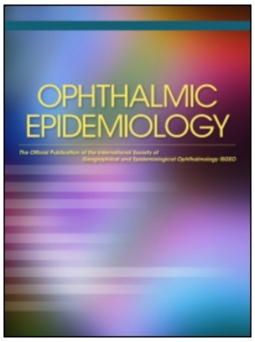

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Interventions to improve gender equity in eye care in low-middle income countries: A systematic review

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ABSTRACT

Purpose: Women bear an inequitable burden of blinding conditions compared to men primarily because they have more limited access to eye care services. This systematic review sought evidence regarding interventions to increase gender equity in eye care.

Methods: We searched MEDLINE, Cochrane Central Register of Controlled Trials, EMBASE, and EBSCO CINAHL, and contacted experts to identify studies in low- and middle-income countries of health services interventions for age-related cataract, childhood cataract, and trachoma. Eligible studies could be clinical trials or observational studies, but had to present sufficient data for intervention effects to be estimated separately for women and men.

Results: We included four cluster RCTs and nine observational studies. All were judged to have serious risk of bias. Six studies examined interventions involving training rural community volunteers to identify, educate and assist individuals with unmet eye care needs. Interventions were associated with reduced gender inequities in all-cause blindness, clinic attendance, cataract surgery coverage and trachoma treatment coverage (low-to-very low quality evidence). Studies in Nepal and Tanzania examining a multicomponent intervention to improve follow-up after pediatric cataract surgery found reduced gender inequities in follow-up rates at 10 weeks (low quality evidence).

Conclusion: Limited evidence exists to inform health service planners regarding interventions to reduce gender inequity in visual impairment and blindness. Training community volunteers to identify and counsel affected individuals, and empower them to circumvent or challenge socio-economic barriers to accessing care holds promise. Future interventions ought to explicitly consider gender in their design and implementation, and incorporate high-quality evaluation efforts.

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Introduction

Gender is an important determinant of eye health. In 2015, women accounted for 56% of the world's 36 million blind people and 55% of the 217 million people with moderate-to-severe visual impairment (defined as a presenting visual acuity <6/18 but ≥3/60).[1]

Gender differences in the risk of blindness and visual impairment have been found to exist in all regions of the world and among all age groups.[1] Globally, uncorrected refractive error and cataract are the most significant treatable causes of avoidable visual impairment. Macular degeneration and glaucoma are the next most significant contributors, while trachoma is still an important contributing condition in parts of Africa.[2] Women experience higher risks of blindness than men from cataract, uncorrected refractive error and trachoma.[2]

Gender differences in eye health probably result from a number of factors, which vary somewhat by eye condition and region of the world. However, except that women have a longer average life expectancy, there is little evidence that biological sex-based differences contribute significantly. A factor that does appear to be important is that women in many societies have poorer access to health care services than men. For example, adult women have lower cataract surgical coverage rates than men in the majority of low- and middle-income countries surveyed, even though they account for a larger percentage of the population in need.[3] Similarly, in Sub-Saharan Africa, East Asia and the Pacific, and South Asia, girl children are less likely

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than boys to have surgery for bilateral cataracts, a condition that shows no gender predilection in high-income countries.[4]

In patriarchal societies, the relative social positions of women and men render women less able to access and utilize health care. In Tanzania, researchers have found that women tend to be less able to obtain cataract surgery than men because they have less say over household financial resources and because there is a societal perception that older men play a more significant community role than older women, and consequently have a greater need for sight.[5] This empowers men to ask for family support in obtaining surgery, while making women more likely to accept their visual impairment.[5]

Global efforts to combat blindness and visual impairment necessitate a substantial improvement in access to eye health services in low- and middle-income countries, where the burden of disease is greatest.[1] Recognizing that women and girls face particular barriers in accessing care, policy makers and programme planners ought to be aware of the potential for gender differences in the effects of interventions to improve access to eye care services, and ought to give preference to interventions with the potential to reduce existing gender inequities. We carried out a systematic literature review to synthesize the impact of existing eye health services interventions on gender equity.

Materials and methods

Literature search

We searched the MEDLINE, Cochrane Central Register of Controlled Trials, EMBASE, and EBSCO CINAHL databases (up to October 16, 2017) for published studies of interventions in low- and middle-income countries aimed at improving access to care for age-related cataract, childhood cataract, and trachoma. Expecting to find few controlled clinical trials, we did not include limits related to study design in our search. The search terms used are shown in Supplementary Table 1. We hand searched reference lists of included articles and contacted experts in the field for additional relevant published and unpublished studies.

Inclusion and exclusion criteria

Studies were included if they were designed to estimate the "treatment effect" of an intervention to improve access to prevention or treatment services for one or more of the ophthalmic conditions of interest. Experimental, quasi-experimental, and non-experimental designs were eligible, provided there was an adequate comparison group who had not received the intervention. Studies comparing purely pharmaceutical or surgical interventions or physical infrastructure development were excluded. Eligible study participants were adults or children residing in countries defined by The World Bank as low- or middle-income.[6] Eligible outcomes included relative or absolute differences in rates of blindness or visual impairment due to the ophthalmic conditions of interest, differences in rates of health services utilization (e.g. treatment coverage or surgery uptake) among eligible individuals with the conditions of interest, or any estimate of a gender differential in the effect of an intervention (e.g. difference-in-differences estimate). Studies were excluded if they did not include both female and male participants or if they did not present sufficient information for intervention effects to be estimated separately for women and men.

Eligibility screening and data extraction

A single reviewer (G.D.M.) screened titles and abstracts and retrieved full articles meeting the inclusion criteria. Full text articles were reviewed by two individuals (G. D.M., K.B.) to confirm eligibility. Data extraction was performed by a single reviewer (G.D.M) using a standardized template.

Risk of bias assessment

A single reviewer (G.D.M) assessed each study for risk of bias. For Randomized Controlled Trials (RCTs) the Cochrane Collaboration's tool was used to categorize risk of bias as "Low", "High", or "Unclear".[7] For non-randomized studies we used the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool to assign a judgment of "Low", "Moderate", "Serious" or "Critical" risk of bias, or "No information".[8]

Quality of evidence grading

We assessed quality of evidence according to the GRADE approach adopted by the Cochrane Collaboration,[9] whereby evidence is judged as "High", "Moderate", "Low", or "Very Low" quality. Evidence from RCTs is assigned a starting grade of "High" and evidence from observational studies is assigned a starting grade of "Low". Quality of evidence is upgraded or downgraded according to factors such risk of bias in the contributing studies, magnitude of effects and precision of effect estimates.

Data analysis and qualitative synthesis

For the purposes of this review, we defined interventions with the potential to reduce gender inequities as those having a greater beneficial effect among female recipients than male recipients. Using sex-stratified outcome data from each study, we estimated the effect of the intervention separately for female and male recipients. For binary outcomes we used Logistic regression to estimate odds ratios (ORs) comparing intervention recipients to non-recipients. For counts we used Poisson regression to estimate rate ratios (RRs). We estimated the magnitude of any differential effect of the intervention by including in the statistical models an interaction term involving binary indicator variables for sex and receipt of the intervention. The coefficient for the interaction term is equivalent to the ratio of the effect for females to the effect for males. For studies with sufficiently overlapping interventions and outcomes we estimated pooled effect estimates using a generalized linear mixed effects model with a random intercept for study identifier. To assess for heterogeneity in the meta-analyses we used Cochrane's Q test and the I^2 index.[10] In cases where study authors estimated the relative effect of their intervention among females and males, but did not present sufficient data for us to produce the models described above, we presented the estimates from the original report.

We used a theoretical framework of access to healthcare to qualitatively synthesize the findings from across studies. According to the model proposed by Levesque *et al*., individuals go through the following sequential steps in the process of accessing health care: Perception of need and desire for health care; Health care seeking; Health care reaching; Health care utilization; and Receiving appropriate care.[11,12] We referred to this model to organize the interventions according to which step(s) of health care access they addressed. We also classified the interventions based on whether and how gender was considered during the design and evaluation. Broadly speaking, interventions to address gender inequities may adopt either a "gender accommodating" or a "gender transformative" approach.[13] Gender accommodating strategies aim to improve gender equity in health by working around the barriers to health care access imposed by entrenched gender norms and power relationships. In contrast, gender transformative strategies directly challenge harmful gender norms and foster more equitable relationships between women and men with the aim of improving health for all.

Results

Included studies

Our database search identified 3250 unique records, from which we reviewed 26 full text articles. We reviewed full texts of a further 21 articles identified through hand searches of references lists and recommendations from experts. Twelve studies met our eligibility criteria, four cluster RCTs (1 unpublished) and eight observational studies. We also included a pair of population-based cross-sectional surveys,[14,15] which we combined and treated as a single pre- and post-intervention observational study. For the remainder of the article we treat these two articles as a single study. Supplementary Figure 1 shows the PRISMA flow diagram indicating the numbers of records included and excluded at each stage of the review. Supplementary Table 2 presents details of the included studies. Supplementary Table 3 presents reasons for excluding the remainder of the full text articles reviewed.

Included studies evaluated interventions for age-related cataract (5 studies), childhood cataract (2 studies), trachoma (3 studies), and general paediatric eye health (3 studies). Seven studies were conducted in Sub-Saharan Africa (Ethiopia, Malawi, Nigeria, and Tanzania), four in South Asia (Bangladesh, India and Nepal), and one each in China and Egypt.

Risk of bias in included studies

We judged the four cluster RCTs to have high risk of bias in several domains including inability to mask participants to the intervention received, possible incomplete outcome data resulting from the inability to precisely define the intervention population, and inadequate description of study groups in terms of the distribution of potential confounding variables (Supplementary Table 4).

We judged all nine observational studies to be at serious overall risk of bias because it was likely that important potential confounding variables had either not been measured or were not adequately controlled for in the analyses (Supplementary Table 5). Four studies were also felt to have serious risks of selection bias because sampling procedures for intervention and control cohorts were different and potentially related to the outcome.[14,16–18]

Summary of findings

Age-related cataract

Table 1 summarizes evidence for the effects on gender equity of five interventions designed to improve access to care for age-related cataract. Two studies, a cluster RCT in Tanzania [Lewallen, S. *et al*., unpublished data] and an observational study in Nepal, which compared pre- and post-intervention data from two separate cross-sectional surveys,[14,15] evaluated similar multicomponent interventions involving outreach by

Table 1. Summary of findings for interventions to improve access to care for age-related cataract.

Intervention (Country) *Steps of health care access targeted*[a]	Outcome	Females: Comparison Intervention Risk/Odds Ratio (95% CI)	Males: Comparison Intervention Risk/Odds Ratio (95% CI)	Ratio Female-to-Male Risk/ Odds Ratios (95% CI)	Number of participants (Studies)	Quality of Evidence (GRADE)
Lewallen, n.p. Train community volunteers to identify, counsel and refer individuals in need of eye health services and advocate for social and financial support at household and village level to overcome barriers to access (Tanzania) *Steps: 1,2,3*	Clinic attendance	65 per year 107 per year RR: 1.39 (1.03–1.87)[b]	53 per year 87 per year RR: 1.40 (1.01–1.95)[b]	0.99 (0.64–1.54)[b]	5,007 (1 RCT)	Moderate[c]
	Cataract surgery acceptance	35/46 = 0.76 51/59 = 0.86 OR: 1.65 (0.55–4.89)[b]	39/47 = 0.83 49/67 = 0.73 OR: 0.18 (0.04–0.83)[b]	9.37 (1.41–62.17)[b]	338 (1 RCT)	Very low[d]
Sherchan, 2010 & Pokharel, 1998 Train female community health volunteers to identify women in need and assist them to access existing eye health services (Nepal) *Steps: 1,3*	All-cause blindness	143/2349 = 0.06 116/2701 = 0.04 OR: 0.69 (0.54–0.89)	98/2253 = 0.04 121/2437 = 0.05 OR: 1.15 (0.88–1.51)	0.60 (0.42–0.87)[f]	9,740 (1 Obs. study)	Very low[e]
	Cataract surgical coverage	71/175 = 0.41 148/209 = 0.71 OR: 3.55 (2.33–5.46)	53/120 = 0.44 111/180 = 0.62 OR: 2.03 (1.28–3.26)	1.75 (0.93–3.29)	684 (1 Obs. study)	Very low[e]
Zhang, 2010 & Jefferis, 2008 Rural outreach screening for operable cataract compared to referral or spontaneous presentation to urban clinic/hospital (China, Tanzania) *Steps: 3*	Clinic attendance	Not available	Not available	OR: 1.31 (0.66–2.58)[g] OR: 1.21 (1.06–1.39)[h]	240 (1 Obs. study) 3,765 (1 Obs. study)	Very low[e]
Okoye, 2015 Cataract surgical fee reduction (Nigeria) *Steps: 4*	Cataract surgery acceptance	71 per year 89 per year RR: 1.25 (0.91–1.72)	93 per year 123 per year RR: 1.32 (1.01–1.74)	0.95 (0.62–1.44)	376 (1 Obs. study)	Very low[e]

The "Females" column shows a measure of absolute risk of the outcome among females in the comparison and intervention groups and the risk ratio or odds ratio, as indicated, comparing intervention to comparison groups, estimated using Poisson regression for count outcomes and Logistic regression for binary outcomes. The "Males" column shows equivalent estimates for males. The "Ratio Female-to-Male Risk/Odds Ratios" shows the ratio of the risk ratio/odds ratio among females to that among males. This ratio of ratios was estimated using a Poisson or Logistic regression model with an interaction between sex and receipt of the intervention. Except where indicated, a value >1 means the intervention was more beneficial for females than males.

[a]Steps of health care access: 1 – Perception of need and desire for healthcare, 2 – Healthcare seeking, 3 – Healthcare reaching, 4 – Healthcare utilization, 5 – Receiving appropriate care.

[b]Intervention effect estimated from a regression model with terms for time period (pre- and post-intervention), site (intervention and control) and the interaction between time period and site.

[c]Quality of evidence from RCT downgraded one point for high risk of bias due to lack of masking of participants and personnel and confounding.

[d]Quality of evidence from RCT downgraded one point for high risk of bias due to lack of masking of participants and personnel and confounding, one point for unexplained inconsistency of results, and one point for imprecision of effect estimates.

[e]Quality of evidence from observational studies downgraded one point for serious risk of bias in participant selection.

[f]For this outcome, a Ratio of Female-to-Male Relative Risks <1 means the intervention was more beneficial for females than males.

[g]Study in China. Logistic regression model adjusted for age, visual acuity in better seeing eye, and questionnaire scores for 4 domains of barriers to surgery uptake (knowledge, cost, transport, quality).

[h]Study in Tanzania. Logistic regression model not adjusted for potential confounding variables.

lay community members trained to identify and counsel women with visual impairment and assist them to access existing cataract surgical services. The intervention in Tanzania additionally involved advocacy efforts, at household- and village-levels, to generate social and financial supports for individuals requiring cataract surgery.

In Tanzania, the intervention was associated with a significant increase in clinic attendance rates by both women and men, with no significant gender differential (Ratio Female-to-Male Risk Ratios (RRR) = 0.99, 95% Confidence Interval (CI): 0.64–1.54). The intervention was also associated with a significant increase in cataract surgery acceptance by women but a concomitant decline in surgery acceptance by men (Ratio Female-to-Male Odds Ratios (ROR) = 9.37, 95% CI: 1.41–62.17) [Lewallen, S. *et al.*, unpublished data]. Although this intervention might initially be expected to reduce existing gender inequities in cataract surgery coverage, the effect of reducing surgery acceptance by men is undesirable. We judged this evidence to be of very low quality due to this unexplained inconsistency of results, the lack of masking of participants and personnel and imprecision in the effect estimates.

In Nepal, the intervention was associated with a significant reduction in all cause blindness (visual acuity <6/60 in the better-seeing eye) among women but not men (ROR = 0.60, 95% CI: 0.42–0.87).[14,15] The reduction in gender inequity in blindness may have been attributable to the larger increase in cataract surgical coverage among women than men associated with the intervention (ROR = 1.75, 95% CI: 0.93–3.29). We judged the strength of this evidence as very low because of a high risk of selection bias. The pre-intervention survey sampled individuals from two geographic areas of Nepal (Bheri and Lumbini zones), whereas the post-intervention study was restricted to the Lumbini zone. The initial study did not present sex-stratified outcome data for the two zones, making it difficult to predict whether differences in the base population between the surveys might have biased the estimated intervention effects upwards or downwards.

Two prospective cohort studies (China and Tanzania) provide very low quality evidence that outreach screening in rural villages identified a greater percentage of women eligible for cataract surgery than standard clinic referrals. In China, 74.2% of individuals identified by outreach screening were women, versus 54.3% of individuals presenting to clinics.[16] A multiple logistic regression model, which adjusted for age, visual acuity in the better seeing eye, and scores from a questionnaire on barriers to surgery uptake, estimated that outreach screening was positively associated with female sex but the effect was not statistically significant (OR = 1.31; 95% CI: 0.66–2.58). In contrast, in the Tanzanian study, female sex was significantly associated with presenting to care through outreach clinics versus walk-in (OR = 1.21, 95% CI: 1.06–1.39). The latter analysis did not account for the effect of potential confounding factors.[19]

Finally, there is very low quality evidence from a study in Nigeria that reducing surgical fees (from the equivalent of 393-428USD to 71-129USD) did not increase gender equity in utilization of surgery for adult and pediatric cataract (RRR = 0.95, 95% CI: 0.62–1.44).[17]

Childhood cataract

Table 2 summarizes evidence for the gender equity effects of interventions to improve access to care for childhood cataract. Two studies evaluated similar multicomponent interventions to improve post-operative follow-up for childhood cataract.[20,21] In the analysis in which we pooled data from both studies, the intervention was associated with significantly increased odds of follow-up at 2 and 10 weeks post-operatively. The beneficial effect appeared to be greater among girls than boys, with the ratio of effects being statistically significant at 10-weeks (ROR = 2.74, 95% CI: 1.39–5.57), but not at 2 weeks (ROR = 1.62, 95% CI: 0.66–4.11). In non-pooled analyses, the intervention effect was found to be relatively homogenous across the two studies (Supplementary Table 6). In Tanzania, the beneficial effect of the intervention was still evident, but diminished in magnitude, by 24 weeks post-operatively, with no significant gender differential (ROR = 0.69, 95% CI: 0.34–1.39). We judged this evidence to be of low quality because, although point estimates from both studies suggest the intervention had a large beneficial effect, there was a large degree of uncertainty in the estimates.

Trachoma

Table 3 summarizes evidence for the gender equity effects of interventions to improve access to care for trachoma. There is low quality evidence from a cluster RCT in Egypt that a multicomponent intervention involving community mobilization and health care provider capacity building around access to trichiasis surgery may have reduced the prevalence of trachomatous trichiasis among women to a greater extent than among men. However, the quality of this evidence is limited by low precision in the effect estimates (ROR = 0.66, 95% CI: 0.09–5.03).[22] A study of Azithromycin mass treatment in Tanzania compared coverage rates in villages randomized to have household recruitment done by

Table 2. Summary of findings for interventions to improve access to care for childhood cataract.

Intervention (Country) *Steps of health care access targeted*[a]	Outcome	Females: Comparison Intervention Risk/Odds Ratio (95% CI)	Males: Comparison Intervention Risk/Odds Ratio (95% CI)	Ratio Female-to-Male Risk/Odds Ratios (95% CI)	Number of participants (Studies)	Quality of Evidence (GRADE)
Kishiki, 2009 & Rai, 2014 Multicomponent post-surgical follow-up intervention: patient education and counselling, designated childhood blindness and low vision co-ordinator, tracking database, reminder calls (Nepal, Tanzania) *Steps: 1,2,3,4*	Attendance at 2-week post-op. follow-up visit	112/156 = 0.72 140/151 = 0.93 OR: 5.27 (1.48–18.76)[c]	248/299 = 0.83 345/365 = 0.95 OR: 4.07 (1.79–9.27)[c]	1.62 (0.66–4.11)[c] Heterogeneity: $Q = 0.15$, df = 1 (P = 0.30), $I^2 = 0\%$	971 (2 Obs. studies)	Low[b]
	Attendance at 10-week post-op. follow-up visit	75/156 = 0.48 134/151 = 0.89 OR: 8.90 (4.90–16.20)[c]	168/299 = 0.56 294/365 = 0.81 OR: 3.25 (2.30–4.60)[c]	2.74 (1.39–5.57)[c] Heterogeneity: $Q = 0.00$, df = 1 (P = 0.03), $I^2 = 0\%$	971 (2 Obs. studies)	Low[b]
	Attendance at 24-week post-op. follow-up visit	37/100 = 0.37 39/86 = 0.45 OR: 1.41 (0.79–2.54)	74/201 = 0.37 135/248 = 0.54 OR: 2.05 (1.40–3.00)	0.69 (0.34–1.39)	635 (1 Obs. study)	Low[d]

The "Females" column shows a measure of absolute risk of the outcome among females in the comparison and intervention groups and the risk ratio or odds ratio, as indicated, comparing intervention to comparison groups, estimated using Poisson regression for count outcomes and Logistic regression for binary outcomes. The "Males" column shows equivalent estimates for males. The "Ratio Female-to-Male Risk/Odds Ratios" shows the ratio of the risk ratio/odds ratio among females to that among males. This ratio of ratios was estimated using a Poisson or Logistic regression model with an interaction between sex and receipt of the intervention. Except where indicated, a value >1 means the intervention was more beneficial for females than males.

[a]Steps of health care access: 1 – Perception of need and desire for healthcare, 2 – Healthcare seeking, 3 – Healthcare reaching, 4 – Healthcare utilization, 5 – Receiving appropriate care.

[b]Quality of evidence from observational studies upgraded one point for large magnitude of effect and downgraded one point for imprecision of effect estimates.

[c]Relative risks and ratios between female and male relative risks for post-operative follow-up at 2 weeks and 10 weeks were estimated from pooled data from *Kishiki, 2009* and *Rai, 2014* using a generalized linear mixed effects model with a random intercept for study identifier.

[d]Quality of evidence from observational studies assigned a starting grade of "Low" due to serious risk of confounding.

Table 3. Summary of findings for interventions to improve access to care for trachoma.

Intervention (Country) *Steps of health care access targeted*[a]	Outcome	Females: Comparison Intervention Risk/Odds Ratio (95% CI)	Males: Comparison Intervention Risk/Odds Ratio (95% CI)	Ratio Female-to-Male Risk/ Odds Ratios (95% CI)	Number of participants (Studies)	Quality of Evidence (GRADE)
Mousa, 2015 Multicomponent: Trained community volunteers doing outreach education and assisting with accessing existing eye health services; institute surgical booking lists; educate care providers to better serve the needs of the population and train them in modern surgical techniques (Egypt) *Steps: 1,2,3,5*	Trachomatous trichiasis	19/161 = 0.12 8/157 = 0.05 OR: 0.41 (0.17–0.99)[b]	6/106 = 0.06 2/105 = 0.02 OR: 0.63 (0.10–3.92)[b]	0.66 (0.09–5.03)[b,c]	1,043 (1 RCT)	Low[d]
Lynch, 2003 Community volunteers compared to elected members of village governments recruiting households for	Treatment coverage (school-aged children)	677/1498 = 45 486/790 = 62 OR: 1.25 (1.04–1.49)	677/1498 = 0.45 496/939 = 0.53 OR: 1.36 (1.15–1.60)	0.92 (0.72–1.17)	4,491 (1 RCT)	Low[d]
Azithromycin mass treatment (Tanzania) *Steps: 2,3*	Treatment coverage (adults)	1861/3565 = 0.52 1248/2016 = 0.62 OR: 1.49 (1.33–1.66)	1479/4997 = 0.30 996/3298 = 0.30 OR: 1.03 (0.93–1.13)	1.26 (0.93–1.73)	13,876 (1 RCT)	Low[d]
Ngondi, 2009 SAFE strategy for Trachoma control[f] (Ethiopia) *Steps: 3,4*	Trachomatous trichiasis	187/2094 = 0.09 54/1304 = 0.04 OR: 0.44 (0.32–0.60)	58/1825 = 0.03 15/973 = 0.02 OR: 0.48 (0.27–0.85)	0.92 (0.49–1.82)[c]	6,196 (1 Obs. study)	Low[g]

The "Females" column shows a measure of absolute risk of the outcome among females in the comparison and intervention groups and the risk ratio or odds ratio, as indicated, comparing intervention to comparison groups, estimated using Poisson regression for count outcomes and Logistic regression for binary outcomes. The "Males" column shows equivalent estimates for males. The "Ratio Female-to-Male Risk/Odds Ratios" shows the ratio of the risk ratio/odds ratio among females to that among males. This ratio of ratios was estimated using a Poisson or Logistic regression model with an interaction between sex and receipt of the intervention. Except where indicated, a value >1 means the intervention was more beneficial for females than males.

[a]Steps of health care access: 1 – Perception of need and desire for healthcare, 2 – Healthcare seeking, 3 – Healthcare reaching, 4 – Healthcare utilization, 5 – Receiving appropriate care.

[b]Intervention effect estimated from a regression model with terms for time period (pre- and post-intervention), site (intervention and control) and the interaction between time period and site.

[c]For this outcome, a Ratio of Female-to-Male Relative Risks <1 means the intervention was more beneficial for females than males.

[d]Quality of evidence from RCT downgraded one point for high risk of bias due to lack of masking of participants and personnel and incomplete outcome data and one point for imprecision in effect estimates.

[e]Quality of evidence from RCT downgraded one point for high risk of bias due to problems with random sequence generation and confounding and one point for high risk of selective reporting of results.

[f]SAFE – Surgery, Antibiotics, Facial Hygiene, Environmental Improvements.

[g]Quality of evidence from observational studies assigned starting grade of "Low" due to serious risk of confounding.

local volunteers (intervention) versus by elected members of village governments (comparison). Treatment coverage rates in intervention villages were significantly higher for all risk groups except adult males. The intervention effect was not significantly different comparing school-aged girls and boys (ROR = 0.92, 95% CI: 0.72–1.17), but trended towards being greater for adult women compared to men (ROR = 1.26, 95% CI: 0.93–1.73). This evidence was judged to be of low quality because of biased selection of smaller villages into the intervention arm and because outcomes were not reported stratified by sex for pre-school age children, suggestive of selective reporting.

A historically-controlled observational study in Ethiopia provided low quality evidence that the WHO-recommended SAFE strategy (Surgery, Antibiotics, Facial hygiene, Environmental improvements) reduced the odds of trachomatous trichiasis to a similar extent among women and men (ROR = 0.92; 95% CI: 0.49–1.82).[23] An important limitation of this evidence is that the researchers did not account for the effect of either individual- or area-level confounding variables. In addition, health jurisdictions may have differed in their implementation of the SAFE strategy, and the influence of this variation was not examined.

General paediatric eye health

Table 4 summarizes evidence for the gender equity effects of interventions to improve access to care for general paediatric eye health. Two studies, a cluster RCT in Malawi[24] and a prospective cohort study in Bangladesh,[18] evaluated using Key Informants (i.e.: trained volunteers who live or work in the target community) for outreach vision screening and referral of children with visual impairment. The evidence from these studies is limited by potential confounding and because the investigators did not use a “gold standard” against which to calculate the accuracy of the experimental vision screening strategies. The study in Bangladesh provides very low quality evidence that outreach screening by Key Informants resulted in greater numbers of female children with blindness and severe visual impairment being identified and referred to appropriate care compared to recruitment through schools serving blind children (OR = 1.6; 95% CI: 1.3–2.1). The findings from the study in Malawi are not statistically interpretable because of small numbers of children in the comparison group.

A non-randomized controlled study in India compared vision screening performed by children’s own class teachers to the standard practice of using a smaller number of selected teachers to screen all children in the school. The study provides low quality evidence that screening by class teachers significantly increased the likelihood of identifying female children with visual impairment (ROR = 1.90, 95% CI: 1.66–2.17). Screening by class teachers also significantly increased the likelihood, for both girls and boys, of reaching hospital follow-up care within 3 months (ROR = 1.52, 95% CI: 0.61–3.52).

Discussion

We reviewed studies of interventions to improve access to care for common, treatable ophthalmic conditions in low- and middle-income countries, with the aim of identifying evidence-based strategies for reducing gender inequities in access to care. To be included, evaluation studies had to collect and present sufficient information to determine whether the intervention had a differential effect among female and male participants. We identified few relevant studies that presented data in this way. There was a particular paucity of randomized controlled trials, which, when adequately designed and conducted, provide the highest quality evidence for an intervention’s effect. Studies that did meet our inclusion criteria had significant design limitations. These limitations were due, in part, to the technical challenges of evaluating health systems interventions in lower-income settings and of controlling for confounding in studies of behavioural outcomes that are influenced by a complex interplay of societal and economic factors. Despite these limitations, the evidence compiled in this review provides guidance for future research and intervention efforts. It is noteworthy that none of the interventions included in this review were associated with a worsening of gender inequity in eye health outcomes.

To enable translation to future interventions, we organized the evidence according to a model of the process that prospective patients undergo in accessing health care.[11] As a whole, the reviewed interventions covered every step in the model (from perception of need for care to utilizing and receiving appropriate care). Three quarters of the included interventions were designed to address more than one step in the health care access process, making it difficult to draw conclusions about the effect of intervening on each step in isolation. The steps most commonly targeted together were perception of need and desire for healthcare, healthcare seeking and healthcare reaching. Evidence from interventions that targeted a single step in the health care access process was all of very low quality. Whereas rural outreach screening for operable age-related cataract improved gender equity in healthcare reaching, reducing cataract surgical

Table 4. Summary of findings for interventions to improve access to care for general paediatric eye health.

Intervention (Country) *Steps of health care access targeted*[a]	Outcome	Females: Comparison Intervention Risk/Odds Ratio (95% CI)	Males: Comparison Intervention Risk/Odds Ratio (95% CI)	Ratio Female-to-Male Risk/ Odds Ratios (95% CI)	Number of participants (Studies)	Quality of Evidence (GRADE)
Muhit, 2007 Recruitment of blind or visually impaired children by trained volunteer community members compared to through schools providing education to blind children (Bangladesh) *Steps: 2,3*	Blind or severe visual impairment (visual acuity <6/60 in better eye)	Not available	Not available	OR: 1.6 (1.3–2.1)	1639 (1 Obs. study)	Very low[b]
Reddy, 2015 Routine vision screening and referral of school children by their regular class teacher compared to selected teachers (India) *Steps: 2,3*	Visual acuity ≤20/30 in either eye	774/19599 = 0.04 1431/19465 = 0.07 OR: 1.93 (1.76–2.11)	780/20598 = 0.04 800/20801 = 0.04 OR: 1.02 (0.92 −1.12)	1.90 (1.66–2.17)	80,463 (1 Obs. study)	Low[c]
	Reaching hospital follow-up within 3 months	29/171 = 0.17 311/450 = 0.69 OR: 10.96 (7.01–17.12)	9/145 = 0.06 54/167 = 0.32 OR: 7.22 (3.42–15.26)	1.52 (0.61–3.52)	933 (1 Obs. study)	Low[c]
Kalua, 2012 Identification and referral of blind children to existing ophthalmic services by trained volunteer community members compared to primary health care workers (Malawi) *Steps: 2,3*	Reaching referral centre and confirmed visual acuity <3/60 in better seeing eye	0/2 = 0 5/78 = 0.06 *Not calculated*[d]	2/3 = 0.67 15/80 = 0.19 *Not calculated*[d]	*Not calculated*[d]	163 (1 RCT)	Very low[e]

The "Females" column shows a measure of absolute risk of the outcome among females in the comparison and intervention groups and the risk ratio or odds ratio, as indicated, comparing intervention to comparison groups, estimated using Poisson regression for count outcomes and Logistic regression for binary outcomes. The "Males" column shows equivalent estimates for males. The "Ratio Female-to-Male Risk/Odds Ratios" shows the ratio of the risk ratio/odds ratio among females to that among males. This ratio of ratios was estimated using a Poisson or Logistic regression model with an interaction between sex and receipt of the intervention. Except where indicated, a value >1 means the intervention was more beneficial for females than males.

[a]Steps of health care access: 1 – Perception of need and desire for healthcare, 2 – Healthcare seeking, 3 – Healthcare reaching, 4 – Healthcare utilization, 5 – Receiving appropriate care.

[b]Quality of evidence from observational study downgraded one point for serious risk of bias in participant selection.

[c]Quality of evidence from observational studies assigned starting grade of "Low" due to serious risk of confounding.

[d]Statistics not calculated because of small number of observations in primary health care worker arm of the study.

[e]Quality of evidence from RCT downgraded one point for high risk of selective reporting and confounding, one point for inadequate description of random sequence generation, masking of participants and personnel, masking of outcome assessment and completeness of outcome data, and one point for imprecision of effect estimates resulting from the small number of observations in the control arm of the study.

fees did not appear to be sufficient to improve gender equity in healthcare utilization. A limitation of the latter study is that patients in the reduced-surgical fee group still had to pay the equivalent of between 71USD and 129USD for cataract surgery, which may be a significant barrier to access for many. We did not identify any studies examining the effect of completely eliminating cataract surgical fees.

To inform future work, it is also important to examine whether and how an awareness of gender was integrated into the design, implementation and evaluation of the interventions reviewed here. Only two interventions included in our review seemed to have had an explicit gender focus integrated at the design stage[14] [Lewallen, S. *et al*., unpublished data]. We consider the intervention in Lumbini Zone, Nepal, to be predominantly gender accommodating.[14] Recognizing that women are typically disadvantaged in their access to health education and services, intervention designers used female community health volunteers to bring eye care knowledge to women in their communities and assist them in accessing services. Though gender did not seem to be an explicit focus in their design, the interventions that employed door-to-door health education,[22] outreach screening,[16,19] and assistance with transport and accommodation,[20,22] nevertheless did addressed barriers that disproportionately affect women in many low- and middle-income settings, so could also be considered gender accommodating.[13] The intervention in Same District, Tanzania, may be considered an example of a predominantly gender transformative intervention because it was designed with the goal of challenging some of the economic and decision-making dynamics, at household and community levels, which can act to prevent women from accessing health services [Lewallen, S. *et al*., unpublished data].

The evidence accumulated in this review, albeit of low quality, supports the view that both gender accommodating and gender transformative strategies may be used effectively to improve equity in eye health outcomes. This is consistent with the findings of a previously published systematic review of gender-integrated health interventions, which did not include interventions for ophthalmic conditions.[13] Gender transformative interventions may have broader, more enduring health benefits, because they are more likely than gender accommodating interventions to also produce beneficial gender outcomes, like more gender-equitable attitudes and beliefs and greater autonomy for women.[13] However, there is presently limited evidence for how transformative strategies ought best to be "scaled up and sustained".[13]

Limitations of this review are that the protocol was not made publicly available and a single reviewer screened the search results, extracted data and assessed studies for risk of bias. These limitations increase the potential for bias in the results. We identified only a single study from Southeast Asia and none from Latin America, which potentially limits the generalizability of the findings to these regions. Including an unpublished study has the associated limitation that the work has not been subject to peer-review. This is particularly problematic for this review because the unpublished study is the only to have assessed a gender transformative intervention. Finally, labeling interventions that have greater beneficial effects on female than male recipients as those with the potential to reduce gender inequities assumes that females have poorer access to care than males. While this has been shown to be the case for some ophthalmic conditions in some settings, the findings of this review should not uncritically be implemented without first considering the local gender distribution of access to eye care services.

In conclusion, our review provides some evidence for the potential of gender-integrated interventions to reduce inequities in common, treatable causes of visual impairment. However, the evidence is of moderate quality, at best. For both operational and research reasons, it is critical to incorporate adequate planning and funding for methodologically rigorous monitoring and evaluation of future interventions in this area.

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Conflicts of interests

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