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# Prevalence and Causes of Visual Impairment in a Chinese Adult Population

## *The Taizhou Eye Study*

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***Purpose:*** To study the current prevalence and causes of low vision and blindness in an adult Chinese population.

***Design:*** Population-based, cross-sectional study.

***Participants:*** We used a random cluster sampling method and evaluated 10 234 eligible subjects ≥45 years old (response rate, 78.1%) in the Taizhou Eye Study.

***Methods:*** Examinations were performed from July 2012 through December 2013. Participants underwent a detailed examination, including uncorrected visual acuity, best-corrected visual acuity (BCVA), intraocular pressure, axial length, slit-lamp, and fundus examinations to evaluate the prevalence and primary causes of visual impairment (VI).

***Main Outcome Measures:*** We defined low vision and blindness according to the World Health Organization (WHO) criteria (low vision: BCVA, <20/63−≥20/400; blindness: BCVA, <20/400 in the better eye) and United States criteria (low vision: BCVA, <20/40−≥20/200; blindness: BCVA, <20/200 in the better eye).

***Results:*** Using the WHO BCVA criteria, the standardized prevalence of bilateral low vision and blindness were 5.1% and 1.0%, respectively. Using the United States BCVA criteria, the standardized prevalence were 12.8% and 1.5%, respectively. Using the WHO criteria, the primary causes of bilateral low vision and blindness were cataract (59.1% and 48.5%, respectively), myopic macular degeneration (17.6% and 17.2%, respectively), and age-related macular degeneration (11.6% and 10.1%, respectively). The primary causes of monocular low vision were cataract (55.6%), age-related macular degeneration (12.6%), and myopic macular degeneration (8.9%), whereas those of monocular blindness were cataract (46.8%), atrophy of eyeball or prosthetic eye (10.2%), and cornea opacity (7.3%). A further analysis revealed that in adults 45-59 years old, myopic macular degeneration (59.6% and 27.2%, respectively) and cataract (13.8% and 23.4%, respectively) were the leading causes of bilateral and monocular VI. In adults ≥60 years old, cataract (66.8% and 61.2%, respectively) and age-related macular degeneration (12.6% and 11.8%, respectively) were the primary causes of bilateral and monocular VI.

***Conclusions:*** The prevalence of low vision and blindness in Chinese adults remains a severe public health problem. In the Taizhou Eye Study, cataract was the leading cause of low vision and blindness. Myopic macular degeneration and cataract were the primary causes of VI in adults 45-59 years and ≥60 years old, respectively. *Ophthalmology 2015;■:1−9 © 2015 by the American Academy of Ophthalmology.*

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Low vision and blindness prevention in the aging population remains an important public health project worldwide, particularly in developing countries.[1] According to the World Health Organization (WHO), vision loss represents 3.9% of the total global health burden because of different functional vision disabilities.[2,3] In China, the rapid growth of the aging population is a major medical and socioeconomic concern. However, China has also undergone rapid medical, public health, and economic improvement over the past 10 years.[4,5] The increasing size of the elderly population and the improved public health and economic state of China may alter the prevalence and causes of visual impairment (VI) in the Chinese population.

According to the National Bureau of Statistics, the per-capita annual net income in China, regardless of urban or rural resident status, increased by more than 70% in the past 5 years.[6] Meanwhile, the size of the aging population is increasing at the dramatic rate of 5 to 8 million per year.[7,8] Large-scale, population-based, ophthalmologic epidemiologic studies remain scarce in mainland China. Furthermore,



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most current studies of low vision and blindness were conducted before 2009, including the Beijing Eye Study, the Nine-Province Eye Survey, and the Liwan Eye Study.[9–20] With the rapid changes in the aging situation and health care system, these studies may not accurately present the current status of VI in mainland China. Epidemiologic studies of the current prevalence of low vision and blindness are needed urgently.

Taizhou, a mid-sized city, is located in the Jiangsu Province of China. Taizhou is at the junction of north and south China and downstream on the Yangzi River. The Taizhou Eye Study is a large-scale, population-based, prospective cohort study initiated in April 2012. This study primarily focuses on the prevalence, incidence, and risk factors of age-related cataract and other age-related eye diseases. The objective of this article is to report the current prevalence and causes of low vision and blindness in the Taizhou Eye Study and to compare them with previous studies performed in China and other countries.

## Methods

### Study Design and Procedure

The Taizhou Eye Study was part of the Taizhou Longitudinal Study,[21] which is an ongoing large-scale, population-based cohort study initiated by Fudan University and supported by the National Science and Technology Ministry since 2007. For the Taizhou Eye Study, we performed a baseline ophthalmologic examination between July 2012 and December 2013 in Taizhou. We used a random cluster sampling method and constructed a sampling frame based on the Public Security Bureau and Community Committee. We selected 20 villages and 6 communities with a sample of 13 106 people 45 years of age or older. The study staff distributed recruitment materials to every household in the target community 3 to 7 days before the survey. All participants self-identified as Han Chinese. This study adhered to the Declaration of Helsinki and was approved by the Human Ethics Committee of Fudan University.

### Examination Procedure

At each examination site, we conducted a general physical examination and a full ophthalmic examination and administered a questionnaire for all participants at the nearby village clinics or community offices on prescheduled examination days. For those who were physically disabled, we offered a home visit at the end of the workday.

After registering the participants, their blood pressure, heart rate, height, and weight were recorded. We also collected venous blood for serologic and genetic analysis. For presenting visual acuity (PVA; wearing present correction if any), we used a retroilluminated logarithm E chart at a distance of 4 m, as Zhao et al[11] used in the Nine Province Eye Survey. We recorded visual acuity as the smallest line read with 1 or no error and tested counting fingers, hand movements, light perception, or no light perception for those unable to read the top line at 1 m. We measured each eye separately. Participants wore glasses during the examinations if they regularly wore them for correction. When the PVA was 20/40 or worse in either eye, we measured the best-corrected visual acuity (BCVA) by subjective refraction without cycloplegia. We also measured the intraocular pressure using Icare rebound tonometry (Icare TAO1i, Helsinki, Finland), the axial length, central anterior chamber depth, and lens thickness using A-scan (AL-3000; Tomey, Tokyo, Japan) for all participants. Four experienced technicians from the Taizhou Eye Study team performed all of these ocular examinations. All technicians underwent standardized ophthalmologic training and received certification. The examination consistency was more than 95% between the different examiners.

One ophthalmologist (Y.T.) conducted the examinations of the anterior and posterior segments for all participants using a slit lamp (Topcon SL-8Z; Topcon, Inc., Tokyo, Japan) and +90-diopter lens or direct ophthalmoscopy before and after dilation of the pupil. Those who had a high risk of angle closure glaucoma underwent eye examinations only under a small-pupil situation. Moreover, we obtained fundus photographs for individuals with typical fundus diseases after pupil dilation using a Canon retinal camera system (CX1; Canon, Inc, Tokyo, Japan).

Furthermore, the study clerks administered face-to-face questionnaire interviews concerning socioeconomic status, education level, life habits, tobacco and alcohol consumption, and drug and disease history on computers. For quality control, we centralized and standardized the methods of sampling, questionnaire design, training, physical examination, laboratory examination, and data management. The examination and interviewer candidates were certified to conduct the specific survey. We used tape-recorded interviews and evaluated 5% of the tapes for quality control. We put all the data into computers on the examination days and completed phase summaries to make sure the data were accurate, consistent, and standardized.

### Definitions of Low Vision and Blindness

We used the WHO criteria to define bilateral low vision (BCVA $<$20/63$-\geq$20/400 in the better eye) and bilateral blindness (BCVA $<$20/400 in the better eye). Moreover, we also used the United States criteria for bilateral low vision (BCVA $<$20/40$-\geq$20/200 in the better eye) and bilateral blindness (BCVA $<$20/200 in the better eye). In addition to reporting the bilateral VI, we also present the data on monocular VI.

### Causes of Low Vision or Blindness

We determined the principle cause of low vision and blindness in patients using a 16-item list (amblyopia, myopic macular degeneration, strabismus, cataract, posterior capsular opacification, corneal opacity, pterygium, ocular atrophy or prosthetic eye, glaucoma, other optic atrophy, uveitis, age-related macular degeneration [AMD], diabetic retinopathy, retinal detachment, other posterior segment eye disease, and unknown causes). The examining ophthalmologist (Y.T.) made the primary diagnoses for the residents with VI. If the principal causes of VI were in question, consensus was reached by discussion with 2 senior ophthalmologists (Y. Lu and Y. Luo) based on general and ocular records. In eyes with 2 or more disorders that might have caused the VI, we regarded the causes that had the presumed greatest impact on VI as the primary diagnosis.

We used the Lens Opacities Classification System III to diagnose cataract and regarded it as the main cause of VI when the lens opacity was commensurate with VI. We diagnosed amblyopia if the BCVA was 20/32 or worse and there was no underlying structural abnormality of the eye or visual pathway that would explain the poor vision.[22] We defined myopic macular degeneration in subjects with a refractive error exceeding −6.0 dipoters, axial length of 26 mm or more, and typical degenerative myopic fundus changes.[14] We defined AMD according to the Wisconsin Age-related Maculopathy Grading System[23,24] and glaucoma according to the International Society for Epidemiological Ophthalmology classification.[25] Additionally, the diagnoses of diabetic retinopathy, corneal opacity, retinal detachment, pterygium, uveitis, and others diseases followed the clinical standard.