

Prevalence and causes of vision loss in East Asia: 1990–2010

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ABSTRACT

Aims To describe the prevalence and causes of visual impairment and blindness in East Asia in 1990 and 2010.

Method Data from population-based studies conducted from 1980 to 2012 were identified, and eligibility for inclusion was assessed. Data on prevalence of blindness (presenting visual acuity <3/60 in the better eye) and moderate to severe visual impairment (MSVI; presenting visual acuity <6/18 to 3/60 in the better eye) and causes were extracted.

Results The age-standardised prevalence of blindness was 0.7% (95% CI 0.6 to 0.9) in 1990 and 0.4% (95% CI 0.3 to 0.5) in 2010, while that of MSVI was 3.6% (95% CI 2.3 to 4.4) and 2.3% (95% CI 1.7 to 2.8), respectively. These prevalence estimates were lower than those of other countries globally. The absolute numbers affected by blindness and MSVI in 2010 were 5.2 million and 33.3 million, respectively, and were higher among women than men. Cataract was the leading cause of blindness, whereas uncorrected refractive error was the leading cause of MSVI.

Conclusions There has been a significant reduction in prevalence of blindness in East Asia, but a substantial absolute number of people remain blind and visually impaired, largely caused by cataract and uncorrected refractive error.

INTRODUCTION

East Asia is a subregion of Asia with five constituent countries/territories, including mainland China, Hong Kong, Macau, North Korea and Taiwan (box). East Asia is home to 1.4 billion people and is diverse in social, economic and political conditions.¹ Previous population-based studies showed that visual impairment remains one of the leading causes of morbidity in this area,^{2–3} and the total number of visually impaired people is expected to increase due to population aging.³ There have been increasing efforts (eg, the ‘Sight First, China Action’ project and the ‘Free Cataract Surgeries for A Million Poor Patients’ programme in China) to address the issues of visual impairment,⁴ but there is insufficient investment and an imbalance in distribution of eye-care resources in most of the rural East Asia regions.^{4–6}

While there are increasing numbers of county-specific surveys in mainland China (Beijing,⁷ Handan,⁸ Kunming,⁹ Guangzhou¹⁰), Taiwan¹¹ and Hong Kong,¹² reliable data are not available in other countries such as North Korea and Macau.

Box Countries and Territories Included in the Category of ‘East Asia’

East Asia:

- ▶ China (24/)
- ▶ Hong Kong SAR (China) (1)/
- ▶ Macau SAR (China) (0)/
- ▶ Democratic People’s Republic of Korea (0).
- ▶ Taiwan (2).

The ‘n’ numbers indicate the number of studies from that country

To date, several global reviews of the prevalence of visual impairment have been published,^{3 13 14} but these do not examine, or explicitly address, issues that may be unique to East Asia. For example, given the high prevalence of myopia in East Asia,¹⁵ it can be anticipated that uncorrected refractive error may be a more significant cause of visual impairment than in other regions globally.¹⁶ If so, efforts targeted at uncorrected refractive error may yield greater benefits in East Asia. Furthermore, with rapidly ageing populations, increasing levels of obesity and diabetes, and changing lifestyle, it is likely that visual impairment and blindness from age-related macular degeneration, diabetic retinopathy and other chronic eye diseases may increase in this region in the future.^{17 18}

This report draws on a specific analysis of the Global Burden of Diseases, Injuries and Risk Factors Study (herein referred to as the Global Burden of Disease (GBD) study) vision data^{19–21} to examine the prevalence and major causes of vision loss in East Asia in 1990 and 2010.

METHODS

Detailed information regarding the GBD Vision Loss Project has been reported previously.^{20 21} Briefly, a systematic review of all medical literature published from 1 January 1980 to 31 January 2012 that reported the incidence, prevalence and causes of blindness and/or moderate and severe vision Impairment (MSVI) were considered for inclusion. Only population-based cross-sectional studies that are representative of the general population were considered for data extraction. The definition of blindness used is presenting visual acuity of <3/60 in the better eye and moderate/severe visual impairment (MSVI) is <6/18 to ≥3/60 in the



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better eye. Unpublished data and data from studies following the protocol of Rapid Assessment of Avoidable Blindness (RAAB) were also included. The proportions of blindness and MSVI caused by cataract, uncorrected refractive error, macular degeneration, glaucoma, diabetic retinopathy and trachoma were estimated. Other causes included amblyopia, corneal diseases, optic nerve atrophy, uveitis, uncorrected aphakia and other uncommon eye diseases. More detailed description of the methodology, search strategy and statistical analysis can be found in the GBD High Income Countries paper (paper under review).^{21 22}

RESULTS

There were 27 studies that fit the inclusion criteria in East Asia,^{20 21} and the list of the studies has been previously published.¹⁹ The majority of studies (21/27) included a broad age range in the adult population. One-third of the studies were conducted in both urban and rural populations, one-third in urban and one-third in rural areas. Most of the studies (20/27) were published after the year 2000.

All prevalence data are model-based, age-standardised estimates, and are given for the population as a whole and for those aged 50 years and above (table 1). The prevalence of blindness was 0.7% (95% CI 0.6 to 0.9) in 1990 and 0.4% (95% CI 0.3 to 0.5) in 2010, and the prevalence of MSVI was 3.6% (95% CI 2.3 to 4.4) in 1990 and 2.3% (95% CI 1.7 to 2.8) in 2010. The absolute number of blind decreased from 6.0 million in 1990 to 5.2 million in 2010, but the absolute number of people with MSVI remained steady at 32 million in 1990 and 33 million in 2010 (table 2).

The overall prevalence of blindness was higher among women than men across all countries, and for 1990 and 2010, as was the overall prevalence of MSVI (figures 1 and 2). The absolute numbers affected by blindness and MSVI were significantly higher among women than men.

The leading causes of blindness remained the same from 1990 to 2010, although there was a slight change in the order due to the reduction in prevalence of trachoma-related blindness. Despite a significant decrease in the proportion of blindness explained by cataract, cataract remained the leading cause of blindness in 2010 (table 3), as in the world. Uncorrected refractive error was the second leading cause, and age-related macular degeneration was the third leading cause. Notably, the proportion of blindness that can be explained by macular degeneration increased from 5.0% in 1990 to 6.9% in 2010. The leading causes of MSVI remained the same from 1990 to 2010, and uncorrected refractive error was the leading cause, followed by cataract and macular degeneration (table 4).

DISCUSSION

This is the first review to specifically estimate the prevalence of blindness and MSVI in East Asia, summarising data published in all epidemiological studies between 1980 and 2012. The key findings are as follows. We showed that despite substantial economic and social development of countries in East Asia, vision loss remains a major public health problem, with substantial numbers of people who are blind and visually impaired. According to our model, China appeared to have a higher prevalence of blindness than the other East Asia regions. Nevertheless, we found two significant trends that may reflect the investments in public health made in East Asia over the last few decades. First, the prevalence of blindness in East Asia was below average levels compared with the global estimate. Second, there has been a significant decline in the absolute number of

Table 1 Age-standardised prevalence of blindness (presenting visual acuity <3/60 in the better eye) and moderate and severe vision impairment (MSVI; presenting visual acuity <6/18, but ≥3/60 in the better eye), by sex and year in East Asia, for 1990 and 2010

Region	Adults >=50 years						All ages						
	Men		Women		All		Men		Women		All		
	Blind (%)	MSVI (%)	Blind (%)	MSVI (%)	Blind (%)	MSVI (%)	Blind (%)	MSVI (%)	Blind (%)	MSVI (%)	Blind (%)	MSVI (%)	
1990													
East Asia	2.4 (2.0, 3.0)	12.5 (7.8, 15.6)	3.3 (2.8, 4.0)	14.3 (9.4, 17.4)	2.9 (2.5, 3.5)	13.5 (8.7, 16.6)	0.6 (0.5, 0.7)	3.3 (2.0, 4.1)	0.8 (0.7, 1.0)	3.8 (2.4, 4.7)	0.7 (0.6, 0.9)	3.6 (2.3, 4.4)	
World	2.9 (2.4, 3.3)	13.7 (10.8, 15.5)	3.3 (2.9, 3.9)	14.6 (11.8, 16.6)	3.0 (2.7, 3.4)	14.3 (12.1, 16.2)	0.7 (0.6, 0.8)	3.8 (3.0, 4.4)	0.9 (0.7, 1.0)	4.2 (3.4, 4.9)	0.8 (0.7, 0.9)	4.1 (3.4, 4.7)	
2010													
East Asia	1.3 (1.1, 1.6)	8.0 (6.2, 10.0)	1.7 (1.5, 2.2)	9.3 (7.2, 11.5)	1.5 (1.3, 1.9)	8.7 (6.7, 10.7)	0.3 (0.3, 0.4)	2.1 (1.6, 2.6)	0.4 (0.4, 0.5)	2.4 (1.9, 3.0)	0.4 (0.3, 0.5)	2.3 (1.7, 2.8)	
World	1.8 (1.6, 2.0)	10.1 (9.0, 11.6)	2.2 (1.9, 2.5)	11.5 (10.3, 13.1)	1.9 (1.7, 2.2)	10.4 (9.5, 12.3)	0.4 (0.4, 0.5)	2.8 (2.5, 3.2)	0.6 (0.5, 0.6)	3.2 (2.9, 3.8)	0.5 (0.4, 0.6)	2.9 (2.6, 3.5)	

95% uncertainty interval is shown in parentheses.

Table 2 Absolute numbers of subjects affected by blindness (presenting visual acuity <3/60 in the better eye) and moderate and severe vision impairment (MSVI; presenting visual acuity <6/18, but ≥3/60 in the better eye), by sex and year in East Asia, for 1990 and 2010

	Males			Females			All		
	Blind ('000s)	MSVI ('000s)	Total population ('000s)	Blind ('000s)	MSVI ('000s)	Total population ('000s)	Blind ('000s)	MSVI ('000s)	Total population ('000s)
	1990								
East Asia	2285 (1898, 2816)	14 300 (8760, 18152)	614 729	3721 (3121, 4513)	17 883 (11 401, 22 126)	577 089	6005 (5016, 7257)	32 200 (20 200, 40 400)	1 190 000
World	12 776 (11 059, 14 746)	75 315 (61 143, 86 983)	2 671 106	19 039 (16 811, 22 103)	96 891 (79 823, 111 438)	2 632 068	31 816 (28 143, 36 745)	172 213 (142 749, 198 125)	5 300 000
2010									
East Asia	2035 (1723, 2545)	14 900 (11 500, 11 800)	724 000	3207 (2730, 3958)	18 400 (14 300, 22 900)	673 000	5242 (4467, 6476)	33 300 (25 700, 41 400)	1 140 000
World	12 848 (11 418, 14 626)	82 740 (74 444, 99 069)	3 491 935	19 610 (17 719, 22 165)	108 883 (99 159, 130 141)	3 434 618	32 411 (29 351, 36 524)	191 342 (173 910, 229 823)	6 890 000

95% uncertainty interval is shown in parentheses.

blind and in the prevalence of blindness and MSVI over the past two decades.

The major finding in this review is that, in absolute terms, there are over 33.3 million people who have MSVI, and another 5.2 million who were blind in East Asia in 2010. The burden of blindness is enormous and substantially higher than the total number of blind in the high-income regions of Asia-Pacific (MSVI: 1.6 million; blind: 281 000), Australasia (MSVI: 403 000; blind: 35 000), Central Europe (MSVI: 3.8 million; blind: 413 000), Western Europe (MSVI: 8.5 million; blind: 1.2 million), and North America (MSVI: 3.0 million; blind: 451 000).²² This finding has important public health implications and suggests a continued effort and need for international and regional initiatives focused on prevention of blindness in East Asia.

As indicated, there has been significant progress made in both non-health and health sectors in East Asia, particularly in mainland China.²³ The demographic transition, particularly the change in fertility and mortality, has been dramatic in East Asia in the past decades. Between 1990 and 2010, for example, there was a significant increase in life expectancy at birth (from 69.3 years to 75.7 years) and a decline in fertility rate (from 24.1 million to 16.0 million) in China, despite the growing population (from 1.14 billion to 1.34 billion).²³ Furthermore, there has been a decline in prevalence of blindness (from 0.7% in 1990 to 0.4% in 2010) and MSVI (from 3.6% in 1990 to 2.3% in 2010) in East Asia in the past decades, despite a demographic trend of absolute increase in the number of elderly subjects. The reasons for the decline in visual impairment are multiple but can be summarised into three broad areas. First, of primary importance is socio-economic development. As one of the largest emerging economies, China has achieved rapid development with an annual gross domestic product (GDP) growth rate of 10% in the past decades, and China's urban population has now exceeded the number of rural dwellers for the first time in its history.²⁴ These social changes to some extent explain the reduction in poverty-related conditions, such as trachoma and other infectious diseases.²⁵ Second, at the broad health systems level, with the recognition by the Chinese government that poor health may become a potential political factor for instability, there have been multibillion dollar stimulus plans directed to health-care after 2000. New insurance schemes have been available, including the New Rural Cooperative Medical Scheme, the Urban Employee-based Basic Medical Insurance Scheme and the Urban Resident-based Basic Medical Insurance Scheme.²³ As a result, China has now achieved a 98% coverage rate of basic health insurance for both the rural and urban populations nationwide.²⁵ This has made a major impact on the uptake of cataract surgical services, as 40–70% of costs for cataract surgery are now covered.²⁶ Finally, at the eye-care level, there has been strong government interest in the fight against blindness. For example, the Chinese Ministry of Health (MOH) launched the Free Cataract Surgeries for A Million Poor Patients Program in 2009, with the goal of providing 1 million surgeries (free to patients) in 3 years.⁴ A national survey released by the Chinese MOH showed that the cataract surgical rate (CSR) reached 900/million population/year⁴ in 2010 (from 450 in 2004), although this is low compared with many other countries (CSR >4000 in India).²⁷ Furthermore, in collaboration with the Lions club International, the Chinese MOH and China Disabled Persons' Federation have recently announced a 'Sight First, China Action' Stage III project with the goal of eliminating blinding trachoma by 2016.⁴

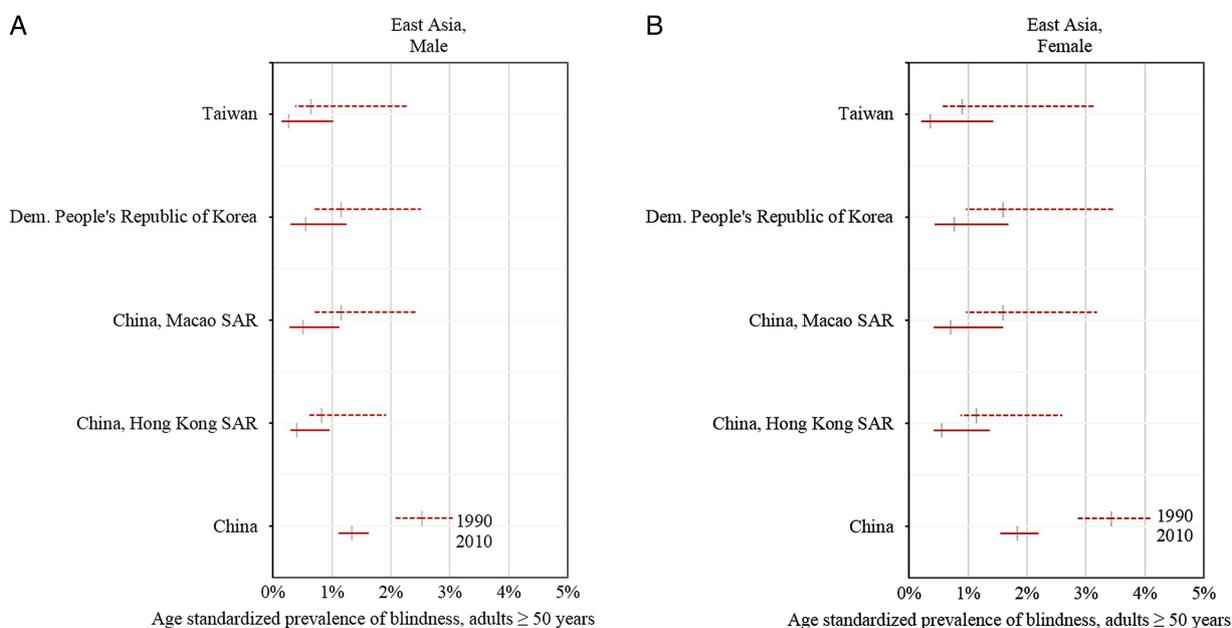


Figure 1 Ladder plots showing the age-standardised prevalence of blindness and change in men (A) and women (B) for adults aged 50 years and over for 1990 and 2010.

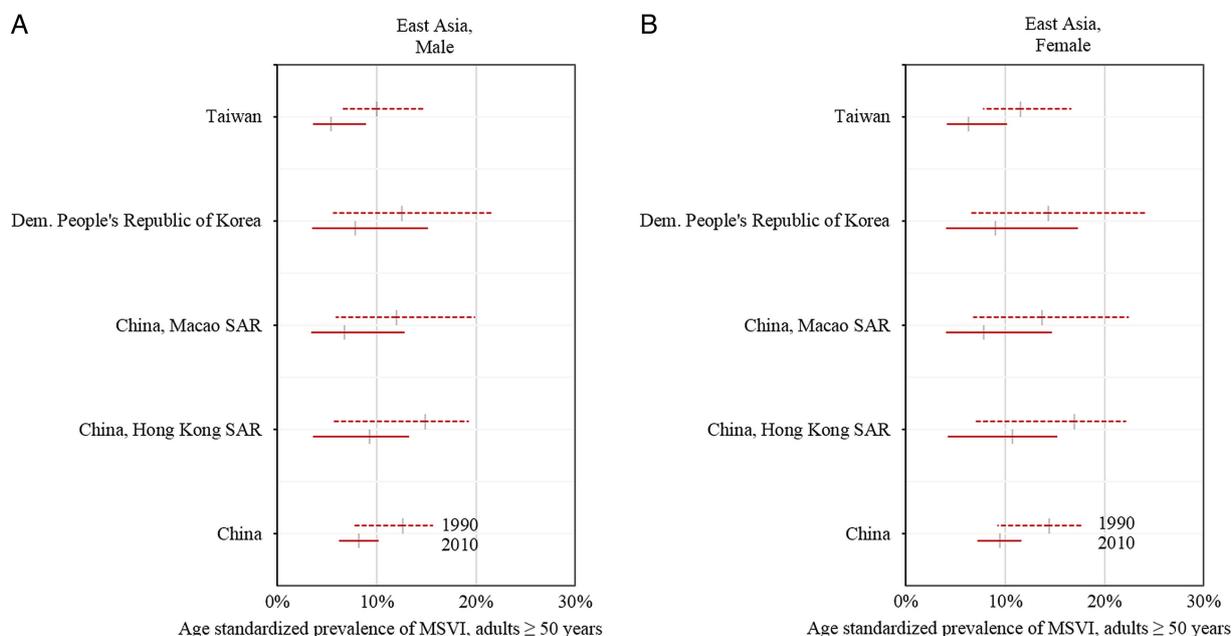


Figure 2 Ladder plot showing the age-standardised prevalence of moderate to severe visual impairment (MSVI) and change in men (A) and women (B) aged 50+ years for 1990 and 2010.

Table 3 Proportion of blindness (presenting visual acuity <3/60 in the better eye), by cause, East Asia region and the world, 1990 and 2010, all ages

Region	Cataract	Uncorrected refractive error	Macular degeneration	Glaucoma	Diabetic retinopathy	Trachoma	Other causes/ unidentified
1990							
East Asia	37.2 (34.1, 39.9)	13.5 (9.2, 16.4)	5.0 (3.7, 6.8)	3.9 (3.1, 5.1)	1.0 (0.8, 1.4)	5.4 (5.0, 5.8)	34.1 (30.7, 36.6)
World	38.6 (35.2, 42.0)	19.9 (14.9, 24.9)	4.9 (4.4, 5.8)	4.4 (4.0, 5.1)	2.1 (1.9, 2.5)	2.8 (2.3, 3.1)	27.4 (24.9, 30.0)
2010							
East Asia	28.1 (22.4, 31.5)	13.7 (9.2, 16.6)	6.9 (5.1, 9.4)	5.4 (4.0, 6.9)	1.1 (0.7, 1.7)	2.0 (1.8, 2.2)	42.7 (37.9, 46.4)
World	33.4 (29.6, 36.4)	20.9 (15.2, 25.9)	6.6 (6.0, 7.9)	6.6 (5.9, 7.9)	2.6 (2.2, 3.4)	1.4 (1.2, 1.7)	28.6 (26.1, 31.5)

95% uncertainty interval is shown in parentheses.

Table 4 Proportion of moderate and severe vision impairment (MSVI; presenting visual acuity <6/18, but \geq 3/60 in the better eye) by cause, East Asia region and the world, 1990 and 2010, all ages

Region	Cataract	Uncorrected refractive error	Macular degeneration	Glaucoma	Diabetic retinopathy	Trachoma	Other causes/ unidentified
1990							
East Asia	24.1 (22.4, 25.5)	44.8 (41.6, 45.7)	3.1 (2.6, 4.0)	0.9 (0.8, 1.2)	0.7 (0.5, 0.9)	2.9 (2.8, 3.2)	23.6 (21.0, 26.2)
World	25.6 (22.7, 28.4)	51.1 (45.6, 56.0)	1.9 (1.6, 2.4)	1.2 (1.1, 1.5)	1.3 (1.2, 1.6)	1.3 (1.0, 1.5)	17.6 (15.4, 20.3)
2010							
East Asia	13.3 (10.3, 16.5)	46.1 (42.3, 49.1)	5.2 (4.0, 6.7)	1.6 (1.2, 2.2)	0.8 (0.6, 1.4)	1.2 (1.1, 1.4)	31.6 (29.6, 33.7)
World	18.4 (15.8, 20.9)	52.9 (47.2, 57.3)	3.1 (2.7, 4.0)	2.2 (2.0, 2.8)	1.9 (1.6, 2.7)	0.7 (0.6, 0.9)	20.8 (18.4, 23.8)

95% uncertainty interval is shown in parentheses.

East Asia's eye-care is also challenged by health inequality due to income and socioeconomic disparities. This is exemplified by higher prevalence of blindness in women than men in 1990 and 2010, and in differences between China and its neighbours (figure 1). Other developed and developing countries have experienced similar gender inequality.²⁸ It is increasingly apparent that eye-care-specific policies alone may not be able to solve this gender inequality, which is closely interlinked with other factors at cultural, social, economic and political levels. Greater emphasis should be placed on the delivery of social services and provision of equal educational opportunities and financial access to care to women.

Not surprisingly, as in other regions, the leading cause of blindness in 2010 was cataract, and the leading cause of MSVI was uncorrected refractive error, as they were in 1990. The decrease in the proportion of visual impairment explained by cataract may reflect an increase in access to cataract surgery in this region. Nevertheless, the proportion explained by uncorrected refractive errors appeared similar during the period; this may be explained by the improvement in eye care for those who would have been blinded due to diseases other than refractive errors, and by the high prevalence of postoperative refractive errors after cataract surgery.¹⁰ The top six causes of blindness/MSVI remained the same from 1990 to 2010, although the order did change slightly owing to the reduction in proportion of trachoma. The finding that the ranking of causes of blindness remained largely unchanged across 20 years reflects a pressing need for supplying spectacles and providing basic surgical services. To address the needs, innovative pricing, financing and reimbursement schemes may be needed to address these issues. Increased financial and managerial autonomy could be one clear route to facilitate progress in government hospitals.

Finally, East Asia should also prepare for specific challenges due to rapidly ageing populations, increasing levels of diabetes, hypertension, obesity and lack of physical activities and changing diet. Thus, it is likely visual impairment and blindness from age-related macular degeneration, diabetic retinopathy, retinal vein occlusion and other chronic eye diseases may increase in East Asia in the future.²⁹ Planning to tackle these conditions requires different resources, training and eye-care services. For example, although diabetic retinopathy only accounted for 2.1% of blindness and 1.3% of MSVI, strategies should be in place to train ophthalmologists to recognise and treat severe diabetic retinopathy, and for public eye-care services to provide for screening of diabetic retinopathy.⁷ Improving awareness of diabetic retinopathy, which continues to be low in many Asian countries, should also be a focus for future planning.

Strengths of this review include the comprehensive search strategy, standardised data collection and extraction, identical

health metrics, and the ability to model trends of prevalence estimates. Nevertheless, this study has several important limitations. First, limited data were available for some regions, especially North Korea, and as a result, the majority of the discussion was only devoted to eye disease and eye care in Mainland China. Second, most of the surveys were conducted in subnational regions, and very few were representative of national populations. Thus, we were making inferences from specific surveys. In particular, China is a big country with substantial geographical variation in health and health systems, but we were unable to provide a geographic-related pattern in prevalence of vision loss, due to the lack of comparable studies across eastern, western and middle China. The China Nine-Province Survey only showed the prevalence data in several rural areas,³⁰ and more such sub-regional data are needed in the future. Notably, studies using the RAAB methodology have been available and have contributed to one-third of the eligible articles in this review. This RAAB method should be recommended for implementation in less developed areas in China and the other East Asia regions. Third, the decline in prevalence of blindness and MSVI may be true, but it can also be explained by methodological differences between studies (such as differences in sampling population's age and sex structures, socioeconomic conditions, and case definitions). Fourth, in our systematic review, data were unavailable for some countries, years, age groups and geographic regions, and there were heterogeneous definitions of visual impairment and classification schemes for causal attributions. To address these issues, hierarchical logistic regressions were fitted to presenting visual impairment to impute the prevalence data by country, year, age, region and cause of visual impairment. The values being imputed may not precisely reflect the actual values. Additionally, some of the included surveys were conducted more than 20 years ago, and their use for statistical imputation is under the assumption that these data were correlated with recent estimates. Fifth, the underlying causes of uncorrected refractive error as well as the prevalence of refractive error may have changed due to the wider use of intraocular lens, although we were unable to determine the precise magnitude of these changes. Finally, the relatively small number of eligible studies in the database limited our ability to perform sensitivity analysis.

In conclusion, blindness and visual impairment remain a significant public health problem in East Asia, although there are promising trends of declining prevalence that may reflect socioeconomic development in this region, particularly in China. The challenges identified will require further efforts, and strong international, national, governmental and local leadership. Efforts to improve eye service capacity and deliver high-quality eye care must be further tailored to address unmet needs (eg, in women). Finally, East Asia should prepare itself for emerging conditions

that are likely to change the cause and pattern of blindness in the future. These include a likely higher burden of blindness and visual impairment from age-related macular degeneration and diabetic retinopathy, due to rapidly ageing populations, increasing levels of obesity and diabetes and changes in lifestyle. Our findings have important implications for eye health services planning, prioritisation and implementation for the 1.4 billion people living in East Asia.

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Collaborators Group Information: A list of the Vision Loss Expert Group members appears at http://www.anglia.ac.uk/ruskin/en/home/microsites/veru/other_research_areas/global_burden_of_diseases.html.

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