texts of articles that either reviewer considered potentially eligible were obtained. The eligibility of articles was determined from the full texts. Similarly, data were abstracted by two reviewers independently and risk of bias was assessed. For all phases of the project, disagreement was resolved by discussion and, as necessary, in consultation with a third reviewer (SKG).

The systematic review included studies calculating blindness prevalence from WHO definition, that is, visual acuity of less than 3/60 in better eye and with available correction, as well as the old definition under the Indian National Programme for Control of Blindness, that is, presenting visual acuity <6/60 in better eye. For the purpose of meta-analysis, the WHO definition of blindness was used. Blindness resulting from cataract was referred to as cataract blindness.

The CSC indicates the number of people who have received cataract surgery divided by the number that 'require' surgery. Thus, for instance, CSC for men is defined as the number of men operated for cataract/(number of men operated for cataract + number of men blind due to cataract). This is similarly defined for women.

Data extraction

The following data were extracted from each study: the first author's last name, publication year, region where the study was conducted, study period, rural or urban area, sample size, mean age of study subjects, proportion of women and response rate.

Risk of bias assessment

Risk of bias was assessed using the Critical Appraisal Skills Programme checklist.[7]

Data synthesis and statistical analysis

Pooled prevalence estimates were calculated using random effects on Stata V.14 software for WHO definition of blindness obtained from rapid surveys. Heterogeneity was estimated using I^2 statistics.

RESULTS

Study selection

Figure 1 presents the process of identifying eligible studies and citations identified through searches in electronic databases. Based on title and abstract screening, 33 full texts were assessed, of which 22 publications were included in the systematic review, which includes published studies (17) and reports (5).[8–24] Two of the published studies reported two estimates which were for two different periods,[16 17] and five published reports were also included in the review.[25–29] The five reports are included at the end of the online supplementary tables 1 and 2. The number of studies included in the meta-analysis of WHO definition of blindness from rapid surveys was 10 for the outcome 'blindness', 5 for 'cataract blindness' and 4 for 'cataract surgical coverage'. Consensus on inclusion of studies on full-text screening was achieved by two authors through discussion.

Study characteristics and estimates reported

Online supplementary tables 1 and 2 depict the study characteristics and reported blindness, cataract blindness and CSC estimates for included studies, respectively. Majority of the studies had been conducted in Southern India, and most study areas were rural. The mean age of study participants ranged from 61 to 70 years. The response rate was satisfactory in most of the studies that reported it. The reference category for all ORs in the online supplementary table 1 is men, and all ORs are computed as female to male ratios.

Risk of bias assessment

Online supplementary table 3 depicts the risk of bias in the included studies. All except two studies mentioned a sampling methodology that allows low risk of selection bias. Apart from four studies, all reported a satisfactory response rate ranging from 80.2% to 99.7%. CIs for estimates were mentioned by all published studies except for two. Only one published report mentioned the CI along with the point estimate.

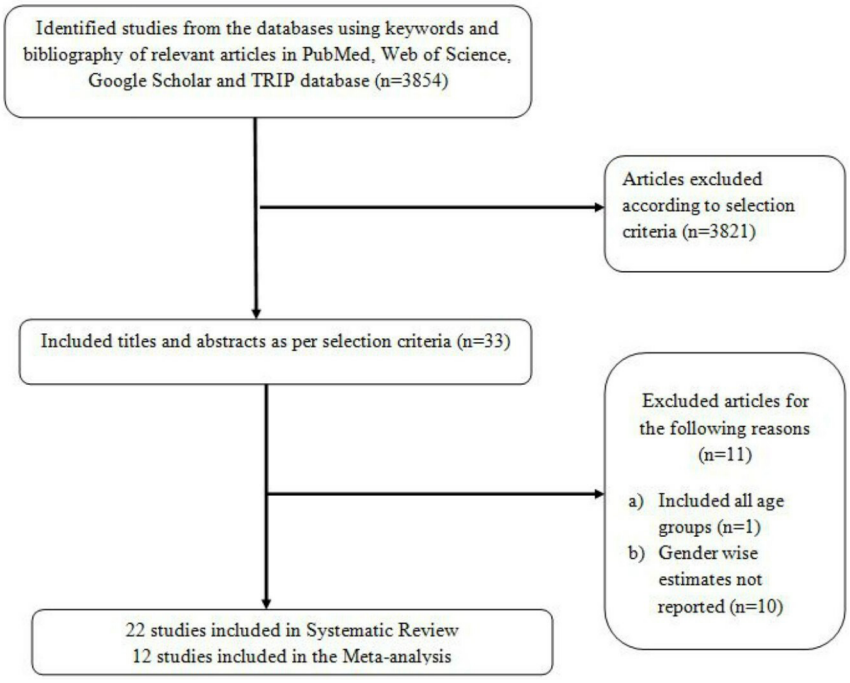

Figure 1 PRISMA flow chart for selection of studies. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-analyses. TRIP, Turning Research Into Practice

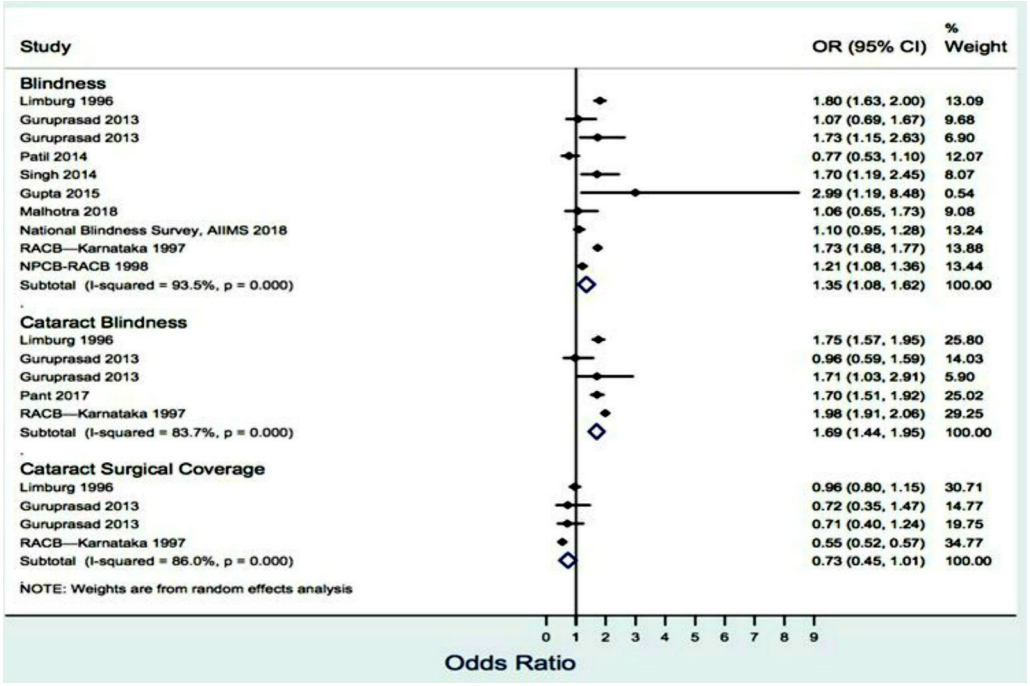

Figure 2 Strength of association between gender and blindness, cataract blindness and cataract surgical coverage. AIIMS, All India Institute of Medical Sciences. RACB, Rapid Assessment of Cataract Blindness. NPCB, National Programme for Control of Blindness.

Pooled ORs, risk difference and prevalence of blindness, cataract blindness and CSC in men and women

Figure 2 depicts the strength of association between gender and blindness, cataract blindness and CSC. The odds of blindness and cataract blindness were significantly higher in women compared with men. Women had 35% higher odds of being blind (OR 1.35, 95% CI 1.08 to 1.62) and 69% higher odds of being cataract blind (OR 1.69, 95% CI 1.44 to 1.95). Women had a 27% lower odds of getting cataract surgery (OR 0.73, 95% CI 0.45 to 1.01) (figure 2).

The pooled risk differences between genders for blindness and cataract blindness were −0.02 (95% CI −0.03 to −0.00) and −0.02 (95% CI −0.03 to −0.00), respectively. The pooled risk difference for CSC was 0.07 (95% CI −0.02 to 0.16) (figure 3).

Online supplementary figures 1, 2, and 3 depict the results of the meta-analysis of proportions using random-effects model.

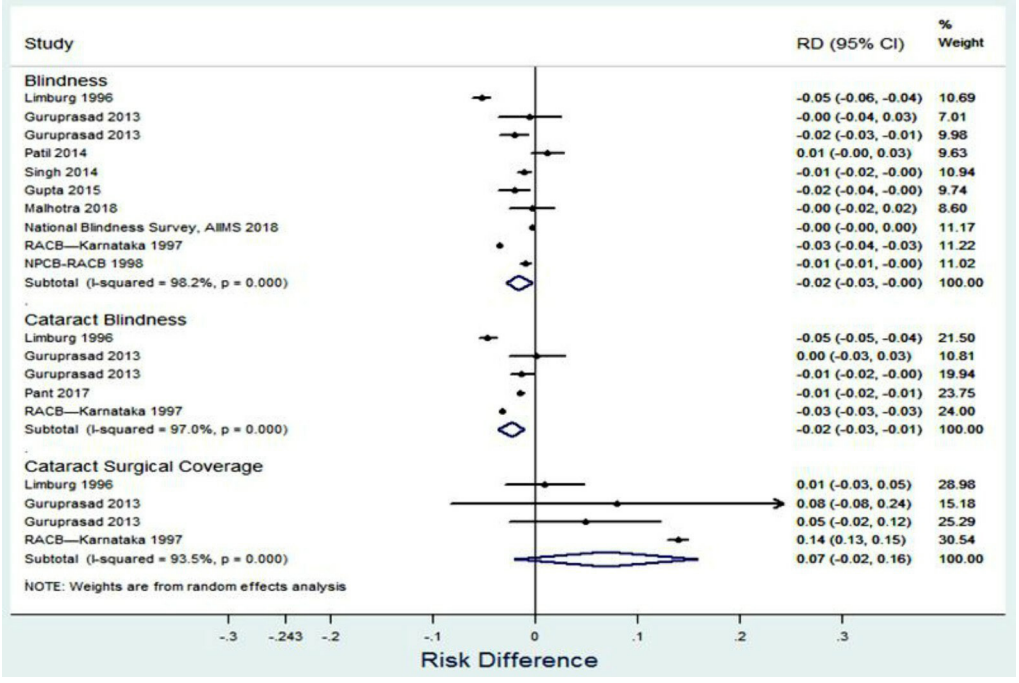

Figure 3 Risk difference (RD) in the prevalence of blindness, cataract blindness and cataract surgical coverage between men and women. AIIMS, All India Institute of Medical Sciences. RACB, Rapid Assessment of Cataract Blindness. NPCB, National Programme for Control of Blindness.

The pooled prevalence of blindness obtained for men was 4.17% and that for women was 5.68%. There was high level of heterogeneity, with the value of I^2 statistics being 99.7%.

The pooled prevalence of cataract blindness obtained for men was 3.92% and that for women was 6.13%. There was high level of heterogeneity, with the value of I^2 statistics being 99.7%.

The pooled CSC obtained for men was 59.29% and that for women was 52.34%. There was high level of heterogeneity, with the value of I^2 statistics being 99.6%.

There was no obvious asymmetry in the funnel plots; however, the number of studies was not enough to draw a firm conclusion through either funnel plot or Egger's regression.

DISCUSSION

The present systematic review found that blindness is more common in women than men in India. Moreover, the overall most common cause of blindness, that is, cataract, has resulted in a greater proportion of blindness in women than men in India. Also, CSC was found to be 27% lower in women than men.

Risk difference across genders provides a measure of attributable risk. Pooled risk difference depicts that among women, 2% out of the overall 5.68% prevalence of blindness (ie, 35% of overall blindness prevalence) is attributable to their gender. Similarly, around 33% of the overall prevalence of cataract blindness in women is attributable to their gender. CSC could be improved by 13.4% in women if the gender gap in coverage is eliminated.

There could be a number of reasons for the gender differences in the prevalence of blindness. First, the gender difference in these unadjusted estimates could be a result of greater longevity. Women, having a longer life expectancy, have higher age-related morbidities, one of them being the diseases associated with blindness, for example, age-related macular degeneration and cataract.[30]

Increased susceptibility to conditions that result in blindness can be postulated as another cause for this discrepancy in burden.[30] This is also supported by our study findings, where women had a 69% higher odds of being cataract blind. Previous studies have demonstrated a greater susceptibility to cataract in women.[31] Also, the pooled prevalence of cataract among women was higher than the pooled prevalence of blindness. This was probably due to available studies that reported cataract blindness but not total blindness.

However, biological predisposition to blindness and its causes can only explain a small proportion of the gender difference, and is unlikely to account for the large overall difference.

CSC serves a meaningful measure of access to cataract surgical services. The present study demonstrated a lower CSC in women, which could be viewed as the third cause of the discrepancy in the magnitude of cataract blindness. Previous studies have also demonstrated a lower coverage of cataract surgical rate in women in India.[32 33] Meta-analyses on CSC have demonstrated a gender difference in the utilisation of cataract surgical programmes in LMICs.[34]

The reasons for the gender gap in the utilisation of cataract surgical services could be manifold, since this is governed by gender-defined social roles. The cost of availing surgery for cataract may be prohibitive, since this incorporates the cost of transport, loss of work of the patient and their attendant, and the cost of stay for the attendant at the hospital, among other things. Women in India have, traditionally, low disposable income and less control over the finances of the household, thus precluding their ability to spend for cataract surgery.[35]

Moreover, cataract surgery may require travelling outside the village they live in, something that they are less likely to do. The perceived 'value' of cataract surgery differs across genders.[36] Finally, community education about cataract surgery may not have been undertaken efficiently or widely, and lack of awareness may be responsible for low access to these services, as has been supported by previous studies.[37 38]

The study by Ramke *et al*[39], which assessed the effect of three social determinants, including gender, on the prevalence of cataract blindness and CSC using national survey data from Pakistan and Nigeria, found the overall prevalence of cataract blindness to be higher in women. CSC was found lower in women in both countries. It was also observed that women who are illiterate and residents of rural area have a higher prevalence of cataract blindness and lower CSC.

There are several limitations to this systematic review. The pooled effect is synthesised from a limited number of studies, that is, only those that reported figures that could be used for the meta-analysis. There is high level of heterogeneity, which could not be explained but can be hypothesised to result from different methods of assessment and varied time periods.

These findings imply that women do not receive cataract surgery at the same rate as men do, and closing this gender gap may be a much needed step towards reducing the prevalence of cataract blindness. Cataract surgical programmes need to take cognisance of the fact that the utilisation of their services is not uniform across genders[37 38 40]; thus, consideration of gender differences is imperative when evaluating programme implementation. Public health experts and community ophthalmology practitioners must consider targeting women specifically for efforts to curb blindness and evaluate local barriers to availing services. Further implementation research in this area will be needed to ascertain barriers for women in seeking eye care services and how best health system can address these barriers to reduce gender inequity prevailing in the magnitude of blindness in India.

Contributors SM, MP and MK had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: SM, PV and SKG. Acquisition, analysis or interpretation of data: SM, MP, MK and SKG. Drafting of the manuscript: MP and SM. Critical revision of the manuscript for important intellectual content: all authors. Statistical analysis: MK, MP and SM. Study supervision: PV and SKG.

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REFERENCES

1 Bourne RRA, Flaxman SR, Braithwaite T, *et al*. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *Lancet Glob Health* 2017;5:e888–97.
2 Abou-Gareeb I, Lewallen S, Bassett K, *et al*. Gender and blindness: a meta-analysis of population-based prevalence surveys. *Ophthalmic Epidemiol* 2001;8:39–56.
3 Saikia N, Bora JK. Gender difference in health-care expenditure: evidence from India human development survey. *PLoS One* 2016;11:e0158332.
4 VISION 2020: The Right to Sight – India. The International agency for prevention of blindness. Available: https://www.iapb.org/member/vision-2020-the-right-to-sight-india/ [Accessed 8 Sep 2018].

5 Moher D, Shamseer L, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;4.
6 Stroup DF, Berlin JA, Morton SC, *et al*. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis of observational studies in epidemiology (moose) group. *JAMA* 2000;283:2008–12.
7 CASP Critical Appraisal Skills Programme Oxford UK [Internet]. Critical appraisal skills programme (CASP). Available: http://www.casp-uk.net [Accessed 8 Sep 2018].
8 Limburg H, Vaidyanathan K, Pampattiwar KN. Cataract blindness on the rise? Results of a door-to-door examination in Mohadi. *Indian J Ophthalmol* 1996;44:241–4.
9 Bachani D, Gupta SK, Murthy GV, *et al*. Visual outcomes after cataract surgery and cataract surgical coverage in India. *Int Ophthalmol* 1999;23:49–56.
10 Dandona L, Dandona R, Srinivas M, *et al*. Blindness in the Indian state of Andhra Pradesh. *Invest Ophthalmol Vis Sci* 2001;42:908–16.
11 Murthy GV, Gupta S, Ellwein LB, *et al*. A population-based eye survey of older adults in a rural district of Rajasthan: I. central vision impairment, blindness, and cataract surgery. *Ophthalmology* 2001;108:679–85.
12 Nirmalan PK, Thulasiraj RD, Maneksha V, *et al*. A population based eye survey of older adults in Tirunelveli district of South India: blindness, cataract surgery, and visual outcomes. *Br J Ophthalmol* 2002;86:505–12.
13 Murthy GVS, Gupta SK, Bachani D, *et al*. Current estimates of blindness in India. *Br J Ophthalmol* 2005;89:257–60.
14 Vijaya L, George R, Arvind H, *et al*. Prevalence and causes of blindness in the rural population of the Chennai glaucoma study. *Br J Ophthalmol* 2006;90:407–10.
15 Murthy GVS, Vashist P, John N, *et al*. Prevelence and causes of visual impairment and blindness in older adults in an area of India with a high cataract surgical rate. *Ophthalmic Epidemiol* 2010;17:185–95.
16 Khanna RC, Marmamula S, Krishnaiah S, *et al*. Changing trends in the prevalence of blindness and visual impairment in a rural district of India: systematic observations over a decade. *Indian J Ophthalmol* 2012;60:492–7.
17 Guruprasad BS, Krishnamurthy D, Narendra DP, *et al*. Changing scenario of cataract blindness in Kolar district, Karnataka, South India. The utility of rapid assessment of avoidable blindness in reviewing programs. *Ophthalmic Epidemiol* 2013;20:89–95.
18 Marmamula S, Ravuri CSLV, Boon MY, *et al*. A cross-sectional study of visual impairment in elderly population in residential care in the South Indian state of Andhra Pradesh: a cross-sectional study. *BMJ Open* 2013;3:e002576.
19 Vijaya L, George R, Asokan R, *et al*. Prevalence and causes of low vision and blindness in an urban population: the Chennai glaucoma study. *Indian J Ophthalmol* 2014;62:477–81.
20 Patil S, Gogate P, Vora S, *et al*. Prevalence, causes of blindness, visual impairment and cataract surgical services in Sindhudurg district on the western coastal strip of India. *Indian J Ophthalmol* 2014;62:240–5.
21 Singh N, Eeda SS, Gudapati BK, *et al*. Prevalence and causes of blindness and visual impairment and their associated risk factors, in three tribal areas of Andhra Pradesh, India. *PLoS One* 2014;9:e100644.
22 Gupta N, Vashist P, Malhotra S, *et al*. Rapid assessment of visual impairment in urban population of Delhi, India. *PLoS One* 2015;10:e0124206.
23 Pant HB, Bandyopadhyay S, John N, *et al*. Differential cataract blindness by sex in India: evidence from two large national surveys. *Indian J Ophthalmol* 2017;65:160–4.
24 Malhotra S, Vashist P, Kalaivani M, *et al*. Prevalence and causes of visual impairment amongst older adults in a rural area of North India: a cross-sectional study. *BMJ Open* 2018;8:e018894.
25 National Blindness Survey 2015-18: District Summary Report [Internet]. New Delhi: All India Institute of Medical Sciences, 2017. Available: https://www.aiims.edu/en/dept-of-community-ophthalmology/survey-reports_20_8_15.html [Accessed 8 Sep 2018].
26 National Programme for Control of Blindness. Rapid assessment of blindness in North eastern states of India. New Delhi Ministry of Health and Family Welfare, Government of India; 2003.
27 Regional Institute of Ophthalmology. The prevalence of cataract blindness and surgical visual outcome in a population based survey in the district South 24 Parganas, West Bengal. West Bengal District Blindness Control Society; 2001.
28 Lions Aravind Eye Institute of community ophthalmology. Cataract Blindness & Surgical Outcomes Survey, Sivaganga, Tamil Nadu. Madurai Aravind Eye Hospital; 1999.
29 Limburg H, Kumar R, Indrayan A. Rapid assessment of cataract blindness, Karnataka. *Int J Epidemiol* 1997;26:1049–54.
30 Courtright P, Lewallen S. Why are we addressing gender issues in vision loss? *Community Eye Health* 2009;22:17–19.
31 Chatterjee A, Milton RC, Thyle S. Prevalence and aetiology of cataract in Punjab. *Br J Ophthalmol* 1982;66:35–42.
32 Angra SK, Murthy GV, Gupta SK, *et al*. Cataract related blindness in India & its social implications. *Indian J Med Res* 1997;106:312–24.
33 Fletcher AE, Donoghue M, Devavaram J, *et al*. Low uptake of eye services in rural India: a challenge for programs of blindness prevention. *Arch Ophthalmol* 1999;117:1393–9.
34 Lewallen S, Mousa A, Bassett K, *et al*. Cataract surgical coverage remains lower in women. *Br J Ophthalmol* 2009;93:295–8.
35 Marmot M. Commission on social determinants of health. achieving health equity: from root causes to fair outcomes. *Lancet* 2007;370:1153–63.
36 Vaidyanathan K, Limburg H, Foster A, *et al*. Changing trends in barriers to cataract surgery in India. *Bull World Health Organ* 1999;77:104–9.
37 Nirmalan PK, Katz J, Robin AL, *et al*. Utilisation of eye care services in rural south India: The Aravind comprehensive eye survey. *Br J Ophthalmol* 2004;88:1237–41.
38 Brilliant GE, Lepkowski JM, Zurita B, *et al*. Social determinants of cataract surgery utilization in South India. The Operations research Group. *Arch Ophthalmol* 1991;109:584–9.
39 Ramke J, Zwi AB, Lee AC, *et al*. Inequality in cataract blindness and services: moving beyond unidimensional analyses of social position. *Br J Ophthalmol* 2017;101:395–400.
40 Joseph S, Ravilla T, Bassett K. Gender issues in a cataract surgical population in South India. *Ophthalmic Epidemiol* 2013;20:96–101.