

Prevalence of self-reported chronic conditions and poor health among older adults with and without vision impairment in China: a nationally representative cross-sectional survey

Yiran Gu,¹ Haozhe Cheng,^{2,3} Xiaoyun Liu,³ Xiaodong Dong,^{2,3} Nathan Congdon,^{4,5} Xiaochen Ma ³

To cite: Gu Y, Cheng H, Liu X, et al. Prevalence of self-reported chronic conditions and poor health among older adults with and without vision impairment in China: a nationally representative cross-sectional survey. *BMJ Open Ophthalmology* 2023;**8**:e001211. doi:10.1136/bmjophth-2022-001211

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjophth-2022-001211>).

Received 24 November 2022
Accepted 7 February 2023



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Dr Xiaochen Ma; xma@hsc.pku.edu.cn

ABSTRACT

Objective To examine the self-reported prevalence of 13 chronic conditions and poor health among Chinese adults aged 45 years and older with and without self-reported vision impairment.

Design Cross-sectional study from the China Health and Retirement Longitudinal Study 2018, a nationally representative survey of Chinese adults aged 45 years and older involving 19 374 participants.

Methods We used logistic regression to assess the association between vision impairment and 13 common chronic conditions and between vision impairment and poor health for those with any of these chronic conditions.

Results Older people with self-reported vision impairment were significantly more likely to report all 13 chronic conditions (all $p < 0.05$). After controlling for age, gender, education, residential status (rural vs urban), smoking and BMI, the highest adjusted odds were for hearing impairment (OR=4.00 (95% CI 3.60 to 4.44)) and depression (OR=2.28 (95% CI 2.06 to 2.51)). The lowest risk, though still significant, was for diabetes (OR=1.33 (95% CI 1.11 to 2.05)) and hypertension (OR=1.20 (95% CI 1.04 to 1.38)). After controlling for these potential confounding factors, among older people with chronic conditions, those with vision impairment were 2.20 to 4.04 times more likely to have poor health, compared with those without vision impairment (all $p < 0.001$), with the exception of cancer ($p=0.595$).

Conclusions Higher prevalence of chronic conditions is strongly associated with vision impairment among older Chinese adults and poor health is strongly associated with vision impairment among people with chronic conditions.

INTRODUCTION

Management of the rising prevalence of chronic disease, especially in low-resource settings, is the main challenge facing health-care systems worldwide and is, thus, a global development imperative.¹ As global life expectancies rise, the proportion of the population affected by chronic conditions climbs as well, as does the prevalence of

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Vision impairment (VI) is associated with higher prevalence of chronic conditions. However, little is known about the impact of VI on specific chronic conditions among older adults in lower and middle-income countries such as China.

WHAT THIS STUDY ADDS

⇒ Self-reported prevalence of all 13 chronic conditions assessed in this nationally representative sample of 19 374 Chinese adults aged 45 years or older was higher among persons with VI (all $p < 0.05$). Among people with chronic conditions, those with VI were 2.20 to 4.04 times more likely to have poor health, compared with those without VI (all $p < 0.001$), with the exception of cancer ($p=0.595$).

HOW THIS RESEARCH MIGHT AFFECT RESEARCH, PRACTICES AND POLICY

⇒ These nationally representative data provide strong evidence that VI is associated with increased risk of a range of common chronic diseases in low or middle-income country such as China. This provides further impetus for aggressive policies to address prevalent causes of VI, many of which are treatable at low cost, and also suggests that investment in such policies might be a way to reduce the burden of chronic disease in this setting.

multimorbidity, the cooccurrence of two or more chronic conditions in a single person.² Chronic conditions, and, in particular, multimorbidity, are associated with a broad range of functional consequences, poor quality of life and well-being and are also a major contributor to health inequalities and constitute an important economic burden.²⁻⁵

Vision impairment (VI) is among the most disabling of chronic conditions and increasingly research attention has focused on the coexistence of VI and other chronic conditions.^{6 7} However, the majority of existing

studies have focused on the association between VI and single chronic disease. A number of studies have reported that persons with VI experience a variety of chronic conditions at higher rates than those with normal vision, including diabetes,⁸ stroke,^{9 10} depression^{11–13} and cognitive decline.^{14 15} Studies describing these associations in low or middle-income countries (LMICs) are relatively rare, highlighting the need for more such data.⁶

As the most populous and rapidly ageing LMIC,¹⁶ China had 59.3 million people with moderate to severe VI or blindness in 2019, nearly equivalent to the entire population of the United Kingdom.¹⁷ Like many other countries, China has witness a considerable disease burden shifting from communicable, maternal, neonatal and nutritional conditions to non-communicable diseases (NCDs).^{18 19} The national data show that among population aged 15 years or older, the prevalence of NCDs has risen from 15.7% in 2008 to 34.3% in 2018.²⁰ The economic losses associated with these diseases over the period 2010–2030 are (measured in real US dollar with the base year 2010) estimated to be US\$7.7 trillion for China.²¹ In addition, 70% of middle-aged or elderly Chinese with chronic conditions have multimorbidity, resulting in an estimated number of 240 million population.⁴

The current study aims to address the relative lack of data on VI and chronic disease risk in LMICs by analysing a nationally representative cross-sectional sample of older Chinese adults, with data on 13 common chronic conditions. We aim to provide updated and robust national prevalence estimates for these 13 chronic conditions among older adults with and without VI. Furthermore, we will examine how health status differs between people with and without VI among those with chronic conditions. We hypothesise that VI is associated with higher prevalence of chronic conditions, and also with higher prevalence of poor health among those with such conditions.

METHODS

This study explores the cross-sectional association between VI and other chronic conditions and health status. We use data from the nationally representative China Health and Retirement Longitudinal Study (CHARLS). The detailed description of sampling strategy and cohort profile has been reported elsewhere.²² Briefly, CHARLS collects a nationally representative sample of Chinese residents aged 45 years and older, selected from 150 county-level administrative units in 28 provinces of China, using multistage stratified probability-proportionate-to-size sampling. CHARLS examines social, economic and health information among community-dwelling persons aged 45 years or older in China. Trained at Peking University, CHARLS staff members conducted one-to-one interviews in respondents' homes with the use of face-to-face computer-assisted personal interview technology.^{22 23}

Our study reports data from the latest wave of CHARLS, conducted in 2018. Among 19816 participants, 19752 (99.7%) self-reported their vision function and 19717

(99.5%) reported on chronic diseases/conditions and health status. Our final analytic database includes 19374 participants (97.8%) with complete vision and health data. Even though this non-response rate (2.20%) is low, we used survey weights from CHARLS to address potential non-response bias.²³

Vision impairment (self-reported distance vision)

Self-reported poor distance vision was used to measure VI. It was ascertained using the question: 'How good is your eyesight for seeing things at a distance, like recognising a friend from across the street (with glasses or corrective lenses if you wear them)? Would you say your eyesight for seeing things at a distance is excellent, very good, good, fair, or poor?' Responses of 'don't know' were excluded, and respondents answering 'poor' were classified as having vision impairment, while those responding 'excellent' to 'fair' were considered to have no vision impairment.

Chronic conditions

Following previous studies,^{4 5} we sought to include chronic conditions that are prevalent among elderly Chinese, which resulted in a list of 13 common chronic conditions. Among these conditions, 11 (hypertension, heart disease, dyslipidaemia, stroke, arthritis, asthma, chronic lung disease, cancer, kidney disease, diabetes and liver disease) were assessed based on self-reported diagnosis by a doctor. Participants were asked 'have you been diagnosed by with (conditions listed below, read by interviewers on by one) by a doctor?'. Similar to the assessment of VI, hearing impairment was defined as having responded 'poor' to the question 'Is your hearing excellent, very good, good, fair or poor (with a hearing aid if you normally use it and without if you normally don't)?'.

In addition, depression was assessed with the 10-item Center for Epidemiologic Studies Depression Scale (CES-D 10), which detects depression risk in general populations, including older adults.^{24 25} Participants were asked 'how often' 10 depressive symptoms they have experienced during the past week on a 4-point scale, ranging from 0 (less than 1 day) to 3 (5–7 days). The CES-D 10 scores were summed to derive scores ranging 0–30. Participants with CES-D 10 scores larger or equal to 10 were classified as having clinically significant depressive symptoms.²⁶ The CESD-10 was highly validated for use in general populations in China and other settings.^{27 28}

Health status

Self-rated health status was evaluated by asking this question: 'Would you say your health is very good, good, fair, poor, or very poor?' and treated as a dichotomous variable.^{29 30} Poor health status was defined as having responded 'poor' or 'very poor,' while good health status was defined by any of the following answers: 'very good', 'good' or 'fair'.

Other covariates

Demographic, socioeconomic and health-related behavioural covariates included self-reported age group (45–54 years, 55–64 years, 65–74 years, 75 years and above), gender (male or female), education (illiterate, some primary school, completed primary school, completed junior high school and above) and ever smoking (yes or no). Body mass index (BMI) was categorised as normal (BMI <24 kg/m²), overweight (BMI from 24 kg/m² to 28 kg/m²), and obese (BMI > 28 kg/m²).

A participant's urban versus rural residence was determined based on the administrative classification of the participant's basic residing community (*hukou*, the Chinese household registration system).³¹ Every Chinese citizen is required to register in one and only one place of residence, which determines access to numerous social resources, such as education, healthcare and work.³²

Statistical analysis

Frequencies (percentages) are reported to summarise the distributions of characteristics for participants with and without VI. Weighted prevalence of various chronic

diseases was calculated separately for those with and without VI using the survey weight. Then, the weighted prevalence of self-rated poor health among people reporting any of each chronic disease was calculated for persons with and without VI. Multivariate logistic regressions were applied to analyse the association between VI and chronic conditions and the association between VI and poor health among participants with chronic diseases. All models are based on the 19374 participants with complete data for both VI and chronic disease status. All analyses were conducted using Stata V.16.0 (StataCorp LP, College Station, Texas).

RESULTS

The mean age of 19374 respondents was 62.0 years, 52.4% were women, 34.4% had junior school or higher education level (table 1). Among these, 4006 (20.6%) reported VI. Compared with those without VI (p<0.001 for all), these respondents had a higher mean age (65.2 vs 61.0), were more likely to be women (61.3% vs 50.1%), illiterate (35.4% vs 19.3%), rural-dwelling

Table 1 Characteristics of study participants drawn from the China Health and Retirement Longitudinal Study (CHARLS) 2018 survey

	Total		Vision impairment				P value
	Total (N=19374)		Yes (N=4006)		No (N=15368)		
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	
Age, years							< 0.001
45–54	5409 (28.2%)	27.6 to 28.9	694 (17.7%)	16.6 to 19.0	4698 (31.0%)	30.3 to 31.8	
55–64	6327 (33.0%)	32.3 to 33.7	1107 (28.3%)	26.9 to 29.7	5194 (34.3%)	33.5 to 35.0	
65–74	5040 (26.3%)	25.7 to 26.9	1309 (33.4%)	32.0 to 34.9	3713 (24.5%)	23.8 to 25.2	
≥75	2395 (12.5%)	12.0 to 13.0	806 (20.6%)	19.3 to 21.9	1544 (10.2%)	9.7 to 10.7	
Gender							< 0.001
Male	9267 (47.6%)	46.9 to 48.3	1552 (38.7%)	37.2 to 40.3	7664 (49.9%)	49.1 to 50.7	
Female	10221 (52.4%)	51.7 to 53.1	2454 (61.3%)	59.7 to 62.8	7704 (50.1%)	49.3 to 50.9	
Education							< 0.001
Illiterate	4439 (22.8%)	22.2 to 23.4	1417 (35.4%)	33.9 to 36.9	2968 (19.3%)	18.7 to 19.9	
Some primary school	4011 (20.6%)	20.0 to 21.2	891 (22.2%)	21.0 to 23.6	3094 (20.1%)	19.5 to 20.8	
Primary school	4326 (22.2%)	21.6 to 22.8	834 (20.8%)	19.6 to 22.1	3481 (22.7%)	22.0 to 23.3	
Junior high school and above	6712 (34.4%)	33.8 to 35.1	864 (21.6%)	20.3 to 22.9	5825 (37.9%)	37.1 to 38.7	
Residence							< 0.001
Urban	3693 (21.4%)	20.8 to 22.0	567 (15.8%)	14.6 to 17.0	3110 (22.9%)	22.2 to 23.7	
Rural	13543 (78.6%)	78.0 to 79.2	3022 (84.2%)	83.0 to 85.4	10446 (77.1%)	76.3 to 77.8	
Ever smoking							< 0.001
No	10199 (57.2%)	56.5 to 57.9	2336 (61.8%)	60.3 to 63.4	7808 (56.0%)	55.1 to 56.8	
Yes	7629 (42.8%)	42.1 to 43.5	1442 (38.2%)	36.6 to 39.7	6146 (44.0%)	43.2 to 44.9	
BMI							< 0.001
Normal	7647 (53.4%)	52.6 to 54.2	1775 (56.5%)	54.8 to 58.2	5831 (52.5%)	51.5 to 53.4	
Overweight	4773 (33.3%)	32.6 to 34.1	982 (31.3%)	29.7 to 32.9	3774 (34.0%)	33.1 to 34.8	
Obese	1905 (13.3%)	12.8 to 13.9	384 (12.2%)	11.1 to 13.4	1511 (13.6%)	13.0 to 14.2	

BMI, body mass index.

Table 2 Prevalence of different chronic conditions among participants with and without self-reported vision impairment

Condition	Total (n=19374)		Vision impairment				P value
	Prevalence (%)	95% CI	Yes (n=4006)		No (n=15368)		
			Prevalence (%)	95% CI	Prevalence (%)	95% CI	
Hypertension	13.9	12.9 to 14.9	18.3	16.5 to 20.2	12.9	11.8 to 14.1	<0.001
Heart attack	7.3	6.7 to 8.0	11.4	9.7 to 13.0	6.4	5.7 to 7.0	<0.001
Dyslipidaemia	11.1	10.2 to 12.1	13.4	11.7 to 15.1	10.6	9.6 to 11.6	<0.001
Stroke	5.1	4.6 to 5.6	8.1	7.0 to 9.3	4.4	3.9 to 4.9	<0.001
Arthritis	10.0	9.2 to 10.7	14.4	12.4 to 16.3	9.2	8.3 to 10.0	<0.001
Asthma	2.1	1.8 to 2.4	4.0	3.1 to 4.8	1.6	1.4 to 1.9	<0.001
Chronic lung disease	5.1	4.7 to 5.6	8.3	7.2 to 9.5	4.4	3.9 to 4.9	<0.001
Cancer	1.3	1.1 to 1.5	1.9	1.3 to 2.5	1.1	0.9 to 1.4	0.0224
Kidney disease	4.2	3.5 to 4.9	5.9	4.7 to 7.0	3.8	3.0 to 4.5	<0.001
Diabetes	5.4	4.9 to 5.9	6.3	5.3 to 7.2	5.2	4.6 to 5.8	0.0065
Liver disease	3.4	2.8 to 4.0	4.4	3.6 to 5.3	3.1	2.4 to 3.8	<0.001
Hearing impairment	14.1	13.2 to 15.0	33.3	31.3 to 35.2	9.1	8.5 to 9.8	<0.001
Depression	41.4	39.7 to 43.0	60.5	58.1 to 63.0	37.0	35.2 to 38.8	<0.001

(84.2% vs 77.1%), have never smoked (61.8% vs 56.0%) and have a normal BMI (56.5% vs 52.5%).

The weighted prevalence of all 13 chronic conditions was significantly higher among people with VI compared with those without ($p<0.001$ for all, [table 2](#)). Depression (60.5% (95% CI 58.1, 63.0)) was the most prevalent chronic condition among participants with VI, compared with 37.0% (95% CI 35.2 to 38.8) of people without VI. The prevalence of hearing impairment also differed strikingly between those with and without VI (33.3% (95% CI 31.3 to 35.2) vs 9.10% (95% CI 8.50 to 9.80)).

Participants with VI reported a significantly higher weighted prevalence of poor health than did those without ($p<0.001$ for all except cancer, $p=0.542$); [table 3](#)).

For participants with VI, the prevalence of self-reported poor health status exceeded 50% among those self-reporting all of the 13 chronic diseases. People with VI and diagnosed asthma reported the highest prevalence of poor health of 72.7% (95% CI 63.6 to 81.9).

After controlling for potential confounding factors, VI was significantly associated with greater odds of self-reporting all 13 chronic diseases (all $p<0.05$) among participants in the current study ([table 4](#)). The highest adjusted ORs were for hearing impairment (OR=4.00 (95% CI 3.60, 4.44)) and depression (OR=2.28 (95% CI 2.06 to 2.51)), while diabetes (OR=1.33 (95% CI 1.11 to 2.05)) and hypertension (OR=1.20 (95% CI 1.04 to 1.38)) had the lowest.

Table 3 Prevalence of self-rated poor health among participants with and without self-reported vision impairment reporting different chronic diseases

Condition	Total		Vision impairment		No vision impairment		P value
	Prevalence of self-reported poor health (%)	95% CI	Prevalence of self-reported poor health (%)	95% CI	Prevalence of self-reported poor health (%)	95% CI	
Hypertension	34.8	30.3 to 39.3	58.2	53.1 to 63.3	27.6	21.8 to 33.5	<0.001
Heart attack	43.0	39.4 to 46.6	63.6	56.8 to 70.5	34.6	30.5 to 38.8	<0.001
Dyslipidaemia	37.9	33.0 to 42.7	63.6	58.0 to 69.3	29.9	23.8 to 36.0	<0.001
Stroke	51.8	47.5 to 56.2	68.5	62.1 to 74.9	44.6	39.5 to 49.6	<0.001
Arthritis	32.6	29.0 to 36.2	54.9	48.3 to 61.5	26.1	22.6 to 29.6	<0.001
Asthma	57.5	51.5 to 63.4	72.7	63.6 to 81.9	48.5	40.9 to 56.1	<0.001
Chronic lung disease	44.7	40.5 to 48.8	64.0	58.0 to 70.0	36.2	31.4 to 40.9	<0.001
Cancer	55.8	47.1 to 64.6	60.2	43.9 to 76.4	54.2	43.4 to 64.9	0.5422
Kidney disease	53.2	45.4 to 61.0	70.6	62.8 to 78.4	46.5	35.3 to 57.7	<0.001
Diabetes	34.4	30.2 to 38.6	57.0	48.8 to 65.3	27.6	23.0 to 32.2	<0.001
Liver disease	40.6	32.2 to 49.1	66.6	57.3 to 75.8	30.9	22.3 to 39.5	<0.001
Hearing impairment	48.9	46.0 to 51.8	61.2	57.8 to 64.7	37.0	33.3 to 40.7	<0.001
Depression	38.6	36.5 to 40.8	58.3	55.3 to 61.4	31.3	28.9 to 33.6	<0.001

Table 4 Odds of different chronic diseases among participants with versus without self-reported vision impairment

Condition	OR	95% CI	P value
Hypertension	1.197	1.037 to 1.381	0.014
Heart attack	1.659	1.417 to 1.941	<0.001
Dyslipidaemia	1.415	1.228 to 1.630	<0.001
Stroke	1.544	1.294 to 1.844	<0.001
Arthritis	1.635	1.385 to 1.930	<0.001
Asthma	1.716	1.318 to 2.234	<0.001
Chronic lung disease	1.610	1.343 to 1.929	<0.001
Cancer	1.440	1.014 to 2.044	0.041
Kidney disease	1.552	1.266 to 1.903	0.002
Diabetes	1.333	1.111 to 1.599	<0.001
Liver disease	1.641	1.314 to 2.049	<0.001
Hearing impairment	3.998	3.600 to 4.439	<0.001
Depression	2.277	2.064 to 2.512	<0.001

After controlling for potential confounding factors, VI was associated with greater odds of self-reported poor health among persons self-reporting 12 of the 13 chronic conditions ($p < 0.001$ for all, [table 5](#)), the exception being cancer ($p = 0.595$). The highest adjusted odds were for hypertension (OR=4.04 (95% CI 3.04 to 5.36)) and dyslipidaemia (OR=4.02 (95% CI 3.03 to 5.33)).

DISCUSSION

VI is an important public health problem in China.^{33–38} Due to population growth and ageing, the prevalence of eye disease has steadily increased over the past decades.³⁹ Data from the Global Burden of Diseases, Injuries and Risk Factors Study (GBD) 2019 show that the age-standardised prevalence of moderate and severe VI in China increased more rapidly than in any other

Table 5 Odds of self-rated poor health among participants reporting different chronic diseases with versus without self-reported vision impairment

Condition	OR	95% CI	P value
Hypertension	4.037	3.040 to 5.360	<0.001
Heart attack	2.366	1.714 to 3.264	<0.001
Dyslipidaemia	4.022	3.033 to 5.332	<0.001
Stroke	2.200	1.509 to 3.208	<0.001
Arthritis	2.849	2.037 to 3.986	<0.001
Asthma	3.334	1.835 to 6.057	<0.001
Chronic lung disease	3.364	2.292 to 4.937	<0.001
Cancer	1.241	0.560 to 2.749	0.595
Kidney disease	3.392	2.170 to 5.301	<0.001
Diabetes	3.796	2.602 to 5.538	<0.001
Liver disease	2.320	1.460 to 3.688	<0.001
Hearing impairment	2.621	2.148 to 3.198	<0.001
Depression	2.900	2.546 to 3.303	<0.001

G20 countries from 1990 to 2019.¹⁷ Our analysis using nationally-representative data revealed that people with VI had significantly elevated prevalence of self-reported chronic conditions. We also found that VI was significantly associated with higher weighted prevalence of poor health among those reporting chronic conditions.

We conducted a systematic literature search for published papers addressing VI and chronic conditions among Chinese populations in PubMed and Web of Science for English publications and China National Knowledge Infrastructure for Chinese publications on 20 January 2023. We used the search terms “vision disorders”, “visual impairment”, “vision impairment”, “vision disorder”, “vision loss”, “loss of vision”, “eye disease” and “eye disorder” to identify vision impairment. To identify chronic conditions, we use the search terms “chronic conditions”, “chronic diseases”, “multimorbidity”, “comorbidity”, “cardiovascular disease or CVD”, “cardiovascular metabolic disease, CMD” as well as each of 13 common chronic conditions included in our analysis. We limited our search to studies published in English in 2010 or later, using data on adults collected in China.

We found no studies examining the prevalence and effects of VI across a broad range of chronic conditions among older Chinese adults. We did encounter publications confirming the association between VI and a number of individual chronic condition in a dyadic analytic fashion. Such analyses have been limited to a few conditions, most notably cardiometabolic disease and its risk factors: diabetes,⁴⁰ stroke,^{41 42} hypertension⁴³ and dyslipidaemia.³⁵ VI is also found to coexist frequently alongside hearing loss in elderly populations, and this dual sensory impairment is reported to be associated with negative impacts on function, cognitive abilities, mental health and well-being.^{12–14} Although rigorous casual evidence is limited, a number of potential pathways have been hypothesised to explain the observed association between VI and specific conditions. For example, in the area of cognitive decline and dementia, some common causes (eg, neurodegenerative or microvascular disease) of both VI and poor cognition might explain the correlation.^{44 45} Several indirect pathways have also been proposed. Poor vision is known to increase cognitive load,⁴⁶ which causes sensory stress and takes a negative impact on cognitive function that increases dementia risk. VIs may also be associated with risk factors for cognitive impairment, such as depression, social isolation, and lack of physical activity.^{47 48} Sensory deprivation hypothesis suggests that a prolonged lack of adequate sensory input may directly result in cognitive deterioration and result in direct alteration of brain structure and function.⁴⁹

In addition, there is another body of literature specifically studying multimorbidity, the coexistence of two or more chronic conditions; however, vision has rarely been included in such analyses. A few studies have examined visual impairment in conjunction with other chronic diseases,^{4 5} but these analyses have focused on the



cumulative number of conditions, including VI, rather than assessing VI as a risk factor for other chronic conditions.

Our analysis using CHARLS 2018 data is, according to the above review, the most up-to-date, nationally representative estimate of the prevalence and impact of VI across a broad range of chronic conditions among older Chinese adults. Our analysis extended on previous work by including a broad inventory of 13 chronic conditions highly prevalent among older Chinese adults. Our analysis closely mirrors that of a cross-sectional US population study from the National Health Interview Survey (2010–2014).⁵⁰ Both studies used a similar self-reported definition of VI and included a similar list of 13 chronic conditions, controlling for similar confounders. In both studies, participants with VI were more likely to report chronic conditions than those without. Among those with chronic conditions, participants reporting VI were more likely also to report poor health status than were those without VI, although the magnitude of that associated was larger in the Chinese setting (adjusted ORs for the 13 conditions: 2.20 to 4.04 in China vs 1.66 to 2.70 in the USA)

The demographic characteristics, social-economic development, risk profiles of chronic diseases and the healthcare systems in the USA and China differ in many ways. Nevertheless, the patterns of the prevalence and impact of VI across a broad range of chronic conditions among older adults in China parallel those found in their counterparts in the USA. This reflects the global epidemiological transition in low and middle-income countries, as previously seen in high-income countries. China, like many other countries in the world, is undergoing rapid epidemiological transition and population ageing with a rising burden of NCDs. Consequently, the prevalence of multimorbidity is increasing.^{4,5} The coexisting of VI and other chronic conditions warrants further investigation and contextually relevant evidence to inform policies.

In addition, the larger magnitude of the association between VI and poor health among people with chronic conditions in our study highlights the challenge China and many other LMICs are facing regarding management of NCDs. Hypertension is a case in point. Among the US adults with hypertension, 81.6% are aware, 73.1% are on treatment, and 48.6% have well-controlled blood pressure.⁵¹ By contrast, the corresponding rates are only 44.7%, 30.1%, and 7.2% in China.⁵² Many factors contribute to these differences, a crucial one being the suboptimal quality of primary healthcare (PHC) in China.⁵³ Shortfalls in financing, service integration, education and training still exist in China that undermine its PHC system's ability to deliver services for the prevention and management of chronic conditions in equitable fashion.⁵³

Our results have profound public health implications for eye health services in China and other LMICs: the fact that VI is linked with the prevalence of a broad list of chronic conditions underscores the importance of

prevention and treatment of VI as public health priorities. Due to traditional beliefs,¹⁴ older Chinese adults often view age-related eye disease as an inevitable part of ageing and may be reluctant to receive formal diagnosis or treatment. A recent cross-sectional study in rural areas across nine Chinese provinces shows that mild and moderate-to-severe visual impairment are mostly caused by uncorrected refractive error and cataract, both highly treatable.³⁴ Our results suggest that public awareness should be raised and VI among the elderly treated more actively. The additional burden of poor health among people with chronic conditions suffering from VI highlights the need for more frequent vision assessment,³⁴ particularly among those with hypertension and dyslipidaemia. As the global burden of NCDs increases, PHC is emerging as the focus of both prevention and life-long management of chronic disease.⁵⁵ In the era of increasing disease and economic burden of NCDs and multimorbidity,^{4,18,19,56} health system must shift from a single disease focus to a person-centred approach.⁵⁷ The GBD 2019 China Study¹⁷ shows that age-standardised prevalence of all common blinding eye diseases dropped over the past three decades in China, except for diabetic retinopathy. Their analysis found that the increase was attributed more to age-specific prevalence than to population ageing, largely due to the substantial changes in the lifestyle of Chinese people. Within the context of universal health coverage (UHC), it is of particular importance to integrate the prevention and control of chronic eye diseases into China's national management of chronic diseases. As China advances its UHC in the *Healthy China 2030* policy,⁵⁸ this also illustrates the need for an Integrated People-centred Eye Care strategy⁵⁹ in China.⁶⁰

The causal relationship between VI and general health is complex, recently published reviews have summarised a number of potential pathways (illustrated in online supplemental figure S1)^{6,61}: (1) direct pathways through the effect of VI on systemic health: increased risk of chronic disease, decreased functional status, frailty; (2) indirect pathways through activity and participation: reduced access to healthcare, increased injuries, limitations in physical activity, increased risk of social isolation, leading to depression and dementia; (3) shared common risk factors (individual-level traits, environmental and health system characteristics) including smoking, alcohol consumption, socioeconomic status and conditions with both ocular and systemic manifestations (eg, cardiovascular disease, diabetes, hypertension, stroke). However, most of the existing studies are conducted from, future studies based on representative data from LMICs are warranted to generate context-relevant evidence for countries in the developing world.

Strengths of the present study included the large, nationally representative sample, and the detailed information regarding demographic, socioeconomic and health-related behavioural characteristics in addition to self-reported data on vision, chronic conditions and

health status collected in CHARLS. Compared with previous studies,^{12 14 40–43} the wider array of 13 chronic conditions allows us to explore more fully the impact of VI on the health of older Chinese adults.

Despite these strengths, our study has several limitations. First, the data we used were cross-sectional; we, therefore, cannot interpret the associations found as causal. Irrespective of their direction, these associations underscore the need for more attention to VI in the current health system. Second, our measurement of VI was non-objective. As a large-scale, nationally representative survey, it was only practical for CHARLS to acquire self-reported vision measures. Similar definition of self-reported poor vision was also used based on the English Longitudinal Study of Ageing⁶² as well as the National Health Interview Survey⁵⁰ conducted among older adults in England and the USA. Although previous studies have shown a strong correlation between self-reported vision and objective measurements,⁶³ some discrepancies may exist.⁶⁴ Last but not least, we used participant-reported diagnosis by a physician for 12 of the 13 chronic illnesses studied (with the exception of depression). Despite China's recent health system reform, which extended essential healthcare and insurance coverage to the entire population, high-quality care for prevention and management of chronic conditions is still less accessible in rural settings, particularly at the PHC level.⁵³ As a result, the actual prevalence of the included chronic conditions might be higher than the current estimate, due to underdiagnosis. Hence, the actual association between VI and prevalence of chronic conditions might be even stronger than the current estimate in our analysis.

A higher prevalence of a broad range of chronic conditions is significantly associated with VI among older Chinese adults. Among those with chronic conditions, the burden of poor health is significantly greater among persons with VI compared with those without. These findings from a nationally representative cohort suggest the need for further attention among both policymakers and researchers to the coexistence of VI and chronic conditions, both to better understand the problem and to inform contextually relevant strategies to promote healthy ageing among older persons in China and other LMICs.

Author affiliations

¹School of Public Health, University of California Berkeley, Berkeley, California, USA

²School of Public Health, Peking University, Beijing, China

³China Center for Health Development Studies, Peking University, Beijing, China

⁴Centre for Public Health, Queen's University Belfast, Belfast, UK

⁵Zhongshan Ophthalmic Center, Sun Yat-Sen University, Guangzhou, Guangdong, China

Acknowledgements We thank Mr. LIU Zhifang (Health Bureau of Yongyang District, Handan) for providing insightful comments.

Contributors XM has full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Concept and design: XM. Data analysis: YG, XM. Interpretation of data: XM, NC. Drafting of the manuscript: YG, HC, XD, XM. Critical revision of the manuscript for important intellectual content: XM, NC. Supervision: XM, XL. XM is the guarantor.

Funding National Natural Science Foundation of China (Number 71703002; Number 72174009) and China Medical Board Grants (Number 17-267).

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Consent obtained directly from patient(s)

Ethics approval This study involves human participants. All participants provided written informed consent, and survey protocols were approved by the Peking University Ethics Review Board (IRB approval number: IRB00001052-11015). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data are available upon reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Xiaochen Ma <http://orcid.org/0000-0002-8251-3373>

REFERENCES

- Nugent R, Bertram MY, Jan S, *et al*. Investing in non-communicable disease prevention and management to advance the sustainable development goals. *Lancet* 2018;391:2029–35.
- Barnett K, Mercer SW, Norbury M, *et al*. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *The Lancet* 2012;380:37–43.
- The Lancet. Making more of multimorbidity: an emerging priority. *The Lancet* 2018;391:1637.
- Ma X, He Y, Xu J. Urban–rural disparity in prevalence of multimorbidity in China: a cross-sectional nationally representative study. *BMJ Open* 2020;10:e038404.
- Zhao Y, Atun R, Oldenburg B, *et al*. Physical multimorbidity, health service use, and catastrophic health expenditure by socioeconomic groups in China: an analysis of population-based panel data. *The Lancet Global Health* 2020;8:e840–9.
- Burton MJ, Ramke J, Marques AP, *et al*. The lancet global health commission on global eye health: vision beyond 2020. *Lancet Glob Health* 2021;9:e489–551.
- Zheng DD, Christ SL, Lam BL, *et al*. Patterns of chronic conditions and their association with visual impairment and health care use. *JAMA Ophthalmol* 2020;138:387–94.
- Klein R, Klein BE, Moss SE, *et al*. The Beaver dam eye study. retinopathy in adults with newly discovered and previously diagnosed diabetes mellitus. *Ophthalmology* 1992;99:58–62.
- Sand KM, Midelfart A, Thomassen L, *et al*. Visual impairment in stroke patients—a review. *Acta Neurol Scand Suppl* 2013;52–6.
- Sand KM, Wilhelmsen G, Naess H, *et al*. Vision problems in ischaemic stroke patients: effects on life quality and disability. *Eur J Neurol* 2016;23 Suppl 1:1–7.
- Jones GC, Rovner BW, Crews JE, *et al*. Effects of depressive symptoms on health behavior practices among older adults with vision loss. *Rehabil Psychol* 2009;54:164–72.
- Xie T, Liu D, Guo J, *et al*. The longitudinal effect of sensory loss on depression among chinese older adults. *J Affect Disord* 2021;283:216–22.
- Fenwick EK, Ong PG, Man REK, *et al*. Vision impairment and major eye diseases reduce vision-specific emotional well-being in a Chinese population. *Br J Ophthalmol* 2017;101:686–90.

- 14 Ma X, Wei J, Congdon N, *et al.* Longitudinal association between self-reported sensory impairments and episodic memory among older adults in China: a prospective cohort study. *J Geriatr Psychiatry Neurol* 2022;35:382–91.
- 15 Uhlmann RF, Larson EB, Koepsell TD, *et al.* Visual impairment and cognitive dysfunction in Alzheimer's disease. *J Gen Intern Med* 1991;6:126–32.
- 16 World Bank. Population ages 65 and above in china. 2022. Available: <https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?view=chart&locations=CN> [Accessed 14 Jul 2022].
- 17 Xu T, Wang B, Liu H, *et al.* Prevalence and causes of vision loss in china from 1990 to 2019: findings from the global burden of disease study 2019. *Lancet Public Health* 2020;5:e682–91.
- 18 Yang G, Wang Y, Zeng Y, *et al.* Rapid health transition in china, 1990–2010: findings from the global burden of disease study 2010. *Lancet* 2013;381:1987–2015.
- 19 Zhou M, Wang H, Zeng X, *et al.* Mortality, morbidity, and risk factors in china and its provinces, 1990–2017: a systematic analysis for the global burden of disease study 2017. *Lancet* 2019;394:1145–58.
- 20 National Health Commission. *China's health statistics yearbook 2021*. Peking Union Medical College Press, 2020.
- 21 Bloom DE, Chen S, Kuhn M, *et al.* The economic burden of chronic diseases: estimates and projections for China, Japan, and South Korea. *The Journal of the Economics of Ageing* 2020;17:100163.
- 22 Zhao Y, Hu Y, Smith JP, *et al.* Cohort profile: the China health and retirement longitudinal study (CHARLS). *Int J Epidemiol* 2014;43:61–8.
- 23 Zhao YS, Chen X, *et al.* *China health and retirement longitudinal study wave 4 user's guide: national school of development*. Peking University, 2020.
- 24 Beekman AT, Deeg DJ, Van Limbeek J, *et al.* Criterion validity of the center for epidemiologic studies depression scale (CES-D): results from a community-based sample of older subjects in the Netherlands. *Psychol Med* 1997;27:231–5.
- 25 Turvey CL, Wallace RB, Herzog R. A revised CES-D measure of depressive symptoms and a DSM-based measure of major depressive episodes in the elderly. *Int Psychogeriatr* 1999;11:139–48.
- 26 Zhou L, Ma X, Wang W. Relationship between cognitive performance and depressive symptoms in chinese older adults: the china health and retirement longitudinal study (CHARLS). *J Affect Disord* 2021;281:454–8.
- 27 Chen H, Mui AC. Factorial validity of the center for epidemiologic studies depression scale short form in older population in China. *Int Psychogeriatr* 2014;26:49–57.
- 28 Ruiz M, Hu Y, Martikainen P, *et al.* Life course socioeconomic position and incidence of mid-late life depression in China and England: a comparative analysis of CHARLS and ELSA. *J Epidemiol Community Health* 2019;73:817–24.
- 29 Yu T, Jiang Y, Gamber M, *et al.* Socioeconomic status and self-rated health in China: findings from a cross-sectional study. *Medicine (Baltimore)* 2019;98:e14904.
- 30 Haseli-Mashhadi N, Pan A, Ye X, *et al.* Self-Rated health in middle-aged and elderly Chinese: distribution, determinants and associations with cardio-metabolic risk factors. *BMC Public Health* 2009;9:368.
- 31 Yep R, Wang J, Johnson T. *Handbook on urban development in china*. Edward Elgar Publishing, 2019.
- 32 Liu Z. Institution and inequality: the hukou system in China. *Journal of Comparative Economics* 2005;33:133–57.
- 33 Zhao J, Ellwein LB, Cui H, *et al.* Prevalence of vision impairment in older adults in rural China: the China nine-province survey. *Ophthalmology* 2010;117:16.e1:409–16, .
- 34 Zhao J, Xu X, Ellwein LB, *et al.* Causes of visual impairment and blindness in the 2006 and 2014 nine-province surveys in rural china. *Am J Ophthalmol* 2019;197:80–7.
- 35 Fu Z, Chen CT, Cagnone G, *et al.* Dyslipidemia in retinal metabolic disorders. *EMBO Mol Med* 2019;11:e10473.
- 36 Luo Y, He P, Guo C, *et al.* Association between sensory impairment and dementia in older adults: evidence from China. *J Am Geriatr Soc* 2018;66:480–6.
- 37 Wang J, Xiao LD, Wang K, *et al.* Gender differences in cognitive impairment among rural elderly in China. *Int J Environ Res Public Health* 2020;17:3724.
- 38 Wang L, Zhu Z, Scheetz J, *et al.* Visual impairment and ten-year mortality: the liwan eye study. *Eye (Lond)* 2021;35:2173–9.
- 39 Wang B, Congdon N, Bourne R, *et al.* Burden of vision loss associated with eye disease in China 1990–2020: findings from the global burden of disease study 2015. *Br J Ophthalmol* 2018;102:220–4.
- 40 Song P, Yu J, Chan KY, *et al.* Prevalence, risk factors and burden of diabetic retinopathy in china: a systematic review and meta-analysis. *J Glob Health* 2018;8:010803.
- 41 Siong KH, Woo GC, Chan DY-L, *et al.* Prevalence of visual problems among stroke survivors in Hong Kong Chinese. *Clin Exp Optom* 2014;97:433–41.
- 42 Gangwani RA, Lian JX, McGhee SM, *et al.* Diabetic retinopathy screening: global and local perspective. *Hong Kong Med J* 2016;22:486–95.
- 43 Liu L, Quang ND, Banu R, *et al.* Hypertension, blood pressure control and diabetic retinopathy in a large population-based study. *PLoS One* 2020;15.
- 44 Chan VTT, Sun Z, Tang S, *et al.* Spectral-domain OCT measurements in alzheimer's disease: a systematic review and meta-analysis. *Ophthalmology* 2019;126:497–510.
- 45 Wayne RV, Johnsrude IS. A review of causal mechanisms underlying the link between age-related hearing loss and cognitive decline. *Ageing Res Rev* 2015;23(Pt B):154–66.
- 46 Pigeon C, Li T, Moreau F, *et al.* Cognitive load of walking in people who are blind: subjective and objective measures for assessment. *Gait Posture* 2019;67:43–9.
- 47 McDonnall MC. Risk factors for depression among older adults with dual sensory loss. *Ageing Ment Health* 2009;13:569–76.
- 48 Cosh S, Naël V, Carrière I, *et al.* Bidirectional associations of vision and hearing loss with anxiety: prospective findings from the Three-City study. *Age Ageing* 2018;47:582–9.
- 49 Whitson HE, Cronin-Golomb A, Cruickshanks KJ, *et al.* American geriatrics Society and National Institute on aging bench-to-bedside conference: sensory impairment and cognitive decline in older adults. *J Am Geriatr Soc* 2018;66:2052–8.
- 50 Crews JE, Chou C-F, Sekar S, *et al.* The prevalence of chronic conditions and poor health among people with and without vision impairment, aged ≥65 years, 2010–2014. *Am J Ophthalmol* 2017;182:18–30.
- 51 Aggarwal R, Chiu N, Wadhwa RK, *et al.* Racial/Ethnic disparities in hypertension prevalence, awareness, treatment, and control in the United States, 2013 to 2018. *Hypertension* 2021;78:1719–26.
- 52 Lu J, Lu Y, Wang X, *et al.* Prevalence, awareness, treatment, and control of hypertension in china: data from 1-7 million adults in a population-based screening study (china peace million persons project). *Lancet* 2017;390:2549–58.
- 53 Li X, Krumholz HM, Yip W, *et al.* Quality of primary health care in china: challenges and recommendations. *Lancet* 2020;395:1802–12.
- 54 Park SJ, Ahn S, Woo SJ, *et al.* Extent of exacerbation of chronic health conditions by visual impairment in terms of health-related quality of life. *JAMA Ophthalmol* 2015;133:1267–75.
- 55 Hanson K, Brikci N, Erlangga D, *et al.* The lancet global health commission on financing primary health care: putting people at the centre. *Lancet Glob Health* 2022;10:e715–72.
- 56 LY YANGJ, XY CHEN, *et al.* Economic burden among middle-aged and elderly patients with chronic diseases. *Chinese Health Economics* 2019;05:71–3.
- 57 Pearson-Stuttard J, Ezzati M, Gregg EW. Multimorbidity—a defining challenge for health systems. *Lancet Public Health* 2019;4:e599–600.
- 58 The State Council. Opinions of the state council on the implementation of the healthy china action. 2019. Available: http://www.gov.cn/zhengce/content/2019-07/15/content_5409492.htm [Accessed 1 Feb 2023].
- 59 WHO. World report on vision. 2019. Available: <https://www.who.int/publications/i/item/9789241516570> [Accessed 29 Jan 2023].
- 60 Wang NC. Without eye health , there is no great health—the contribution and prospect of cataract blindness prevention and treatment to national health. *China Medicine* 2020;15:1817–9.
- 61 Ehrlich JR, Ramke J, Macleod D, *et al.* Association between vision impairment and mortality: a systematic review and meta-analysis. *Lancet Glob Health* 2021;9:e418–30.
- 62 Lijas AEM, Carvalho LA, Papachristou E, *et al.* Self-Reported vision impairment and incident prefrailty and frailty in English community-dwelling older adults: findings from a 4-year follow-up study. *J Epidemiol Community Health* 2017;71:1053–8.
- 63 Kenny Gibson W, Cronin H, Kenny RA, *et al.* Validation of the self-reported hearing questions in the Irish longitudinal study on ageing against the whispered voice test. *BMC Res Notes* 2014;7:361.
- 64 Kim SY, Kim H-J, Kim M-S, *et al.* Discrepancy between self-assessed hearing status and measured audiometric evaluation. *PLoS One* 2017;12:e0182718.