

BMJ Open Barriers to uptake of cataract surgery among elderly patients in rural China: a cross-sectional study

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ABSTRACT

Objective To investigate factors that differentiate elderly adults in rural China who accept free vision screening and cataract surgery from those who could benefit from vision care but refuse it when offered.

Design We conducted a population-based, cross-sectional study between October and December 2016. Logistic regression models were used to examine the predictors of accepting free vision screening and cataract surgery.

Setting Rural communities in Handan, China.

Participants Adults aged 50 years or older, with presenting visual acuity $\leq 6/18$ in the better seeing eye, suspected by examining ophthalmologist to be due to cataract.

Results Among 613 persons with cataract identified on a population basis, 596 (97.2%) completed the household survey (mean (SD) age, 71.5 (10.0) years; 79.8% female). A total of 214 persons (35.9%) refused participation, while 382 (64.1%) took part in the vision screening. A total of 193 (50.5%) participants were found eligible for surgery, while 189 (49.5%) were not. Among 99 randomly selected participants who were offered immediate free surgery, surgery was accepted by 77 participants (77.8%) and refused by 22 (22.2%). In the multivariate model, being engaged in income-generating activities ($p < 0.01$), self-reported better physical capacity ($p < 0.001$) and having had a recent physical examination ($p = 0.01$) were significantly associated with acceptance of vision screening. The only variable significantly associated with acceptance of surgery was presenting visual acuity, with better vision inversely associated with acceptance of surgery ($p < 0.05$) models.

Conclusion Our results suggest that refusal of basic eye examinations may be at least as important a determinant of low surgical rates in rural China as lack of acceptance of surgery itself.

INTRODUCTION

Cataract is the world and China's leading cause of blindness.^{1–3} Cataract surgery is the only available treatment and has been rated among the most cost-effective procedures in medicine by WHO.^{4 5} However, cataract surgical coverage rates are low in rural China. A recent multiprovince study found

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study reports a rural population-based cross-sectional sample, with both individual and household-level potential determinants of elderly adults' decisions to accept or refuse free vision screening and cataract surgery.
- ⇒ The study population is highly relevant to the problem of increasing service uptake, and is of recent vintage, reflecting important recent changes in the Chinese healthcare system, such as the wide adoption of the New Cooperative Medical System health insurance system.
- ⇒ The number of persons eligible for cataract surgery was relatively modest, a direct consequence of the population-based design, and half of these were removed from consideration by having been randomised to the control group.

that as few as 43% of rural patients bilaterally blind from cataract had undergone surgery.⁶ Trials have found that the uptake of offered surgery is only 20–30% in rural China, even when patients have significant vision loss and surgery is offered free of cost.^{7 8}

A number of studies including our own⁹ have found various barriers to the uptake of cataract surgery in China: cost, including direct out-of-pocket surgical expense and the cost of transportation and accommodation^{10 11}; lack of knowledge about cataract and surgery¹¹; and concerns about the quality of local surgeons.¹² Prior work in this area has several shortcomings. First, many existing studies^{9 10 12} used data from prior to 2009, the year China announced systematic health reforms.^{13 14} Access to cataract surgery in rural areas has since improved substantially due to the universal coverage under the New Cooperative Medical System (NCMS).¹⁵ Second, while studies from lower and middle-income countries show that health decisions are usually made at the household level,¹⁶ most existing studies in China have been limited to

considering patient-level data, mostly concerning clinical rather than socioeconomic variables.

To address these limitations, in the present study we carried out a population-based household survey to understand factors that differentiate elderly adults in rural China who accept free vision screening and cataract surgery from those who could benefit from vision care but refuse it when offered. We report in the current manuscript on:

- ▶ Determinants of acceptance of free vision screening among elderly rural dwellers.
- ▶ Determinants of acceptance of free surgery among elderly patients with visually significant cataract.

METHODS

Setting

Our study cohort was drawn from an ongoing population-based study, the Handan Eye Study (HES), which was designed to determine the prevalence and impact of visual impairment and major eye disorders in rural adult Chinese people.¹⁷ It was conducted in Yongnian County, Handan Prefecture, located in southern Hebei province, about 500 km south of Beijing. Yongnian has demographic characteristics similar to other rural Chinese locations according to the National Census,¹⁸ and the cataract surgical rate in the region is similar to other parts of rural China.⁴ Thus, our sampling region is demographically and epidemiologically representative of rural China.

Sampling and eligibility criteria

The original HES sample consisted of 6830 participants of Han ethnicity aged 30 years and older from 13 villages who

underwent visual acuity screening in 2012.¹⁹ In October 2016, a list was compiled of 784 participants from all 13 villages in the original HES study who met the following criteria: aged 50 years or older in 2016; presenting visual acuity (PVA) in 2012 $\leq 6/18$ (logarithm of the minimum angle of resolution (LogMAR) 0.5) in the better seeing eye, suspected by the examining ophthalmologist in 2012 to be due to cataract. With the help of local health workers, our study personnel identified potential participants who had died or moved out of the area, leaving a cohort of 613 persons on whom analyses in the current study are based (figure 1).

Questionnaire

During October and December 2016, all participants were administered a home visit survey, requiring approximately 30–45 min per household. This questionnaire consisted of the following seven sections (see details of the questionnaire in online supplemental material):

1. Basic household demographic characteristics: gender, age, educational level and number of household members.
2. Household wealth, measured by ownership of a list of 13 items (TV, washing machine, refrigerator, internet access, automobile, etc).
3. Being engaged in income-generating activities²⁰ (none, farming only, off-farm only, both).
4. Awareness, knowledge and attitudes about cataract and cataract surgery: whether the participant believed he/she had cataract, whether cataract could be treat-

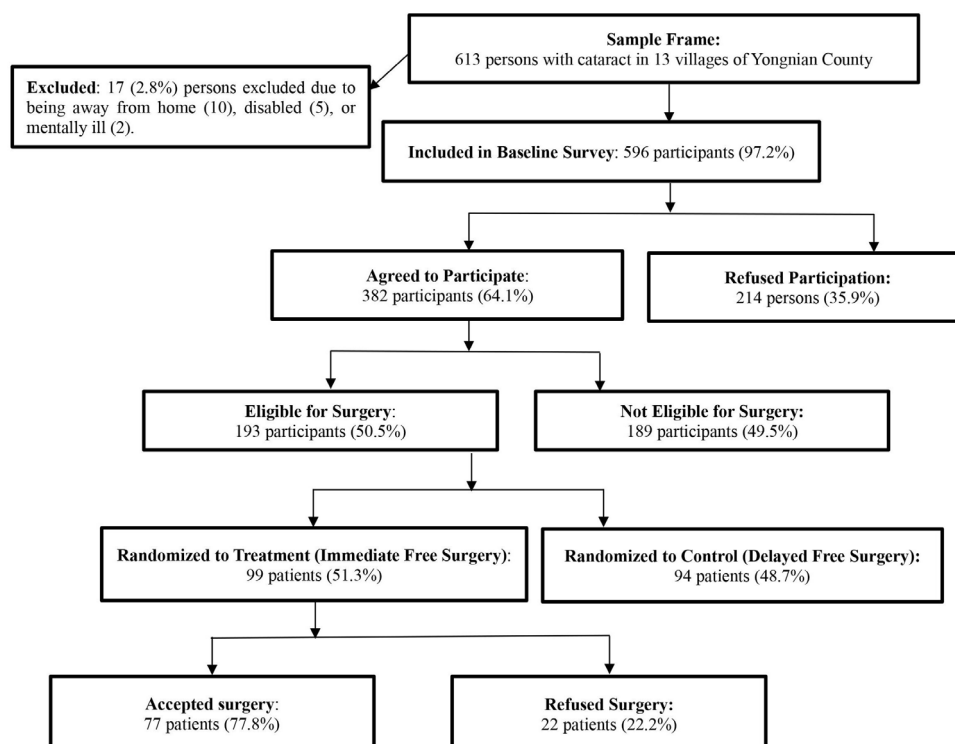


Figure 1 Study flow chart.

ed surgically and perception of the quality of local surgeons.

5. Self-reported physical capacity: a list of nine questions from Nagi's upper and lower extremity assessment²¹ was used to assess physical activities, including bending down/kneeling/squatting, climbing 10 steps, walking different distances (100/500/1000 m), holding things with the fingers, holding 5 kg with one hand, etc.
6. Self-reported mental health: the 10-question version of the Center for Epidemiological Studies-Depression Scale was used to assess the depressive symptoms including 10 items about feelings and behaviour during the last week, including bother, attention, depression, difficulty, future, fear, sleep, happiness, loneliness and life.²²
7. Utilisation of healthcare: whether a general physical examination or inpatient services had been received in the last 12 months.

Ophthalmic screening

In late December 2016, participants who had completed the household survey were referred to the Yongnian County Hospital for a free vision screening to test to determine eligibility for surgery as defined below. The protocol for the screening examination was the same as had been used for the original sample in 2012. The screening examination was announced door to door prior to the day of screening by local health workers. On the day of screening, participants from each village were brought together to the county hospital, in vans arranged by study personnel and local health workers. At the hospital, all participants were registered using a standardised case report form. Two ophthalmic nurses measured the PVA of each person separately in each eye using a Snellen chart at a distance of 5 m. An ophthalmologist then carried out a full ocular examination with dilation of the pupil to determine eligibility for cataract surgery, which required PVA $\leq 6/18$ in the better seeing eye, thought by the examiner to be due to cataract.

Persons who were unwilling to participate in the vision screening, and those who were eligible for surgery but not willing to accept it, were asked about their reasons for refusal using a short questionnaire. Based on previous studies on barriers to the uptake of cataract surgery,⁷⁻¹¹ the questionnaire included the following seven reasons: (1) sick or disabled; (2) outmigrated for work; (3) too old to leave home; (4) dead; (5) feel current vision adequate; (6) already did screening and/or surgery; (7) others, please specify.

Statistical methods

Descriptive analysis and logistic regression models were used to investigate the determinants of the two outcome variables: acceptance of free vision screening among selected rural dwellers and acceptance of free surgery among eligible patients with cataract. Visual acuity values are presented as Snellen fractions but were converted to LogMAR values for analysis. Visual acuity data collected in

2012 were used in the analysis of determinants of acceptance of free vision screening, as these were available for all potential participants, irrespective of acceptance or refusal of screening in 2016. Visual acuity data from 2016 were used in analysis on acceptance of free surgery. Household wealth was calculated by summing the values, as reported in the China Rural Household Survey Yearbook (Department of Rural Surveys, National Bureau of Statistics of China, 2016), of items on a list of 13 reported as being owned by the household.

Differences in baseline household demographic characteristics, wealth, productive activities, participants' awareness, knowledge and perception about cataract and cataract surgery, self-reported physical and mental health and healthcare utilisation were compared between groups accepting and refusing vision screening and surgery using the t-test. Multivariate logistic regression models were used to examine the potential predictors of the two main study outcomes: acceptance of vision screening and cataract surgery. All statistical analyses were performed using STATA V.15.1 (StataCorp, College Station, Texas).

Patient and public involvement

No patient was involved in the protocol's development. Written informed consent was obtained from all participants.

RESULTS

Among 613 persons with cataract identified on a population basis in Yongnian County, 596 (97.2%) took part in the baseline household survey, while 17 (2.8%) were excluded due to being away from home, disabled or mentally ill (figure 1). Among these, 214 persons (35.9%) refused participation, while 382 (64.1%) took part. A total of 193 participants (50.5%) were found eligible for surgery, while 189 (49.5%) were not. Eligible participants were randomised to treatment (immediate free surgery, n=99, 51.3%) or control (delayed surgery, n=94, 48.7%). Within the treatment group, surgery was accepted by 77 participants (77.8%) and refused by 22 participants (22.2%) (figure 1).

Compared with eligible persons accepting the screening eye examination, those refusing it were significantly older ($p<0.001$), more likely to be illiterate ($p<0.01$), have no current income-generating work ($p<0.001$), self-reported lower physical capacity ($p<0.001$) and no physical examination over the last 12 months ($p<0.01$). Other characteristics did not differ significantly (table 1). Participants who refused surgery had significantly worse PVA in the better seeing eye than those accepting surgery ($p<0.05$, table 1).

The leading cause for refusing screening, reported by over half of potential participants (115/214=54%), was poor health (table 2). Regarding refusal of surgery, the two leading causes were satisfaction with current vision (7/22=32%) and lack of an accompanying family

Table 1 Baseline characteristics of participants

Characteristics	Accepted screening	Refused screening	P value	Accepted surgery	Refused surgery	P value
	n=382	n=214		n=77	n=22	
Patient characteristics						
Age (years) mean (SD)	70.0 (9.0)	74.1 (11.0)	<0.001	70.9 (8.8)	75.1 (10.2)	0.060
Male sex, n (%)	124 (32.6)	56 (26.1)	0.109	28 (36.4)	9 (40.9)	0.701
Illiterate, n (%)	210 (55.1)	145 (67.3)	0.004	44 (57.1)	9 (40.9)	0.181
Presenting visual acuity in better eye, LogMAR (Snellen equivalent)	0.6 (6/24)	0.6 (6/24)	0.505	0.7 (6/30)	0.8 (6/38)	0.026
Underwent surgery prior to the project, n (%)	56 (14.7)	41 (19.2)	0.154	9 (11.7)	2 (9.1)	0.736
Aware of cataract, n (%)	341 (90.0)	174 (85.7)	0.166	70 (90.9)	19 (86.4)	0.537
Believes cataract can be treated surgically, n (%)	207 (54.6)	103 (50.7)	0.405	35 (45.5)	8 (36.4)	0.453
Perceives surgeon to be of high or very high quality, n (%)	158 (41.7)	89 (43.8)	0.664	27 (35.1)	10 (45.5)	0.380
Being engaged in income-generating activities, n (%)						
None	179 (46.9)	149 (69.3)	<0.001	41 (53.2)	16 (72.7)	0.356
Farming only	141 (36.9)	36 (16.4)		22 (28.6)	4 (18.2)	
Off-farm employment only	27 (7.1)	6 (2.8)		6 (7.8)	1 (4.6)	
Both	32 (8.4)	12 (5.6)		8 (10.4)	1 (4.6)	
Self-reported physical capacity*, n (%)						
Bottom tercile	99 (26.1)	112 (55.5)	<0.001	23 (30.0)	6 (27.3)	0.602
Middle tercile	168 (44.3)	50 (24.6)		32 (41.6)	11 (50.0)	
Top tercile	112 (29.6)	41 (20.3)		22 (28.6)	5 (22.7)	
Self-reported mental health†, n (%)						
Bottom tercile	140 (36.9)	74 (36.5)	0.707	32 (41.6)	7 (31.8)	0.375
Middle tercile	124 (32.7)	63 (31.0)		20 (26.0)	10 (45.5)	
Top tercile	115 (30.3)	66 (32.5)		25 (32.5)	5 (22.7)	
Underwent physical examination over the past 12 months, n (%)	153 (40.1)	62 (29.0)	0.007	23 (29.9)	9 (40.9)	0.339
Received inpatient service over the past 12 months, n (%)	56 (14.7)	37 (17.8)	0.326	5 (6.5)	3 (13.6)	0.252
Household characteristics						
Number of family members living together, mean (SD)	3.3 (2.2)	3.2 (2.1)	0.656	3.4 (2.4)	3.6 (2.7)	0.690
Household wealth‡, n (%)						
Bottom tercile	125 (32.7)	72 (33.5)	0.533	24 (31.2)	10 (45.5)	
Middle tercile	126 (33.0)	75 (34.9)		27 (35.1)	6 (27.3)	0.429
Top tercile	131 (34.3)	68 (31.6)		26 (33.8)	6 (27.3)	

*Questionnaire asked respondents to rate their ability to perform 9 selected physical tasks. Each task had four values: 1=I don't have any difficulty; 2=I have difficulty but can still do it independently; 3=I have difficulty and need help; 4=I cannot do it. A total value was summed and categorised into three terciles.

†Questionnaire asked about presence or absence of 10 selected mental conditions over the last week. Each condition had four values: 1=rarely or none of the time (<1 day); 2=some or a little of the time (1–2 days); 3=occasionally or a moderate amount of the time (3–4 days); 4=most of the time (5–7 days). A total value was summed and categorised into three terciles.

‡Questionnaire asked about ownership of 13 selected items as an index of household wealth.

LogMAR, logarithm of the minimum angle of resolution (0.1 change in LogMAR indicates one line change on the vision chart).

member (5/22=23%), which together accounted for over half of refusals.

In the multivariate model for determinants of accepting visual screening (table 3), being engaged in income-generating activities ($p<0.001$), better self-reported physical capacity ($p<0.001$) and having had a recent physical examination ($p=0.01$) remained significantly associated with acceptance of vision screening.

In model of potential determinants of accepting surgery (table 4), better vision was inversely associated

with acceptance of surgery in the multivariate ($p=0.05$) models. Other variables were not significantly associated with this outcome.

We also conducted sensitivity analysis using a variety of different vision variables, including (a) change in PVA (LogMAR) in better seeing eye between 2012 and 2016; (b) type of cataract (Lens Opacity Classification System (LOCS I), LOCS II and LOCS III); and (c) difference between the PVA (LogMAR) in the two eyes. Similar results were found in the multivariate logistic regression

Table 2 Reasons for not participating in vision screening and refusing surgery

Reasons for not participating in screening	n	%
Sick or disabled	115	53.7
Outmigrated for work	35	16.4
Too old to leave home	20	9.4
Already did screening	6	2.8
Dead	1	0.5
Other	37	17.3
Total	214	100.0
Reasons for refusing surgery		
Felt current vision adequate	7	31.8
No one to accompany during surgery	5	22.7
Worried about outcome of surgery	4	18.2
Sick or disabled	3	13.6
Other	3	13.6
Total	22	100.0

model of acceptance of free vision screening (online supplemental appendix table 1) and the multivariate logistic regression model on the determinants of acceptance of free surgery (online supplemental appendix tables 2 and 3).

DISCUSSION

China's cataract surgical rate remains lower than neighbouring countries such as India and Vietnam with lower per capita gross domestic product.^{15 23} Results of the current study suggest that refusal of basic eye examinations may be at least as important a determinant of this low surgical rate as lack of acceptance of surgery itself. Nearly 40% of this population-based sample of rural dwellers, all of whom who had participated in an ophthalmic study 5 years previously, refused an eye examination that could potentially have led to free cataract surgery. This rate of refusal was nearly twice as high as the proportion refusing surgery itself (22.2%). Perhaps more important from the standpoint of devising interventions to improve uptake, those refusing eye examinations differed in a number of potentially important ways from those accepting them, whereas only PVA differentiated those accepting and refusing cataract surgery. This latter difference does not suggest obvious strategies to increase acceptance of surgery. Given the high proportion of persons refusing vision examinations due to self-perceived poor health, additional support for such persons (wheelchairs, accessible vans, etc) may be an effective way to increase uptake of initial examinations.

The relatively high rate of acceptance of surgery in the current study (78%) stands in distinction to two relatively recent trials which reported only 20–30% of rural Chinese patients accepting cataract surgery, even when surgery was offered free or educational interventions were used to

Table 3 Multivariate logistic regression model of acceptance of free vision screening among elderly rural dwellers (n=596)

Variables	OR	(95% CI)
Patient characteristics		
Age (years)	0.992	(0.966, 1.018)
Male sex (%)	1.340	(0.846, 2.123)
Illiterate (%)	0.969	(0.629, 1.494)
Presenting VA (LogMAR) in better eye	1.028	(0.374, 2.823)
Conducted surgery prior to the project (%)	0.993	(0.710, 1.390)
Aware of cataract (%)	0.987	(0.568, 1.714)
Believe cataract can be treated surgically (%)	1.481	(0.826, 2.658)
Perceived local surgeon to be of high or very high quality (%)	1.014	(0.672, 1.531)
Being engaged in income-generating activities*	2.127**	(1.282, 3.529)
Self-reported better physical capacity†	2.644***	(1.743, 4.012)
Self-reported better mental health‡	0.812	(0.549, 1.200)
Had physical examination over the past 12 months	1.672**	(1.114, 2.511)
Received inpatient service over the past 12 months	0.746	(0.498, 1.116)
Household characteristics		
Number of family members living together	1.014	(0.924, 1.113)
Higher household wealth§	0.802	(0.515, 1.250)

*Significant at 0.05. **Significant at 0.01. ***Significant at <0.001.

*Recoded as a binary variable. 0=none, 1=engaged in any of the income-generating activities (farming, off-farm employment, both).

†Recoded as a binary variable. 0=lower than average self-reported physical capacity, 1=higher than average self-reported physical capacity. Questionnaire asked respondents to rate their ability to perform 9 selected physical tasks. Each task had four values: 1=I don't have any difficulty; 2=I have difficulty but can still do it independently; 3=I have difficulty and need help; 4=I cannot do it. A total value was summed as physical capacity scores.

‡Recoded as a binary variable. 0=lower than average self-reported mental health, 1=higher than average self-reported mental health. Questionnaire asked about presence or absence of 10 selected mental conditions over the last week. Each condition had four values: 1=rarely or none of the time (<1 day); 2=some or a little of the time (1–2 days); 3=occasionally or a moderate amount of the time (3–4 days); 4=most of the time (5–7 days). A total value was summed as mental health scores.

§Recoded as a binary variable. 0=lower than average household wealth, 1=higher than average household wealth. Questionnaire asked about ownership of 13 selected items as an index of household wealth.

LogMAR, logarithm of the minimum angle of resolution (0.1 change in LogMAR indicates one line change on the vision chart); VA, visual acuity.

Table 4 Multivariate logistic regression model on the determinants of acceptance of free surgery among elderly patients with cataract (n=99)

Variables	OR	(95% CI)
Patient characteristics		
Age (years)	0.919	(0.823, 1.025)
Male sex (%)	1.729	(0.372, 8.026)
Illiterate (%)	3.225	(0.728, 14.288)
Presenting VA (LogMAR) in better eye	0.029*	(0.001, 0.975)
Conducted surgery prior to the project (%)	2.992	(0.508, 17.634)
Aware of cataract (%)	3.553	(0.363, 34.749)
Believe cataract can be treated surgically (%)	1.634	(0.245, 10.893)
Perceived local surgeon to be of high or very high quality (%)	0.668	(0.158, 2.823)
Being engaged in income-generating activities*	0.609	(0.172, 2.155)
Self-reported better physical capacity†	1.372	(0.265, 7.098)
Self-reported better mental health‡	0.756	(0.177, 3.224)
Had physical examination over the past 12 months	0.382	(0.094, 1.548)
Received inpatient service over the past 12 months	0.374	(0.099, 1.408)
Household characteristics	0.557	(0.085, 3.638)
Number of family members living together	0.980	(0.755, 1.272)
Higher household wealth§	1.748	(0.428, 7.137)

*Significant at 0.05. **Significant at 0.01. ***Significant at <0.001.

*Recoded as a binary variable. 0=none, 1=engaged in any of the income-generating activities (farming, off-farm employment, both).

†Recoded as a binary variable. 0=lower than average self-reported physical capacity, 1=higher than average self-reported physical capacity. Questionnaire asked respondents to rate their ability to perform 9 selected physical tasks. Each task had four values: 1=I don't have any difficulty; 2=I have difficulty but can still do it independently; 3=I have difficulty and need help; 4=I cannot do it. A total value was summed as physical capacity scores.

‡Recoded as a binary variable. 0=lower than average self-reported mental health, 1=higher than average self-reported mental health. Questionnaire asked about presence or absence of 10 selected mental conditions over the last week. Each condition had four values: 1=rarely or none of the time (<1 day); 2=some or a little of the time (1–2 days); 3=occasionally or a moderate amount of the time (3–4 days); 4=most of the time (5–7 days). A total value was summed as mental health scores.

§Recoded as a binary variable. 0=lower than average household wealth, 1=higher than average household wealth. Questionnaire asked about ownership of 13 selected items as an index of household wealth.

LogMAR, logarithm of the minimum angle of resolution (0.1 change in LogMAR indicates one line change on the vision chart); VA, visual acuity.

promote uptake.^{7 8} This may reflect the fact that we decomposed acceptance of surgery into two steps: acceptance of the initial examination and then of surgery itself. Our overall rate of acceptance (49%), multiplying the observed rates for the two steps (64%*78%), was more similar to previous reports, though still higher. Previous population studies in rural China have identified lack of confidence in local surgeons as an important barrier to acceptance of surgery,²⁴ and it is possible that ours having offered surgery by experts from one of China's most famous and respected eye hospitals (Beijing Tongren Hospital) might explain the higher rates of acceptance which we observed.

Our results suggest that promotion of the vision screening which can lead to cataract surgery could be an important strategy to increase cataract surgical coverage in rural Chinese settings. This is consistent with a study covering several dozen rural, county-level Chinese hospitals which identified participation in high-volume outreach screening activities as the single most significant predictor of a facility's 3-year increase in cataract surgical volume.²⁵ Active

outreach strategies have also been identified as a means to increase equity of surgical access, leading to higher levels of participation among women, the elderly and those with lower levels of education.¹² To successfully increase uptake of eye examinations, strategies would need to target those persons at the greatest risk of refusal, which in the case of the current study included the elderly, illiterate, and those with poor self-rated health, no productive work and having little contact with the healthcare system. The fact that these disadvantaged groups refused participation even when free eye examinations were offered on an outreach basis underscores the difficulty of eliciting their involvement in even the most basic of healthcare activities. Additionally, universal health coverage (UHC) is not universal without affordable, high-quality, equitable eye care such as cataract service.⁵ As China advances its UHC in the Healthy China 2030 policy,²⁶ integrating eye health services with the multiple relevant components of health service delivery is crucial for improving the access to essential eye care services, particularly at the level of primary healthcare for those who are less likely to participate

in regular outreach eye examinations. Visual acuity testing or visual function questionnaires are practical ways to screen persons in residential facilities for the elderly. Where educational interventions and offers of free cataract surgery⁸ have not been successful in motivating uptake of eye care services, there is the need for studies of other types of interventions, such as conditional cash transfers, which have been successful in motivating greater participation in healthcare services, for example, in-hospital delivery among women in India,²⁷ and which might be cost-effective, given evidence that cataract surgery can increase the economic productivity of patients and the families who care for them.^{20 28 29}

Strengths of the current study include its population-based nature, which allowed us to study uptake of offered eye care services among persons who would be unlikely to seek out care spontaneously. Additionally, the study involved a rural Chinese population, highly relevant for the problem of increasing service uptake, and is of recent vintage, thus taking into account important recent changes in the Chinese healthcare system, such as the wide adoption of the NCMS health insurance system.

However, findings and implications of the present study need to be interpreted with caution in light of some limitations: First, the number of persons actually eligible for cataract surgery was relatively modest, a direct consequence of the population-based design, and half of these were removed from consideration by having been randomised to the control group in the parent trial. It is possible that more significant determinants of surgical uptake would have been elucidated with a larger sample size. Second, all participants in our study were drawn from a single rural county in Hebei province; this inevitably limits to some extent our ability to apply our results to other parts of rural China. Despite these limitations, the current report does offer useful insights into determinants of acceptance of basic eye examinations, which other research has suggested are a crucial gateway to sight-restoring cataract surgery.¹²

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Contributors Concept and design: XM, CJ, NC, SR, NW. Data collection: XM, JH, CJ, YW, YX, CL, YS, ZD. Data analysis: XM, KC. Interpretation of data: XM, JH, CJ, NC. Drafting of the manuscript: XM, JH, CJ, NC. Critical revision of the manuscript for important intellectual content: XM, CL, AH, SR, NC. Supervision: NC, SR, NW. NW is the guarantor of the study. All authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Obtained.

Ethics approval The protocol of the current project was approved by the ethics committees at Stanford University (SU; FWA00000935), Beijing Tongren Hospital (TREC2006-22) and Peking University (IRB00001052-19017). All study personnel obtained written informed consent from all participants.

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