Incidence, causes and risk factors of vision loss in rural Southern China: 6-year follow-up of the Yangxi Eye Study

Xinyu Zhao ,[1,2] Jianqiang Lin,[1,2] Shanshan Yu,[1,2] Liqiong Xie,[1,2] Ling Jin,[1,2] Kun Xiong ,[1,2] Ching-Kit Tsui,[1,2] Yue Xu,[1,2] Benjuan Wu,[1,2] Bin Liu,[1,2] Wei Wang,[1,2] Nathan Congdon ,[1,3,4] Wenyong Huang,[1,2] Mingguang He ,[1,2] Xiaoling Liang[1,2]

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[1]State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-Sen University, Guangzhou, China
[2]Ophthalmology, Guangdong Provincial Key Laboratory of Ophthalmology and Visual Science, Guangzhou, China
[3]Centre for Public Health, School of Medicine, Dentistry and Biomedical Sciences,Queen's University, Belfast, UK
[4]Orbis International, New York, New York, USA

Correspondence to
Dr Xiaoling Liang, Ophthalmolgy, State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou, 510060, China; liangxlsums@qq.com

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ABSTRACT

Purpose To report the 6-year incidence, causes and risk factors for vision loss (visual impairment (VI) and blindness), among elderly adults in rural southern China.
Methods Population-based, cohort study. Initiated in 2014, the study recruited participants aged 50 and older using random cluster sampling from Yangxi County. All eligible participants were invited to attend interviews and comprehensive eye examinations at the 6-year follow-up between November 2020 and March 2021. The WHO categories of vision loss were used to define incident cases of VI (3/60≤VA <6/12), moderate-to-severe VI (MSVI) (3/60≤VA<6/18) and blindness (VA <3/60) in the better-seeing eye.
Results Among the 5825 baseline participants, 3187 (64.4%) of 4946 surviving subjects participated in the 6-year follow-up. Based on presenting and best-corrected VA, respectively, the crude incidence rate of blindness was 0.8% (95% CI 0.5% to 1.1%) vs 0.3% (95% CI 0.1% to 0.5%), for MSVI 6.7% (95% CI 5.7% to 7.6%) vs 4.6% (95% CI 3.8% to 5.4%) and for any VI 16.1% (95% CI 14.5% to 17.6%) vs 12.9% (95% CI 11.6% to 14.1%). Cataract (48.3%) and refractive errors (44.4%) were the most common causes of vision loss. Factors significantly associated with greater incident vision loss were older age, female sex, less education, living alone and longer axial length (all p<0.05).
Conclusions Substantial work is still required to reduce avoidable vision loss in rural China. Screening outreach and efforts to improve awareness which target the poorer and less educated are urgently needed to reduce the growing unmet need for eye care due to ageing.

Key messages

What is already known on this topic
⇒ Incidence of vision loss in urban southern China has been investigated, but in rural areas is lacking. The effectiveness of eye care services needs to be demonstrated by the latest incidence of vision loss.

What this study adds
⇒ The incidence of vision loss in rural southern China is lower than that of urban areas, reflecting effectiveness of eye care services. However, it is still higher than northern China and other countries, suggesting that substantial work to reduce avoidable vision loss is still required.

How this study might affect research, practice or policy
⇒ Cataracts and uncorrected refractive errors remain a priority in reducing incident vision loss in rural China. And efforts to reduce vision loss not only require increased eye care services, but also improved public health education, with more focus on poorer and less-educated groups.

INTRODUCTION

Vision loss (visual impairment (VI) and blindness), currently ranked sixth in the global burden of disease,[1 2] continues to be a major public health problem. The global initiative 'VISION 2020: Right to Sight' has coordinated efforts for the elimination of avoidable vision loss,[3 4] and yet the global burden is set to reach historic levels in the coming years despite reductions in age-adjusted vision loss.[5] Due to an ageing global population, a growing number of people globally suffer the consequences of poor access to high-quality and affordable eye services.[6]

Worldwide, nearly 2.2 billion people experience vision loss, half with conditions that could have been prevented or treated.[5 7] Although initiatives such as VISION 2020 have reduced age-specific rates of avoidable vision loss, the overall magnitude of the burden has increased, due to the ageing global population.[8] People with impaired vision usually have decreased productivity and higher rates of anxiety or depression,[9] reducing their quality of life, imposing significant personal and national burdens, and even increasing the risk of death.[3 10 11] The loss of global productivity caused by uncorrected refractive error alone is estimated to be US$270 billion each year.[7]

The seventh census of China in 2020 showed a current population of 1.4 billion, with rural residents accounting for 36.1% (510 million) and nearly 20% (260 million) of the population aged 60 years or older. Guangdong Province has the largest share of this population at 126 million persons in 2020. As the world's most populous country, China bears a significant burden of moderate-to-severe VI (MSVI) and blindness.[1] Improving public awareness

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of eye health and reducing the prevalence of MSVI is thus a high priority.[1]

Incidence from a population-based study reflects the impact of existing strategies for prevention, detection and treatment of vision loss within a region. Previous studies have reported various figures for the prevalence of vision loss in Chinese cohorts.[8 12–14] However, incidence of vision loss, particularly in rural areas, is not well investigated.[14 15] In China, public health policies to expand the availability of eye services have been executed over the past 10 years, leading to a meaningful increase in cataract surgical coverage (62.7%).[16] These successful policies promoting eye health are likely to be reflected in incidence for vision loss.

This population-based study is designed to assess the 6-year incidence, causes and associated risk factors for vision loss among elderly adults in Yangxi county, a rural area of Guangdong Province, southern China.

METHODS

Study population

Yangxi county, located at the southwest of Guangdong Province in southern China, had a resident population of 434 thousand in 2020. The per capita gross domestic product in 2019, prior to the COVID-19 pandemic, was US$6.7 thousand, compared with US$13.6 thousand for Guangdong province and US$11.0 thousand for China as a whole. This study might roughly reflect the eye health of people in low-income rural areas in China.

The Yangxi Eye Study (YES) was initiated as part of the China Nine-Province Survey in 2014.[13] The details of the methodology have been described previously.[17–19] Briefly, at baseline in 2014, 5825 (90.7%) out of 6425 eligible participants were enrolled in the study.[18] These persons were aged 50 years or older and had lived in the catchment area for at least 6 months, and were selected by random cluster sampling from 268 geographically defined sampling units in Yangxi County.[17 19] The 6-year follow-up was carried out between November 2020 and March 2021 (figure 1). At follow-up, all participants listed in the village registers and enumerated through door-to-door visits at baseline were invited to complete a comprehensive eye examination at local community facilities.

Ocular examination

The basic ocular examinations at follow-up were performed according to the same protocol and using the identical equipment as at baseline. Visual acuity (VA) was assessed using an Early Treatment Diabetic Retinopathy Study chart.[20] Presenting VA (PVA) was recorded, and when PVA was <6/12 in either eye, noncycloplegic automated refraction (KR-800; Topcon, Japan) and best-corrected VA (BCVA) were measured by an experienced optometrist. When participants failed to read the top line at 4 m, they were asked to move to 3, 2 and 1 m, successively as needed. When no optotypes could be read at 1 m, VA was then assessed as counting fingers, hand movements, perception of light (LP), or no LP.

Slit-lamp biomicroscopy (BQ-900, Haag-Streit, Switzerland) was performed by an experienced ophthalmologist to examine the anterior and posterior segments and to record any findings. Biological parameters of the anterior segment were measured using an optical biometer (Lenstar LS 900, Haag-Streit AG, Koeniz, Switzerland). Ultra-widefield (UWF) non-mydriatic images were taken using an Optos camera (Daytona (P200T), Optos, Dunfermline, Scotland), with which UWF images centred on the macula were captured. Optical coherence tomography (OCT) images of the macular and peripapillary regions and retinal nerve fibre layer were acquired using a Heidelberg Retina Angiograph II (HRA II; Heidelberg Engineering, Heidelberg, Germany).

Questionnaire and systemic measurement

A standardised questionnaire was administered by a trained nurse to collect information on past history of ocular diseases, systemic diseases, socioeconomic background (eg, income,

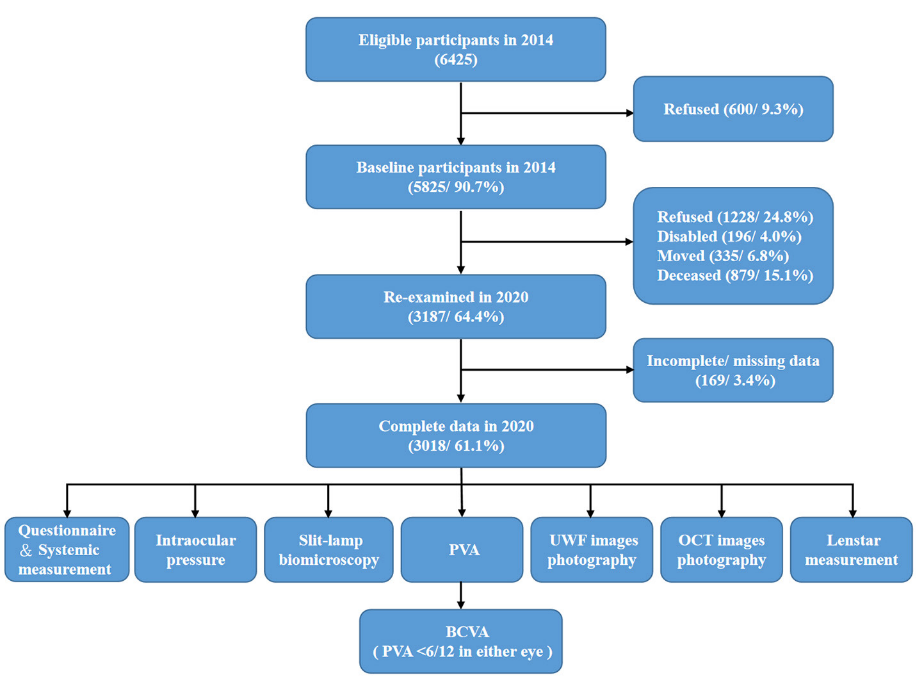

Figure 1 Flow chart of participants and examinations in the Yangxi Eye Study. BCVA, best-corrected visual acuity; OCT, optical coherence tomography; PVA, presenting visual acuity; UWF, ultra-widefield.

education, medical insurance) and lifestyle-related information (eg, alcohol and cigarette consumption).[21] Systemic examinations were performed by a trained nurse, including the measurement of blood pressure (BP), waist and hip circumference, as well as measurement of the height and weight for the computation of body mass index (BMI). Systolic and diastolic BP were measured using an automated sphygmomanometer (Hem-907, Omron, Kyoto, Japan).

Definition of VI and blindness

Vision loss is defined by VA in the better-seeing eye according to the criteria of the International Classification of Diseases (11th edition, 2018): mild (6/18≤VA< 6/12), moderate (6/60≤VA < 6/18), severe VI (3/60≤VA< 6/60) (hence moderate-severe VI (MSVI) is 3/60≤VA< 6/18) and blindness (<3/60).[3] The current report used the same WHO criteria for vision loss as described above. Incident vision loss with different severities is defined as follows: (1) Incident mild VI: newly developed mild VI during the 2014–2020 interval in participants not visually impaired at baseline; (2) Incident MSVI: newly developed MSVI during the 2014–2020 interval in participants not visually impaired or with mild VI at baseline; (3) Incident blindness: newly developed blindness in participants not blind at baseline; (4) Incident any VI: VA at baseline was 6/12 or better, but worse than 6/12 at follow-up.[14 22 23] The crude incidence was converted into annual incidence for comparison with other published population-based studies.[24]

Determination of the causes of VI and blindness

One examining ophthalmologist and two experienced ophthalmologists reviewed all examination results, including the PVA, BCVA, description of corneal clarity and lens grades during slitlamp examination, intraocular pressure and results of UWF and OCT images to make a final diagnosis for each eye using standard clinical criteria. In case of any divergence among ophthalmologists, adjudication was performed by a retinal expert with over 20 years of experience (XL). If multiple diseases were present, the primary cause was assigned as the condition most affecting the vision, and which was most likely to be avoidable or treatable.[15 21] For instance, the moderate cataract and mild DR were both present in the same eye, cataract would be judged as the primary cause of vision loss. Refractive error was defined as present when BCVA was at least two lines better than PVA (VA in this study was converted to a logarithm with a minimum angle of resolution).[21]

Statistical analysis

Statistical analyses were performed using SPSS software V.26.0 (IBM). Student's t-test was used for comparison of continuous variables, while the Pearson χ^2 test was used for comparison of categorical data. Age-sspefic and sex-specific incidence in decade intervals from 50 to 80+ years with 95% CIs were calculated. The age-standardised and sex-standardised incidence was calculated using direct standardisation of the study population to the population in the 2010 census (http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm). Univariate and multiple logistic regression models were used to investigate the associations between incident vision loss and risk factors including age, sex, education, income, hypertension, diabetes, smoking, alcohol consumption, axial length and living alone. Statistical significance was set at p<0.05.

RESULTS

Of the 5825 participants at baseline in 2014, 3187 (64.4%) of 4946 survivors (84.9%) returned for follow-up examination in 2020, while 879 (15.1%) were deceased and 1759 (30.2%) were alive but did not return for follow-up, including 196 (4.0%) disabled, 1228 (25.0%) refused to participate, and 335 (6.8%) had relocated elsewhere (figure 1). Among the 3187 participants, 169 without data on PVA and/or BCVA were excluded. Ultimately, 3018 (61.1%) participants were included in below analyses. Compared with nonparticipants, participants were younger, more likely to be female and had better VA and education, higher BMI and lower rate of hypertension. Diabetes status did not vary significantly between the two groups (table 1).

The incidence of presenting and best-corrected MSVI increased with older age. Based on the presenting VI (PVI), the incidence of mild VI was the highest in the 50–59 and 60–69 age groups, while in the 70–79 and 80+ age groups, the incidence of MSVI was highest (table 2). Based on the best-corrected VI (BCVI), the incidence of mild VI was the highest, followed by MSVI, and blindness was the lowest in all age groups (table 3). The incidence of presenting and best-corrected vision loss was higher in women than in men (p<0.05, tables 2 and 3) (online supplemental figure s1).

The leading causes of incident PVI were cataract (164 participants, 48.3%), refractive error (151 participants, 44.4%) and retinopathies (7 participants, 2.1%). The leading causes of incident BCVI were cataract (312 participants, 90.9%), posterior capsular opacification (13 participants, 3.8%) and retinopathies (6 participants, 1.8%). The leading causes of presenting and best-corrected blindness were cataract. Further information is shown in table 4. Cataract and refractive errors are the most common causes of overall incident vision loss.

In univariate logistic regression models, incident vision loss was significantly associated with older age, female sex, less education, living alone, lower income, longer axial length, hypertension, no smoking and alcohol consumption, higher BMI and more frequent falls (all p<0.05). In multiple logistic regression models, the incident vision loss was significantly associated with older age, female sex, living alone, less education and longer axial length (all p<0.05) (table 5).

DISCUSSION

Eye health should be integrated into the global development and health agendas.[6] As incidence of vision loss is poised to grow due to the ageing population in China and globally, an up-to-date evaluation of the magnitude of eye care needs among the elderly is of particular importance, but data are lacking.[25] Previous study (the Liwan Eye Study (LES)) is representative of an urban southern Chinese population, more data are needed to understand the situation in rural areas.[14] This is the first study to report the incidence of vision loss among the elderly in rural southern China.

The incidence of vision loss in this current cohort is basically lower than that of the LES (online supplemental figure S2), which might reflect the different environments of rural and urban populations in southern China, or benefit from several public health policies in rural China to expand the availability of eye care services. However, it is still higher than northern China and other countries, suggesting that substantial work to reduce avoidable vision loss is still required, especially for the elderly, particularly those living alone, women and poorer, less-educated persons.

Previous studies on the incidence of vision loss are shown in online supplemental table S1, with published figures converted into annual incidence.[2 14 15 23 26–29] Comparisons between these studies should be made with caution due to differences in study

Table 1 Baseline characteristics of participants in the Yangxi Eye Study

Baseline characteristics	Participants	Non-participants		P value
		Alive at follow-up	Deceased at follow-up	
No (%)	3187 (64.4)	1759 (30.2)	879 (15.1)	
Age (SD)*	65.0 (9.0)	64.5 (10.7)	75.7 (9.6)	<0.001
Age (years)				
50–59	993 (31.2%)	698 (39.7%)	59 (6.7%)	
60–69	1224 (38.4%)	524 (29.8%)	168 (19.1%)	
70–79	738 (23.2%)	328 (18.6%)	287 (32.7%)	
80+	232 (7.3%)	209 (11.9%)	365 (41.5%)	
BMI (SD)*	22.44 (3.30)	22.45 (3.20)	21.23 (3.19)	<0.001
PVA (SD), logMAR*	0.41 (0.49)	0.37 (0.46)	0.69 (0.65)	<0.001
BCVA (SD), logMAR*	0.39 (0.57)	0.39 (0.55)	0.63 (0.70)	<0.001
Sex*				
Male	1465 (46.0%)	802 (45.6%)	538 (61.2%)	
Female	1722 (54.0%)	957 (54.4%)	341 (38.3%)	<0.001
Any formal education*				
No	1522 (47.8%)	808 (45.9%)	536 (60.9%)	
Yes	1665 (52.2%)	951 (54.1%)	343 (39.1%)	0.01
Diabetes present				
No	2876 (91.0%)	1570 (90.6%)	748 (88.1%)	
Yes	284 (9.0%)	163 (9.4%)	101 (11.9%)	0.11
Hypertension present*				
No	1750 (55.2%)	944 (54.4%)	312 (36.7%)	
Yes	1420 (44.8%)	791 (45.6%)	537 (63.3%)	< 0.001

*p <0.05 (comparison of participants and non-participants).
BCVA, best-corrected visual acuity; BMI, body mass index; logMAR, logarithm with a minimum angle of resolution; PVA, present visual acuity.

designs and definitions. The annual incidence of any VI in our cohort was lower than that in India (Andhra Pradesh Eye Disease Study). Recent studies reported that cataract surgery coverage in rural China is 62.7%,[16] higher than that in rural India (43.2%),[30] which might account for the lower incidence of vision loss and reflect successful policies to promote eye health in China. In addition, the length and scale of follow-up in different eye studies might also account for different incidence of vision loss.

The annual incidence of cataract surgery in our cohort of rural elderly residents in southern China was higher than that of Handan Eye Study (HES) (1.5% vs 0.2%) with elderly rural northern Chinese and Beijing Eye Study (BES) (1.5% vs 0.4%)

Table 2 Incidence of presenting vision loss in the better-seeing eye according to gender and age categories

	Mild VI*		MSVI		Blindness		Any VI*	
	n/N	% (95% CI)	n/N	% (95% CI)	n/N	% (95% CI)	n/N	% (95% CI)
Men (years)								
50–59	8/316	2.5 (0.8 to 4.3)	3/339	0.9 (0 to 1.9)	2/349	0.6 (0 to 1.4)	22/316	7.0 (4.1 to 9.8)
60–69	33/501	6.6 (4.4 to 8.8)	26/570	4.6 (2.8 to 6.3)	2/621	0.3 (0 to 0.8)	76/501	15.2 (12 to 18.3)
70–79	13/192	6.8 (3.2 to 10.4)	27/267	10.1 (6.5 to 13.8)	3/334	0.9 (0 to 1.9)	43/192	22.4 (16.4 to 28.3)
80+	1/26	3.9 (0 to 11.8)	17/59	28.8 (16.9 to 40.7)	4/88	4.6 (0.1 to 9)	5/26	19.2 (3.0 to 35.5)
Total	55/1035	5.3 (3.9 to 6.7)	73/1235	5.9 (4.6 to 7.2)	11/1392	0.8 (0.3 to 1.3)	146/1035	14.1 (12.0 to 16.2)
Women (years)								
50–59	31/502	6.2 (4.1 to 8.3)	7/554	1.3 (0.3 to 2.2)	4/574	0.7 (0 to 1.4)	56/502	11.2 (8.4 to 13.9)
60–69	39/413	9.4 (6.6 to 12.3)	24/508	4.7 (2.9 to 6.6)	1/566	0.2 (0 to 0.5)	90/413	21.8 (17.8 to 25.8)
70–79	18/146	12.3 (6.9 to 17.7)	47/256	18.4 (13.6 to 23.1)	4/342	1.2 (0 to 2.3)	42/146	28.8 (21.3 to 36.2)
80+	1/26	4.8 (0 to 11.8)	24/65	36.9 (24.9 to 49.0)	3/113	2.7 (0 to 5.7)	6/21	28.6 (7.5 to 49.6)
Total	89/1082	8.2 (6.6 to 9.9)	102/1383	7.4 (6 to 8.8)	12/1595	0.8 (0.3 to 1.2)	194/1082	17.9 (15.6 to 20.2)
Full population (years)								
50–59	39/818	4.8 (3.3 to 6.2)	10/893	1.1 (0.4 to 1.8)	6/923	0.7 (0.1 to 1.2)	78/818	9.5 (7.5 to 11.6)
60–69	72/914	7.9 (6.1 to 9.6)	50/1078	4.6 (3.4 to 5.9)	3/1187	0.3 (0 to 0.5)	166/914	18.2 (15.7 to 20.7)
70–79	31/338	9.2 (6.1 to 12.3)	74/523	14.2 (11.2 to 17.1)	7/676	1.0 (0.3 to 1.8)	85/338	25.2 (20.5 to 29.8)
80+	2/47	4.3 (0 to 10.2)	41/124	33.1 (24.7 to 41.5)	7/201	3.5 (0.9 to 6.0)	11/47	23.4 (10.8 to 36.0)
Total	144/2117	6.8 (5.7 to 7.9)	175/2618	6.7 (5.7 to 7.6)	23/2987	0.8 (0.5 to 1.1)	340/2117	16.1 (14.5 to 17.6)
Standardised		6.4 (5.3 to 7.5)		6.3 (5.4 to 7.3)		0.8 (0.4 to 1.1)		15.6 (13.8 to 17.4)

*Incidence was significantly higher in women than in men (p<0.05, Pearson χ^2 test).
MSVI, moderate and serve visual impairment; VI, visual impairment.

Table 3 The incidence of best-corrected vision loss in the better-seeing eye according to gender and age categories

	Mild VI*		MSVI*		Blindness		Any VI*	
	n/N	% (95% CI)	n/N	% (95% CI)	n/N	% (95% CI)	n/N	% (95% CI)
Men (years)								
50–59	4/340	1.2 (0 to 2.3)	1/346	0.3 (0 to 0.9)	0/350	0 (0 to 0)	10/340	2.9 (1.1 to 4.7)
60–69	25/595	4.2 (2.6 to 5.8)	15/613	2.5 (1.2 to 3.7)	1/622	0.2 (0 to 0.5)	55/595	9.2 (6.9 to 11.6)
70–79	28/277	10.1 (6.5 to 13.7)	20/319	6.3 (3.6 to 8.9)	1/336	0.3 (0 to 0.9)	64/277	23.1 (18.1 to 28.1)
80+	8/56	14.3 (4.8 to 23.7)	14/80	17.5 (9.0 to 26.0)	1/88	1.1 (0 to 3.4)	15/56	26.8 (14.8 to 38.8)
Total	65/1268	5.1 (3.9 to 6.3)	50/1358	3.7 (2.7 to 4.7)	3/1396	0.2 (0 to 0.5)	144/1268	11.4 (9.6 to 13.1)
Women (years)								
50–59	13/566	2.3 (1.1 to 3.5)	8/570	1.4 (0.4 to 2.4)	3/576	0.5 (0 to 1.1)	27/566	4.8 (3.0 to 6.5)
60–69	40/530	7.6 (5.3 to 9.8)	26/560	4.6 (2.9 to 6.4)	0/570	0 (0 to 0)	81/530	15.3 (12.2 to 18.4)
70–79	36/239	15.1 (10.5 to 19.6)	32/310	10.3 (6.9 to 13.7)	0/341	0 (0 to 0)	62/239	25.9 (20.3 to 31.5)
80+	15/61	24.6 (13.5 to 35.7)	17/96	17.7 (9.9 to 25.5)	4/114	3.5 (0.1 to 6.9)	29/61	47.5 (34.6 to 60.4)
Total	104/1396	7.5 (6.1 to 8.8)	83/1536	5.4 (4.3 to 6.5)	7/1601	0.4 (0.1 to 0.8)	199/1396	14.3 (12.4 to 16.1)
Full population (years)								
50–59	17/906	1.9 (1.0 to 2.8)	9/916	1.0 (0.3 to 1.6)	3/926	0.3 (0 to 0.7)	37/906	4.1 (2.8 to 5.4)
60–69	65/1125	5.8 (4.4 to 7.1)	41/1173	3.5 (2.4 to 4.5)	1/1192	0.1 (0 to 0.2)	136/1125	12.1 (10.2 to 14.0)
70–79	64/516	12.4 (9.5 to 15.3)	52/629	8.3 (6.1 to 10.4)	1/677	0.2 (0 to 0.4)	126/516	24.4 (20.7 to 28.1)
80+	23/117	19.7 (12.3 to 27.0)	31/176	17.6 (11.9 to 23.3)	5/202	2.5 (0.3 to 4.6)	44/117	37.6 (28.7 to 46.5)
Total	169/2664	6.3 (5.4 to 7.3)	133/2894	4.6 (3.8 to 5.4)	10/2997	0.3 (0.1 to 0.5)	343/2664	12.9 (11.6 to 14.1)
Standardised		5.9 (5.0 to 6.8)		4.0 (3.3 to 4.7)		0.4 (0.1 to 0.6)		12.0 (10.6 to 13.3)

*Incidence was significantly higher in women than in men ($p<0.05$, Pearson χ^2 test).
MSVI, moderate and serve visual impairment; VI, visual impairment.

with mixed urban and rural northern Chinese. However, the annual incidence of vision loss in our cohort was still higher than that of HES and BES (online supplemental figure S2).[14 15 26] Despite the higher incidence of cataract surgery in south, the incidence of vision loss remained higher than that in the north. Previous studies have also suggested a significantly higher prevalence of vision loss in southern versus northern China.[31] This is consistent with our findings, and may be attributable to different geographic and environmental exposures, such as sunlight.[31] These local differences in patterns of vision loss underscore the importance of formulating geography-specific policies to suit the specific needs of each population.

In the 2006 survey, cataract was the primary cause of vision loss, but by 2014, it had been supplanted by uncorrected refractive error, due to a significant rise in cataract surgical coverage (increased by 81.4% during the 2006–2014 interval).[16] This change benefited from public health policies to expand the availability of eye care services, such as the 'One Million Cataract Blindness Project'. In this study, cataract and refractive error remained the primary causes of incident vision loss. Surprisingly, the incidence of cataract surgery in the current cohort was higher than in that of the LES (1.5% vs 0.96%),[14 25] suggesting that cataract surgical access in at least some parts of rural China are surpassing comparable urban areas. The implementation of a series of projects, such as free cataract surgery sponsored by various foundations, might have contributed to expanding access to eye care services. Besides, more than 90% of the rural population are covered by the government health insurance, improving the healthcare affordability.[26]

The incidence of vision loss increases with age.[15 32] Elder people in rural areas are more likely to live with only spouses or alone. They are particularly susceptible to experience vision loss, which limited their ability to remain independent with ageing.[33] Reducing the proportion of mild VI and MSVI in elder people can improve their quality of life and well-being, which should be prioritised as intervention strategies.

Table 4 Causes of incident vision loss in the better-seeing eye

	PVI				BCVI			
	Mild VI	MSVI	Blindness	Any VI	Mild VI	MSVI	Blindness	Any VI
Cataract	72 (50.0)	135 (77.1)	18 (78.3)	164 (48.3)	163 (96.4)	118 (88.7)	8 (80.0)	312 (90.9)
Refractive error	59 (41.0)	14 (8.0)	0	151 (44.4)	0	0	0	0
Posterior capsule opacity	1 (0.7)	7 (4.0)	1 (4.3)	4 (1.2)	4 (2.4)	3 (2.3)	1 (10.0)	13 (3.8)
Macular degeneration	0	6 (3.4)	1 (4.3)	0	0	3 (2.3)	0	2 (0.6)
Diabetic retinopathy	0	0	0	1 (0.3)	0	2 (1.5)	0	3 (0.9)
Optic neuropathy	0	0	1 (4.3)	0	0	0	0	1 (0.3)
Other retinopathies	5 (3.5)	8 (4.6)	1 (4.3)	7 (2.1)	1 (0.6)	4 (3.0)	1 (10.0)	6 (1.8)
Corneal opacity	0	1 (0.6)	0	0	0	1 (0.8)	0	1 (0.3)
Other reasons	0	4 (2.3)	1 (4.3)	1 (0.3)	0	1 (0.8)	0	2 (0.6)
Undetermined	7 (4.9)	0	0	12 (3.5)	1 (0.6)	1 (0.8)	0	3 (0.9)
Total	144 (100)	175 (100)	23 (100)	340 (100)	169 (100)	133 (100)	10 (100)	343 (100)

Other retinopathies included macular hole, epiretinal membrane, central serous chorioretinopathy and retinal vein occlusion.
BCVI, best-corrected VI; MSVI, moderate and serve VI; PVI, presenting VI; VI, visual impairment.

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Table 5 Risk factors associated with incident vision loss

	Presenting vision loss		Best-corrected vision loss	
	Univariate	**Multiple**	**Univariate analysis**	**Multiple**
Age > 70 years	3.50 (2.89, 4.24)*	3.26 (2.57, 4.15)*	5.49 (4.40, 6.85)*	4.87 (3.65, 6.51)*
Female sex	1.26 (1.05, 1.52)*	1.39 (1.01, 1.90)*	1.33 (1.10, 1.60)*	1.70 (1.19, 2.42)*
Hypertension	1.22 (1.01, 1.48)*	1.01 (0.80, 1.28)	1.54 (1.26, 1.89)*	1.24 (0.94, 1.62)
More frequent falls	1.69 (1.33, 2.14)*	1.23 (0.92, 1.64)	0.46 (0.30, 0.71)*	1.15 (0.84, 1.59)
Living alone	1.61 (1.27, 2.03)*	1.35 (1.02, 1.80)*	1.92 (1.53, 2.40)*	1.27 (0.95, 1.71)*
Less education	0.56 (0.46, 0.67)*	0.71 (0.54, 0.93)*	0.45 (0.36, 0.55)*	0.55 (0.40, 0.75)
Lower income	1.38 (1.05, 1.81)*	0.97 (0.69, 1.35)	1.79 (1.30, 2.48)*	1.12 (0.74, 1.71)
Cataract surgery	1.44 (1.00, 2.09)*	0.88 (0.57, 1.37)	1.22 (0.87, 1.72)	
Longer axial length	1.10 (0.97, 1.26)*	1.20 (1.03, 1.41)*	1.26 (1.12, 1.42)*	1.52 (1.30, 1.78)*
No smoking	0.73 (0.58, 0.93)*	0.93 (0.66, 1.29)	0.74 (0.57, 0.95)*	1.10 (0.75, 1.62)
No alcohol	0.68 (0.50, 0.92)*	0.88 (0.59, 1.30)	0.64 (0.45, 0.90)*	0.80 (0.50, 1.28)
Diabetes	1.02 (0.69, 1.53)		0.41 (0.28, 0.58)*	1.14 (0.39, 3.34)
BMI<24	0.87 (0.72, 1.05)*	0.92 (0.73, 1.17)	0.66 (0.53, 0.80)*	0.77 (0.59, 1.01)

Data of the better-seeing eye in each participant were included for analysis. Variables with p<0.10 in univariate analysis were included in multiple logistic regression analysis.
*p <0.05.
BMI, body mass index.

Previous studies have reported that the burden of cataract blindness was greater in women than men.[34] This is consistent with our own finding, which further highlights the importance of strategies targeting vision loss in women. In addition, nearly 25% of the participants in our cohort refused follow-up, the main reason being that they thought they were healthy and did not need screening. This phenomenon shows the importance of raising the public awareness of physical examination. Moreover, fear of surgery was also a major reason for refusal. Some people even believe that surgery was not effective at restoring vision because of the poor prognosis of several patients. Improving patients' awareness of postoperative examination to deliver the better surgical outcomes after the surgery might reduce fear of surgery and promote the uptake of cataract surgery for unoperated patients.[35] Screening outreach should be supported to promote early diagnosis and prevent vision loss. We hope that some information we provide may offer inspiration for other low-income and middle-income countries to reduce the proportion of vision loss.

Limitations

First, VI was defined based only on distance VA, ignoring near VI and visual field defects. Large-scale population-based studies have generally been limited due to restrictions on examination sites and specialised personnel. Second, although the follow-up rate exceeded 60%, there are still numerous non-participants. Non-participants who were alive were younger and probably had better VA, which could lead to overestimated incidence of vision loss. Third, several socioeconomic factors, such as educational level and income, were based on self-report, and may not have been fully reliable.

In conclusion, much work is required to reduce avoidable vision loss in rural areas of China. Efforts to prevent and control vision loss in China not only require increased investment from governments, but also improved public health education, with more focus on poorer and less-educated groups.

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ORCID iDs
Xinyu Zhao http://orcid.org/0000-0003-1422-5203
Kun Xiong http://orcid.org/0000-0002-3918-9782
Nathan Congdon http://orcid.org/0000-0001-9866-3416
Mingguang He http://orcid.org/0000-0002-6912-2810

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