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Burden of vision loss associated with eye diseases in China 1990-2020: Findings from the Global Burden of Disease Study 2015

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Abstract

Aims ~~Our study aimed to assess and analyze~~ the burden of vision loss due to eye diseases in China between 1990 and 2015, and ~~also~~ to predict the burden in 2020.

Methods Data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015) were used. The main outcome measurements were ~~p~~Prevalence and Years lived with disability (YLDs). ~~The Number, Rate and Percentage in Prevalence and YLDs for vision loss due to Cataract, Glaucoma, Macular degeneration, Other vision loss, Refraction and accommodation disorders~~ Refractive error and Trachoma ~~were computed and analyzed.~~

Results Prevalences for ~~these all the~~ eye diseases ~~increased have been increasing~~ steadily from 1990 to 2015, and will increase till 2020. From 1990 to 2015, the ~~most common~~ leading eye disorder was Refraction and accommodation disorders. Comparing ~~ed~~ with ~~those in~~ 1990, the proportion of the total vision loss burden due to eye disease among those under the age of 14 years in 2015 ~~decreased under the age of 14 years, increased while that~~ above the age of 15 years increased, especially increased substantially ~~most prominently~~ above the age of 50 years. China ranked 10th when comparing YLDs for vision loss due to eye diseases ~~in China with that of the the other 18 member countries members of the G20 (the 20th member is the European Union).~~ Age-standardized YLD Rates for vision loss due to eye diseases declined in ~~the other all the~~ 19 countries, except for ~~that in~~ China. ~~The b~~ Burden from vision loss due to eye diseases ranked 12th and 11th among all ~~the causes of that can lead to~~ health loss in China in 1990 and 2015 respectively.

Conclusion ~~Alone among major economies, For the past 25 years, China has experienced had less control over the vision loss burden from an increase in the burden of age-standardized vision loss from eye disease over the last two decades.~~ In the future, China ~~may will~~ expect a growing larger burden of vision loss ~~due to because of~~ population growth and ageing.

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China has the world's largest population, over 1.406 billion, accounting for nearly 20% of the earth's inhabitants.¹ China has made enormous strides in improving health in the past few decades: life expectancy at birth has steadily increased and the under-5 mortality rate has greatly fallen sharply.²⁻⁴ At the same time, more needs to be done to further enhance the quality of the longer lives of China's citizens. A comprehensive assessment of current and expected disease burdens can help to inform China's health reform efforts, and provide evidence to support long-range strategies.

Vision loss due to eye diseases is a major health problem, greatly affecting quality of life. Globally as of 2015, 34.3 million people were blind, an additional 24.3 million had severe vision impairment, 214 million had moderate vision impairment, and 663 million had near vision impairment in 2015.⁵ Vision loss is the third largest cause of impairment after anaemia and hearing loss,⁶ but the burden of vision loss in China remains still unclear yet. The Global Burden of Diseases Study is the result of a worldwide collaboration aimed at quantifying various health metrics of loss to diseases and injuries. These metrics enable comparison of health data across boundaries of geography and time in a way that is more comprehensive and internally consistent than possible with previous data sources.⁶⁻⁸

Our study aimed to quantify the burden of vision loss due to various eye diseases in China from 1990 to 2015 using the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015), and also to predict the burden in 2020.

Methods

Data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015) from 1990 to 2015 were used to analyze the burden of vision loss due to eye diseases in China.⁷ We searched and extracted related data from a website database (<http://ghdx.healthdata.org>), which was set up and shared by the Global Burden of Disease Study group. Details on the data, approaches to enhancing data quality and comparability, and statistical modeling and metrics for the GBD 2015 have been reported previously.⁶⁻⁹ In brief, the GBD study team collected data from household surveys archived in the Global Health Data Exchange, sources suggested by in-country experts, and surveys identified in major multinational survey data catalogues and Ministry of Health and Central Statistical Office websites. Then they estimated incidence and prevalence of various conditions by age, sex, cause, year, and geography using a wide range of updated and standardised analytical procedures, including s. The procedure includes several steps such as data screening, data adjustment, DisMod-MR 2.1 estimation, and injury modelling strategies, y, and so on. Then, the GBD investigators study used numerous metrics to report results on health loss related to specific causes of disease and injury: deaths and death rates, years of life lost due to premature mortality (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs).^{2,9}

The main outcome measure of our study were pPrevalence and YLDs, and the Numbers, Rates and Percentages of Prevalence and YLDs for associated with the vision loss burden due to various eye diseases were assessed and analyzed. YLDs refer to years of life lived with any short-term or long-term health loss, which were equal to the prevalence of the eye disease multiplied by its associated disability weights.¹⁰ GBD 2013 included new data for disability weights, which quantify the severity of health loss associated with a particular disease.⁸ Disability weights uses numbers on a scale from 0 to 1 that represents the severity of health loss associated with a particular health state.^{8,10-12} The severity of health loss was based on surveys of the general public in five countries (Bangladesh, Indonesia, Peru, Tanzania, and the USA) and an open internet survey.^{8,10-12} These disability weights were used to calculate the YLDs for various diseases. The YLD Rates were calculated by dividing the number of years of life lost by the relevant population.¹⁰⁻¹² The Age-adjusted Rates were calculated using the WHO 2000-2025 World standard population, which excluded the effects of total population size and age structure.^{8,9,12} The Percentage for in YLDs were calculated as the number of years lived with disability lost due to a specific disease divided by the total number of years lived with disability of life lost for all diseases.

The following six ocular diseases were listed in the GBD 2015: Cataract, Glaucoma, Macular degeneration, Trachoma, Refraction and accommodation disorders and Other vision loss.⁷ The other vision loss category included a total of 57 eye conditions.¹³ The changing trends of the burden of vision loss over time and with age were investigated. We also compared the burden of vision loss in China with the burden of other diseases and with the burden of vision loss in other countries.

Results

Figure 1: Prevalence for various eye diseases from 1990 to 2020 in China.

From 1990 to 2015, the most common-leading eye disorder in China was Refraction and accommodation disorders whose prevalences were much higher than those of other eye diseases (Figure 1), while the second most common-leading cause was Cataract, followed by Other vision loss. Prevalences for Macular degeneration and Glaucoma were similar, with Glaucoma being more common-a bit more before 2005 and Macular degeneration being a bit more common after 2005. The pPrevalences for Trachoma was the were lowest. Prevalences for all includedthe eye diseases have been increasing steadily from 1990 to 2015, and willare projected to -increaserise until-till 2020. We further analyzed Age-standardized Pprevalence Rrates-Prevalence Rates for Refraction and accommodation disorders, Cataract and Other vision loss almost remained essentially unchanged, w- While -Prevalence Rrates for Macular degeneration and Glaucoma increased slightly-slightly went up and those for Trachoma fell considerablygreatly went down.

YLDs: years lived with disability

Figure 2: Distribution of prevalence for various eye diseases and YLDs from vision loss due to eye diseases in China, by age, 1990 and 2015 (figure left: Prevalence; figure right: YLDs)

Comparing with those in 1990, the proportion of the total vision loss burden due to eye disease in 2015 decreased between 1990 and 2015 for those under the age of 14 years, and increased among those above the age of 15 years and above, with the most notable especially increased substantially increases occurring at above the age of 50 years and above (Figure 2). The bAbove the age of 50 years, burden of vision loss due to every individual eye disease, which included Cataract, Glaucoma, Macular degeneration, Trachoma, Refraction and accommodation disorders and Other vision loss, increased from 1990 to 2015 among those 50 and above. With the relative contributions of individual eye diseases to the overall burden changeing little over this time between 1990 and 2015. There was lack of data on vision burden from Cataract and Glaucoma in the 0 to 14 age range. Refraction and accommodation disorders accounted for the majority of the burden of vision loss in all age groups both in 1990 and in 2015.

Table 1: All-age YLDs and aAge-standardized YLD rRates for vision loss due to various eye diseases in 1990 and 2015 for 19 member countries of the Group of 20G20 (The 20th member is the European Union)

Country name	All-age YLDs <u>Total</u> Number in 1990	All-age YLDs in 2015		Age- standardised YLD Rate in 1990 (per 100 000)	Age- standardised YLD in 2015	
		<u>Total</u> Number	Rank		Rate (per 100 000)	Rank
Argentina	60599.8	83408.9	16	200.2	184.3	13
Australia	25155.6	40733.2	19	144.1	137.9	15
Brazil	304261.5	571429.5	5	304.6	295.4	8
Canada	32291.3	50606.0	18	112.5	111.4	19
China	2047612.3	3800391.3	2	241.4	257.8	10
France	96785.4	127394.3	14	143.2	134.4	16
Germany	162720.4	198186.4	10	164.1	152.9	14
India	2977270.0	5358196.6	1	574.4	539.0	1
Indonesia	451601.8	700590.1	3	416.1	368.1	5
Italy	143658.6	192572.7	11	207.3	193.9	12
Japan	364310.7	566869.1	6	268.8	261.3	9
Mexico	218669.0	424234.9	8	405.3	405.1	3
Russia	507649.4	615370.6	4	327.9	317.0	6
Saudi Arabia	38520.6	78733.8	17	420.4	371.0	4
South Africa	106195.5	176087.8	12	430.5	420.7	2
South Korea	90642.7	150444.5	13	267.9	254.0	11
Turkey	137962.9	223080.6	9	348.7	314.8	7
United Kingdom	99078.5	114855.4	15	142.2	132.7	17
United States	313948.2	444171.7	7	116.5	115.0	18

YLDs: years lived with disability

We compared YLDs for vision loss due to eye diseases in China with that of the other 18 member countries of the G20 (the 20th member is the European Union) (Table 1). We found that, ~~comparing with that in 1990,~~ aAll-age YLDs for the burden of vision loss ~~in 2015,~~ increased in all ~~the~~ 19 countries ~~between 1990 and 2015~~ in different degrees. In 2015, China ranked 2nd for aAll-age YLDs, ~~only~~ behind only India. In terms of the aAge-standardized YLD rRates for vision loss burden, China ranked 10th, ~~behind India, South Africa, Mexico, Saudi Arabia, Indonesia, Russia, Turkey, and Brazil, and ahead of countries such as Italy, Argentina, Germany, Australia, France, United Kingdom, United States, and Canada, while very similar to Japan and South Korea.~~ Age-standardized YLD rRates for vision loss due to eye diseases

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declined between 1990 and 2015 with varying degrees in all ~~the~~ 19 countries, except ~~for that~~
~~in~~ China.

Table 2: Top 20 causes of aAll-age YLDs and Age-standardised YLD rRates in China in 1990 and 2015

Cause-name	All Ages YLD in 1990		All Ages YLD in 2015		Percentage change in All ages YLD Number between 1990 and 2015 (%)	Age-standardised YLD Rate in 1990	Age-standardised YLD Rate in 2015	Percentage change in Age-standardised YLD Rate between 1990 and 2015
	Total Number	Rank	Number	Rank				
Lower back pain	6824391.5	1	10445627.6	1	53.1	696.0	655.8	
Neck pain	4948621.3	3	9297530.8	2	87.9	514.9	556.1	8.0
Age-related and other hearing loss	4784037.3	4	8555665.2	3	78.8	595.9	581.4	-2.4
Major depressive disorder	4565074.8	5	6681222.8	4	46.4	425.4	426.8	0.3
Diabetes mellitus	2793655.8	10	5884165.5	5	110.6	307.0	360.6	17.5
Other musculoskeletal disorders	3846366.6	6	5866966.2	6	52.5	361.7	371.3	2.7
Iron-deficiency anemia	5615397.3	2	4829908.3	7	-14.0	456.5	413.4	-9.4
Schizophrenia	2855975.1	9	4543735.7	8	59.1	262.9	274.1	4.3
Migraine	3057968.1	8	4127002.9	9	35.0	265.6	265.6	0.0
Anxiety disorders	3208267.9	7	3804590.5	10	18.6	276.6	267.3	-3.4
Vision loss due to eye diseases	2047612.3	12	3800391.3	11	85.6	241.4	257.8	6.8
Osteoarthritis	1477761.2	14	3602698.2	12	143.8	190.0	218.5	15.0
Chronic obstructive pulmonary disease	2634071.1	11	2772680.8	13	5.3	316.5	184.4	-41.7
Dysthymia	1435242.5	15	2300178.5	14	60.3	143.0	143.2	0.1
Drug use disorders	1291166.0	16	2156146.9	15	67.0	100.6	142.8	41.9
Road injuries	726933.0	23	1831072.7	16	151.9	74.2	114.8	54.7
Falls	1056459.5	19	1606745.0	17	52.1	107.4	105.9	-1.4
Food-borne trematodiasis	1237355.3	17	1527471.4	18	23.5	103.9	99.2	-4.5
Bipolar disorder	1074950.0	18	1410904.6	19	31.3	90.8	91.2	0.4
Alcohol use disorders	929596.0	20	1363909.7	20	46.7	80.4	85.0	5.7
Ascariasis	1891992.3	13	42722.1	29	-97.7	164.4	3.0	-98.2

YLDs: years lived with disability

In 1990 and 2015, the burden from vision loss due to eye diseases ranked 12th and 11th respectively among all the causes of that can lead to health loss (Table 2). The rank of vision loss burden remained quite stable compared with burdens from other diseases in China. Most burdens from various causes increased in 2015 compared with those in 1990, except for Iron-deficiency anemia and Ascariasis. Compareding with that in 1990, the All-age YLD total vision loss burden increased greatly in 2015 with percentage change as increased by 85.6%, the fifth-highest such increase in All-age YLD Number between 1990 and 2015. The percentage change for it ranked 5th. The While Age-standardised YLD rRate for the vision loss burden

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changed much less between 1990 and 2015, ~~with the percentage change as~~increasing by only 6.8%, ~~which was the 6th-highest increase.~~ The range of percentage change in Age-standardised YLD Rate for top 20 causes was from 54.7% to -98.2% between 1990 and 2015, and the percentage change for vision loss burden ranked 6th.

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Discussion

Previous studies have usually focused on the prevalence of eye diseases alone to evaluate the burden of vision loss. Our study aimed to investigate the vision loss burden in China using both pPrevalence and YLDs, which enables the comparison of burden from vision loss with those from other diseases and in other countries. ~~The results of our study can provide an overview understanding of vision loss burden in China for the first time.~~

~~Our~~The ~~findings~~results indicated ~~d~~ that ~~by far~~the burden of vision loss in China was dominated by Refraction and accommodation disorders, which is consistent with findings in other countries in the world.¹⁴⁻¹⁸ Considering ~~that~~ most Refraction and accommodation disorders can be safely and inexpensively corrected, greater efforts should be made to tackle this problem. 'VISION 2020: the Right to Sight' aims to eliminate avoidable blindness by the year 2020. Refraction and accommodation disorders mostly belong to avoidable blindness and should be considered as a priority ~~have the priority to be taken care of~~. The second-leading cause of vision loss burden was Cataract, ~~which is also the~~ ~~Cataract was the~~ leading cause for blindness in China.^{16,19} China's cataract surgery rate (CSR) in XXX was 1072/million/year, which was not only lower than those in developed countries, but also lower than rates for other countries in the region with lower per capita incomes than China, including those in Thailand, Vietnam, Laos, Kampuchea, and the Philippines and other developing countries.¹⁹ Tackling Cataract is still a great challenge in China, in part due to inadequate training opportunities for young surgeons.

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Age-standardized pPrevalence ~~rRates~~ reveal ~~can show~~ the true ~~real~~ burden of eye disease, s excluding the effect of population size and age structure. For the past 25 years, aAge-standardized pPrevalence ~~rRates~~ for Refraction and accommodation disorders, Cataract and Other vision loss almost remained virtually unchanged, which was particularly concerning, given that these conditions are eminently treatable. Of even greater concern is the fact that it was even worse that aAge-standardized pPrevalence ~~R~~Rates for Macular degeneration and Glaucoma actually gradually increased over this period. Little progress has been made in controlling ~~the prevalence rate of~~ these eye diseases. Due to ~~Combined with~~ population growth and aging, the aAll-age pPrevalences for all major ~~the~~ eye diseases in China have been dramatically increasing from ~~increased dramatically between~~ 1990 and ~~to~~ 2015, and will be predicted to increase until ~~till~~ 2020. Trachoma was the one exception, whose age-adjusted rate greatly decreased. ~~China has made remarkable success in eradicating Trachoma.~~ This is consistent with the fact that WHO has recently certified China free of active trachoma.

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Young AL, Jhanji V, Liang Y, Congdon N, Chow S, Wang F, Zhang X, Man X, Yang M, Lin Z, Yuen HG, Lam DS. A survey of perceived training differences between ophthalmology residents in Hong Kong and China. BMC Med Educ. 2015;15(1):158-64.

Jiang Y, Luo L, Congdon N, Wang S, Liu Y. Who will be wielding the lancet for China's patients in the future? Lancet 2016;388:1952-1954. (Editorial)

When we studied the vision loss burden by age group, it was encouraging that in population this fell between 1990 and 2015 aged in the 0 to -14-year group, it decreased from 1990 to 2015. But in the age groups above 15 years, the vision loss burden has ~~increased for the past 25 years over this period, particularly among those. Especially~~ above the age of 50 years, ~~the~~ burden substantially increased. Since the family planning policy began to take into effect from the beginning of 1970s and became one of China's basic state policies in 1982, significant

attention has been paid to the children because of one-child only. The observed progress among younger ages may be due to China's one-child policy, promulgated since the 1970s, and the resulting attention paid by families to the well-being of children. Meanwhile, due in part to the one-child policy, China has stepped into an aging population rapidly. China has made great efforts to control the population growth. Some experts predicted that in 2023, the population will stop growing in China.²⁰ But China has faced with severe population ageing and the situation will be more and more serious in the future. According to the classification criteria of the United Nations in 1956, when the number of people aged 60 years and over reaches 10% or the number of people aged 65 years and over reaches 7% of the population, the population is ageing.²¹ In 1990, the population of China was over 1143 million, with 8.48% of the population were over 60 years old and 5.51% were over 65 years old.²⁰ But this policy has also led to the rapid aging of China's population, with the proportion aged 65 years and above growing from 5.51% in 1990 to 10.5% in 2015. In 2015, the population of China was over 1406 million, and 16.1% of the population was above 60 years old and 10.5% above 65 years old in 2015.²⁰ Most vision loss diseases common causes of vision loss are age related, such as cataract, glaucoma and macular degeneration. The ageing population plays a significant impact on the role in the increasing burden of vision loss, and much more attention should be paid to population ageing. National policy should give priority for the aged to control eye diseases to controlling such eye diseases of aging.

The burden of vision loss in China was somewhat less than a little better than that in India and was worse than those in other member countries of the G20. This was to be at was expected, taking China's large the huge population into account. Age-standardized YLDs Rate of vision loss burden in China ranked 10th among the G20 countries, higher than some developed countries and lower than some less developed countries. That is also acceptable. However, it is worth noting that China was the only country whose Age-standardized YLD Rates for vision loss in 2015 was higher than that in 1990. This is quite concerning, as since it shows that there has been little was hardly any progression in controlling vision loss over for the past 25 years. Without considering the population growth and ageing, the vision loss burden in China has not only failed to decrease, but increased. This should serve as be a wakeup call for both the eye care providers eye doctors and health the policy makers.

Comparing to 1990, the All-age YLDs from vision loss burden increased 85.6% in 2015. Meanwhile, the Age-standardized YLDs Rate for it increased with percentage change of 6.8%. It indicated that the difference of vision loss burden was majorly due to population growth and ageing and minorly due to less control of eye diseases. The burden of vision loss due to eye diseases ranked 12th in 1990 and 11th in 2015 among all the causes that can affect people's health causes of health loss in China. The real burden of vision loss may be even worse, because as some diseases which also damage visual function and lead to blindness, such as diabetic retinopathy, were not included in our study. For example, diabetic retinopathy was not evaluated separately in GBD 2015. Thus we could not investigate the vision loss burden from diabetic retinopathy. Furthermore, rarer causes of vision loss among children such as congenital cataract and congenital glaucoma in Children have not been were not investigated in the GBD study. This is understandable, since very few population-based

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studies have included younger age groups, ~~thus it might be making it~~ difficult to establish the precise estimates.⁵ ~~The burden of v~~And the vision loss ~~could~~~~may~~ be under~~estimated~~~~stated~~ ~~due to the scarcity of data for because the data for~~ children aged younger than 15 years ~~are scarce~~.^{2,5}

This study has several limitations. Although the GBD Vision Loss Expert Group ~~has tried their best~~~~made every effort~~ to collect all ~~the~~ published and unpublished data,⁵ the quantity and quality of data available are still limited, ~~which~~. ~~Differences in the quantity and quality of data entered into the system~~ could affect the accuracy of the estimated burden. ~~However, it is persuasive that the data availability in China has similar levels to those in many developed countries.~~^{2,3,5} Also, the ~~estimated~~evaluation of vision loss burden in GBD 2015 ~~might not be~~ ~~may be~~ incomplete ~~due to failure to include certain diseases, as noted above~~. Vision loss from several other diseases have not been included as we described previously. The GBD studies need some improvements. But it is by far Despite these limitations, GBD remains the most standardized and accurate system available to ~~make comparisons, especially when we aim to~~ assess disease burden~~s~~ across times and places, and across different diseases and injuries.

In summary, this study demonstrates that progress in controlling vision loss from eye disease in China has been sub-optimal over the last 25 years. quantitatively evaluated the burden of vision loss due to eye diseases in China. It is crucial to comprehend how well our health system was tackling these problems. It is particularly concerning that for the past 25 years, ~~we had less control over the vision loss burden from eye diseases~~. In the future, China will face more serious population ageing as well as population growth ~~and China will~~and should thus expect ~~expect a larger~~to encounter a growing burden of vision loss. Effective policies and measures to address this rising burden ~~are of great priority for the goals of Vision 2020: The Right to Sights~~. should be a national priority.

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