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Prevalence and causes of vision impairment in elderly Chinese people living in suburban Shanghai

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ABSTRACT

Purpose: To investigate the current prevalence and causes of moderate and severe visual impairment (MSVI) and blindness in elderly people in suburban Shanghai, China.
Methods: A cross-sectional study based on the population was conducted, which involved 5846 individuals (11,692 eyes) aged 65 years or older. Thorough eye examinations were performed to assess the prevalence and leading factors of MSVI (BCVA < 20/63 to ≥20/400) and blindness (BCVA < 20/400).
Results: The standardized prevalence of bilateral MSVI and blindness was 3.3% and 0.6%, correspondingly. The standardized prevalence of monocular MSVI and blindness was 7.4% and 2.0%, correspondingly. Cataract (47.9% and 20.7%, correspondingly) and myopic macular degeneration (MMD, 25.7% and 31.1%, correspondingly) were the principal causes of bilateral MSVI and blindness. As for monocular MSVI, the primary causes were cataract (39.4%), age-related macular degeneration (AMD, 16.6%), and MMD (16.6%). The primary causes of monocular blindness were other posterior segment eye diseases (30.1%) and MMD (14.2%). In adults aged 65–74 years, MMD was the foremost factor causing bilateral vision impairment. Conversely, cataract was identified as the primary cause of bilateral and monocular vision impairment among adults aged ≥ 75 years. AMD accounts for a significant proportion of individuals across all age groups.
Conclusions: The significant prevalence of MSVI and blindness among Chinese adults represents a critical public health issue. In addition to cataract, the vision impairment caused by MMD and AMD become an important issue in the elderly Chinese people.

Introduction

Vision impairment remains a crucial public health issue owing in part to the aging global population, particularly in developing countries.[1] As reported by the World Health Organization (WHO), at least 2.2 billion individuals worldwide suffer from vision impairment, and a minimum of 1 billion of those cases could have been prevented.[2] With improving sociodemographic status and life expectancy, the prevalence of vision impairment is changing drastically and the demands for eye-care services are expected to rise in the forthcoming years.

China is now in a stage of rapid socioeconomic development, with increased aging of the population and accelerated urbanization.[3] The expansion of the elderly demographic and the enhancement of public health and economic conditions are concerning as these factors could influence the prevalence and causes of vision impairment in the Chinese population. As per the National Bureau of Statistics, the proportion of individuals aged ≥ 65 years has increased from 7.0% in 2000 to 11.9% in 2018.[4] Furthermore, the gross national income in China has risen by over 44% in the last 5 years, regardless of whether residents live in urban or rural areas.[5] Consequently, as the population continues to grow and age, huge challenges will have to be overcome to prevent vision impairment.

The imperfect and unbalanced medical and health system has led to uneven medical and health levels in various regions. There is a paucity of large-scale, population-based epidemiological studies on ophthalmology in mainland China. Moreover, previous investigations into eye

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health have been restricted to rural regions.[6–10] The populations included in those studies were relatively young, the medical facilities were relatively limited or not up to date, and many preventable vision impairments were not diagnosed and treated in time.

Thus, the Pujiang Cohort Eye Study was initiated in 2020 to investigate the changes in the distribution and prevalence of vision impairment, providing a valuable reference for evaluating the current prevalence and causes of this condition. Our study population comprises elderly individuals residing in Pujiang Town, Minhang District, Shanghai, China. Due to the stable population, high individual cooperation, and the availability of an extensive family doctor system, Pujiang Town offers an ideal setting for conducting epidemiological, population-based cohort studies that focus on chronic diseases. In this article, we report on the existing prevalence of vision impairment and assess the causes of vision impairment among individuals aged 65 years and above who participated in the Pujiang Cohort Eye Study.

Methods

Study design and participants

This population-based, cross-sectional study was carried out between July 2020 and December 2020 in Pujiang Town, a suburban region of Shanghai, China, that comprises 9 villages and 22 communities. A total of 5853 eligible Han participants aged ≥ 65 years were enrolled and underwent physical and ophthalmic examinations. The study was conducted in accordance with the principles of the Declaration of Helsinki and was authorized by the Human Research Ethics Committee of the Eye and ENT Hospital of Fudan University. Prior to participating in the study, the subjects were provided with an explanation of the nature and potential consequences of the study, and written informed consent was obtained.

Examination procedures

Our team conducted comprehensive ophthalmic examinations on all participants. The technicians received standardized ophthalmologic training and were certified in their field. We initially employed a retroilluminated standard logarithm E visual chart placed at a distance of 5 m to evaluate the presenting visual acuity (PVA), with or without correction lenses. Best-corrected visual acuity (BCVA) was also measured, and visual acuity was recorded as the smallest line read with no more than one error. For participants unable to read the top line at 1 m, counting fingers, hand movements, light perception, or no light perception were tested. If the PVA was < 20/40 in either eye, BCVA was measured through subjective refraction via automatic refractometry (Auto Refractometer AR-610, Nidek Co., Ltd., Tokyo, Japan). Intraocular pressure was measured using a non-contact tonometer (FT-1000, Tomey Corporation, Nagoya, Japan). The anterior and posterior segments were examined using a 90-diopter lens and slit-lamp microscopy. For participants with known or suspected fundus diseases, we obtained fundus photographs using a digital fundus camera system (CX1, Canon, Inc., Tokyo, Japan) after dilating the pupil. Participants at high risk of angle closure glaucoma underwent eye examinations under a small-pupil situation.

Definitions of vision impairment

Data are presented for the PVA and BCVA of the better eye. The degree of vision impairment was classified according to the Global Burden of Disease 2019 Blindness and Vision Impairment Collaborators into three levels: mild visual impairment (VI; BCVA ≥20/63 to < 20/40), moderate VI (BCVA ≥20/200 to < 20/63), or severe VI (BCVA ≥20/400 to < 20/200)[11]. Our study defines MSVI as a term that combines individuals who meet the criteria for moderate or severe VI. We used the WHO categories of vision impairment as well as the United States of America (USA) criteria. According to the WHO definitions, bilateral MSVI is characterized by a BCVA of < 20/63 to ≥ 20/400, and bilateral blindness is defined as a BCVA of < 20/400 in the better eye. According to the USA criteria, bilateral low vision is defined as BCVA of < 20/40 to ≥ 20/200 in the better eye, while bilateral blindness is defined as BCVA of < 20/200 in the better eye. We also determined the prevalence and causes of monocular vision impairment. We used the WHO criteria to define monocular MSVI (BCVA < 20/63 to ≥20/400 in either eye) and monocular blindness (BCVA < 20/400 in either eye). Moreover, we also used the USA criteria for monocular low vision (BCVA < 20/40 to ≥20/200 in either eye) and monocular blindness (BCVA < 20/200 in either eye).

Causes of vision impairment

The principal causes of vision impairment in patients were determined using a 13-item list (cataract, myopic macular degeneration [MMD], age-related macular degeneration [AMD], glaucoma/other optic atrophy, diabetic retinopathy, other posterior segment eye diseases, amblyopia, posterior capsular opacification, atrophy of the eyeball or prosthetic eye, uveitis, cornea opacity, aphakia, and unknown eye diseases). The ophthalmologist (J. Chen) who performed the slit lamp microscopy made the primary diagnosis for residents with vision impairment. If fundus disease was suspected, a consensus was reached by discussing with 2 senior ophthalmologists (Y. Lu and Y. Tang) based on the general and ocular records. In eyes with significant cataract that might have caused vision impairment, fundus photography was not performed and cataract was regarded as the primary diagnosis if it was presumed to have the greatest impact on vision impairment. In cases where the vision impairment was caused by two or more disorders, we identified the cause that was presumed to have the greatest impact on the vision impairment and considered it as the primary diagnosis.

The diagnosis of cataract was based on the Lens Opacities Classification System III and considered the main cause of visual impairment if accompanied by lens opacity. MMD was diagnosed for eyes with a refractive error greater than − 6.0 diopters or an axial length of 26 mm or greater, based on the typical degenerative myopic fundus changes. For participants with BCVA worse than 20/32 and no structural abnormalities of the eye or visual pathway that could account for the poor vision, amblyopia was diagnosed. We defined AMD according to the Wisconsin Age-related Maculopathy Grading System including early-stage AMD, exudative AMD, and geographic atrophy,[12] while glaucoma was defined based on both structural and functional evidence of glaucomatous optic neuropathy, including primary open angle glaucoma, primary angle closure glaucoma, glaucoma with secondary ocular pathology, and glaucoma suspects.[13] Diabetic retinopathy, posterior capsular opacification, atrophy of the eyeball or prosthetic eye, uveitis, and other diseases were diagnosed according to clinical standards.

Statistical analysis

Statistical analyses were performed using SPSS software version 23.0 (IBM Corp., Armonk, NY, USA). We used frequency distributions to determine the age- and sex-specific prevalence of vision impairment in each group, with reference to the China National Census, 2020,[4] and means with 95% confidence intervals (CIs) are reported. The χ^2 test and the Kruskal–Wallis test were used to compare categorical variables as appropriate. *P*-values of < 0.05 were considered statistically significant.

Results

Fig. 1 illustrates the disposition of participants who were enrolled in this study. Among the 9547 individuals aged ≥ 65 years, 5853 (response rate, 61.3%) underwent the ophthalmologic examinations.

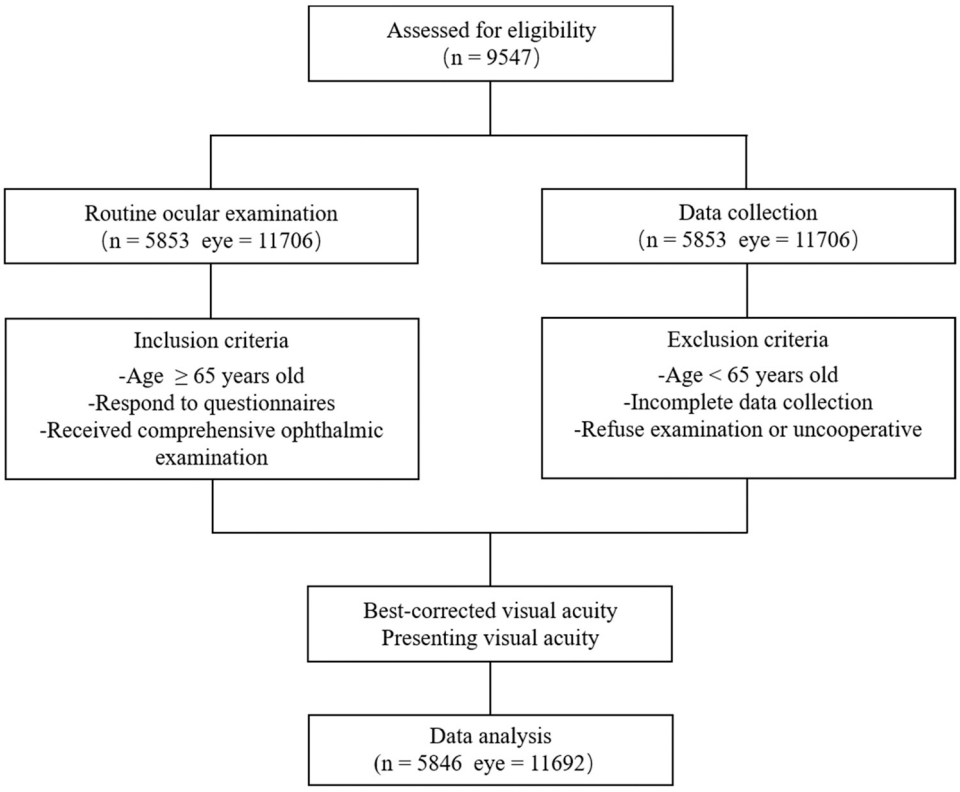

Fig. 1. Participant flowchart.

However, seven participants did not meet the study criteria and were therefore excluded. As a result, data from 5846 participants (11,692 eyes) were analyzed. The participants had a mean age of 71.6 ± 5.6 years (ranged 65–98 years), and there was a higher percentage of females (53.9%) than males (46.1%) in the study.

According to the WHO criteria, the age- and gender-standardized prevalence of bilateral MSVI and blindness among adults aged ≥ 65 years was 3.3% (95% CI, 3.2–3.4) and 0.6% (95% CI, 0.5–0.7), respectively, based on the BCVA of the better eye. When based on the PVA of the better eye, the standardized prevalence of MSVI and blindness was 11.8% (95% CI, 11.6–11.9) and 1.3% (95% CI, 1.2–1.4), respectively (Table 1). The age- and gender-adjusted prevalence of monocular MSVI and blindness among adults aged ≥ 65 years was 7.4% (95% CI, 7.2–7.5) and 2.0% (95% CI, 1.9–2.1), respectively, for BCVA. The corresponding prevalence for PVA was 11.6% (95% CI, 11.4–11.8) and 2.0% (95% CI, 1.9–2.1), respectively, among the same group of adults (Table 2). Using the USA criteria, the age- and gender-adjusted prevalence of low vision and blindness among adults aged ≥ 65 years was shown in supplementary table.

According to the WHO criteria, the prevalence of bilateral MSVI was greater in female than male (3.5% vs. 2.1% [odds ratio {OR}, 0.60; $P = 0.002$]), whereas the prevalence of bilateral blindness was not significantly different between women and men (0.6% vs. 0.3% [OR, 0.53]; $P = 0.103$, Fig. 2A). The prevalence of monocular MSVI was greater in women than in men (7.6% vs. 5.8, $P = 0.008$), whereas the prevalence of monocular blindness did not differ significantly between women and men (1.7% vs. 2.2%, $P = 0.260$, Fig. 2B). Our study revealed that the prevalence of bilateral MSVI, bilateral blindness, and monocular MSVI increased significantly with age (all $P < 0.001$; Fig. 2C and D). However, the prevalence of monocular blindness did not show a significant increase with age ($P = 0.316$, Fig. 2D). Supplementary Fig. 1 shows the prevalence of low vision and blindness by age and gender according to the USA criteria.

Based on the WHO criteria, cataract was the primary cause of bilateral MSVI (47.9%), followed by MMD (25.7%) and AMD (15.0%). Meanwhile, MMD (31.1%), cataract (20.7%), and glaucoma/other optic atrophy (13.8%) were the main causes of bilateral blindness, as shown in Table 3. For monocular MSVI, cataract (39.4%), AMD (16.6%), and MMD (16.6%) were the primary causes, while other posterior segment eye diseases (30.1%) and MMD (14.2%) were the main causes of monocular blindness (Table 4).

Next, we used the WHO criteria to assess the causes of MSVI and blindness in the following age-groups (Fig. 3): 65–69 years, 70–74 years, 75–79 years, and ≥ 80 years. In adults aged 65–74 years, MMD was the foremost factor causing bilateral vision impairment. Conversely, cataract was identified as the primary cause of bilateral and monocular vision impairment among adults aged ≥ 75 years. AMD accounts for a significant proportion of individuals across all age groups.

Discussion

To our knowledge, the Pujiang Cohort Eye study is the largest, single-population-based, cross-sectional eye study to date in a suburban region of China. China's economic status and aging population have undergone significant changes in recent years. According to predictions by the United Nations, China's population will reach a peak of 1.4 billion in 2030, but the population is expected to show a significant decline to 1.3 billion by 2050.[14] We found that the prevalence of MSVI and blindness increased with age in our study among adults aged ≥ 65 years. When comparing the prevalence of MSVI and blindness reported in previous studies in China[6,9,10,15–20] and other countries[21–31] that applied the WHO criteria, some small discrepancies in the definitions of vision impairment were noted. Nevertheless, the Pujiang Cohort Eye Study reported a lower prevalence of MSVI and blindness than our previous study, the Taizhou Eye Study,[10] and a higher prevalence than

Table 1
Age- and gender-specific prevalence of bilateral vision impairment using the World Health Organization definitions of moderate and severe visual impairment and blindness.

Groups	Age (years)	No. of Participants	Moderate and Severe Visual Impairment				Blindness			
			Best-Corrected Visual Acuity		Presenting Visual Acuity		Best-Corrected Visual Acuity		Presenting Visual Acuity	
			No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)
Men	65–69	1224	14	1.1 (0.6–1.9)	100	8.2 (6.7–9.8)	1	0.1 (0.0–0.5)	6	0.5 (0.2–1.1)
	70–74	853	12	1.4 (0.7–2.4)	75	8.8 (7.0–10.9)	1	0.1 (0.0–0.7)	4	0.5 (0.1–1.2)
	75–79	371	17	4.6 (2.7–7.2)	47	12.7 (9.5–16.5)	3	0.8 (0.2–2.3)	8	2.2 (0.9–4.2)
	80–84	156	5	3.2 (1.0–7.3)	18	11.5 (7.0–17.6)	3	1.9 (0.4–5.5)	4	2.6 (0.7–6.4)
	≥ 85	91	9	9.9 (4.6–17.9)	22	24.2 (15.8–34.3)	1	1.1 (0.0–6.0)	2	2.2 (0.3–7.7)
	Total	2695	57	2.1 (1.6–2.7)	262	9.7 (8.6–10.9)	9	0.3 (0.2–0.6)	24	0.9 (0.6–1.3)
Women	65–69	1418	31	2.2 (1.5–3.1)	133	9.4 (7.9–11.0)	5	0.4 (0.1–0.8)	21	1.5 (0.9–2.3)
	70–74	932	30	3.2 (2.2–4.6)	105	11.3 (9.3–13.5)	6	0.6 (0.2–1.4)	9	1.0 (0.4–1.8)
	75–79	457	19	4.2 (2.5–6.4)	66	14.4 (11.3–18.0)	2	0.4 (0.1–1.6)	9	2.0 (0.9–3.7)
	80–84	189	16	8.5 (4.9–13.4)	37	19.6 (14.2–26.0)	2	1.1 (0.1–3.8)	2	1.1 (0.1–3.8)
	≥ 85	155	14	9.0 (5.0–14.7)	38	24.5 (18.0–32.1)	5	3.2 (1.1–7.4)	5	3.2 (1.1–7.4)
	Total	3151	110	3.5 (2.9–4.2)	379	12.0 (10.9–13.2)	20	0.6 (0.4–1.0)	46	1.5 (1.1–1.9)
Women and men	65–69	2642	45	1.7 (1.2–2.3)	233	8.8 (7.8–10.0)	6	0.2 (0.1–0.5)	27	1.0 (0.7–1.5)
	70–74	1785	42	2.4 (1.7–3.2)	180	10.1 (8.7–11.6)	7	0.4 (0.2–0.8)	13	0.7 (0.4–1.2)
	75–79	828	36	4.3 (3.1–6.0)	113	13.6 (11.4–16.2)	5	0.6 (0.2–1.4)	17	2.1 (1.2–3.3)
	80–84	345	21	6.1 (3.8–9.2)	55	15.9 (12.2–20.2)	5	1.4 (0.5–3.3)	6	1.7 (0.6–3.7)
	≥ 85	246	23	9.3 (6.0–13.7)	60	24.4 (19.2–30.3)	6	2.4 (0.9–5.2)	7	2.8 (1.2–5.8)
	Total	5846	167	2.9 (2.4–3.3)	641	11.0 (10.2–11.8)	29	0.5 (0.3–0.7)	70	1.2 (0.9–1.5)
Age- and gender- standardized prevalence*	≥ 65	–	–	3.3 (3.2–3.4)	–	11.8 (11.6–11.9)	–	0.6 (0.5–0.7)	–	1.3 (1.2–1.4)
	≥ 70	–	–	4.4 (4.2–4.5)	–	13.8 (13.5–14.0)	–	0.9 (0.8–1.0)	–	1.5 (1.4–1.6)
	≥ 75	–	–	5.9 (5.7–6.2)	–	16.6 (16.3–16.9)	–	1.2 (1.1–1.3)	–	2.1 (2.0–2.2)
	≥ 80	–	–	7.5 (7.1–7.8)	–	19.4 (18.9–19.9)	–	1.8 (1.7–2.0)	–	2.2 (2.0–2.4)

CI = confidence interval; − = data not available.
*Standardized by age and gender to the China National Census, 2020.

Table 2
Age- and gender-specific prevalence of monocular vision impairment using the World Health Organization definitions of moderate and severe visual impairment and blindness.

Groups	Age (years)	No. of Participants	Moderate and Severe Visual Impairment				Blindness			
			Best-Corrected Visual Acuity		Presenting Visual Acuity		Best-Corrected Visual Acuity		Presenting Visual Acuity	
			No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)
Men	65–69	1224	50	4.1 (3.0–5.4)	82	6.7 (5.4–8.2)	25	2.0 (1.3–3.0)	28	2.3 (1.5–3.3)
	70–74	853	55	6.4 (4.9–8.3)	105	12.3 (10.2–14.7)	14	1.6 (0.9–2.7)	12	1.4 (0.7–2.4)
	75–79	371	26	7.0 (4.6–10.1)	42	11.3 (8.3–15.0)	12	3.2 (1.7–5.6)	13	3.5 (1.9–5.9)
	80–84	156	12	7.7 (4.0–13.1)	20	12.8 (8.0–19.1)	7	4.5 (1.8–9.0)	8	5.1 (2.2–9.9)
	≥ 85	91	14	15.4 (8.7–24.5)	18	19.8 (12.2–29.4)	0	–	1	1.1 (0.0–6.0)
	Total	2695	157	5.8 (5.0–6.8)	267	9.9 (8.8–11.1)	58	2.2 (1.6–2.8)	62	2.3 (1.8–2.9)
Women	65–69	1418	82	5.8 (4.6–7.1)	130	9.2 (7.7–10.8)	23	1.6 (1.0–2.4)	24	1.7 (1.1–2.5)
	70–74	932	61	6.5 (5.0–8.3)	102	10.9 (9.0–13.1)	17	1.8 (1.1–2.9)	19	2.0 (1.2–3.2)
	75–79	457	41	9.0 (6.5–12.0)	72	15.8 (12.5–19.4)	8	1.8 (0.8–3.4)	5	1.1 (0.4–2.5)
	80–84	189	25	13.2 (8.7–18.9)	33	17.5 (12.3–23.6)	3	1.6 (0.3–4.6)	3	1.6 (0.3–4.6)
	≥ 85	155	30	19.4 (13.5–26.5)	36	23.2 (16.8–30.7)	4	2.6 (0.7–6.5)	3	1.9 (0.4–5.6)
	Total	3151	239	7.6 (6.7–8.6)	373	11.8 (10.7–13.0)	55	1.7 (1.3–2.3)	54	1.7 (1.3–2.2)
Women and men	65–69	2642	132	5.0 (4.2–5.9)	212	8.0 (7.0–9.1)	48	1.8 (1.3–2.4)	52	2.0 (1.5–2.6)
	70–74	1785	116	6.5 (5.4–7.7)	207	11.6 (10.1–13.2)	31	1.7 (1.2–2.5)	31	1.7 (1.2–2.5)
	75–79	828	67	8.1 (6.3–10.2)	114	13.8 (11.5–16.3)	20	2.4 (1.5–3.7)	18	2.2 (1.3–3.4)
	80–84	345	37	10.7 (7.7–14.5)	53	15.4 (11.7–19.6)	10	2.9 (1.4–5.3)	11	3.2 (1.6–5.6)
	≥ 85	246	44	17.9 (13.3–23.3)	54	32.9 (27.5–38.6)	4	1.6 (0.4–4.1)	4	2.6 (0.4–4.1)
	Total	5846	396	6.8 (6.1–7.4)	640	10.9 (10.2–11.8)	113	1.9 (1.6–2.3)	116	2.0 (1.6–2.4)
Age- and gender- standardized prevalence*	≥ 65	–	–	7.4 (7.2–7.5)	–	11.6 (11.4–11.8)	–	2.0 (1.9–2.1)	–	2.0 (1.9–2.1)
	≥ 70	–	–	9.0 (8.8–9.2)	–	14.0 (13.8–14.3)	–	2.1 (2.0–2.2)	–	2.1 (2.0–2.2)
	≥ 75	–	–	10.9 (10.6–11.2)	–	15.9 (15.6–16.3)	–	2.4 (2.3–2.5)	–	2.4 (2.2–2.5)
	≥ 80	–	–	13.6 (13.2–14.1)	–	18.0 (17.5–18.5)	–	2.3 (2.2–2.5)	–	2.5 (2.3–2.7)

CI = confidence interval; − = data not available.
*Standardized by age and gender to the China National Census, 2020.

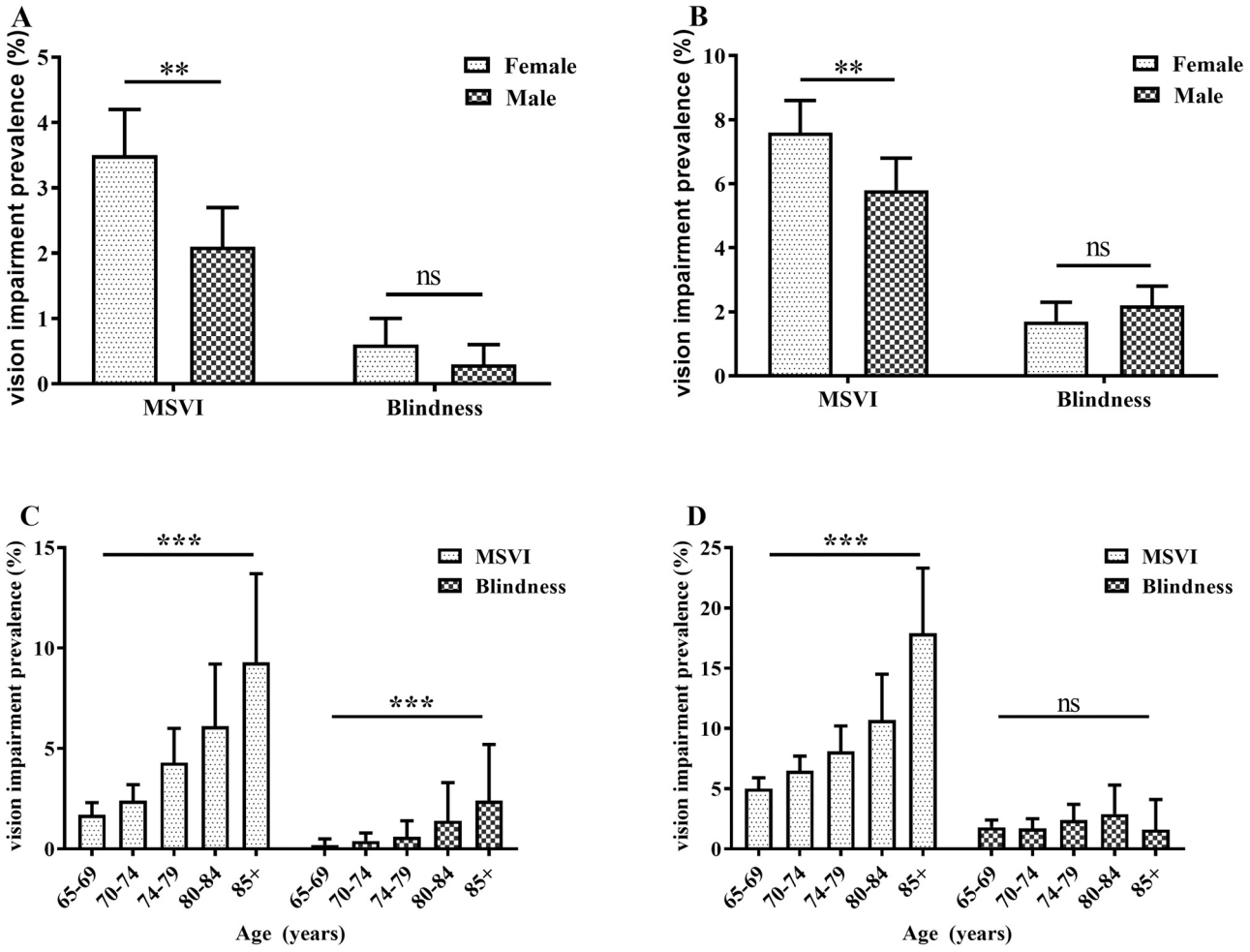

Fig. 2. Bar graphs comparing the prevalence of moderate and severe visual impairment (MSVI) and blindness between genders and among age-groups according to World Health Organization standards. (A) The prevalence of bilateral MSVI was higher in women than in men ($P = 0.002$). (B) The prevalence of monocular MSVI was higher in women than in men ($P = 0.008$). (C) The prevalence of vision impairment increased with age (both $P < 0.001$). (D) The prevalence of monocular MSVI increased with age ($P < 0.001$). ns: $P > 0.05$; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

that reported in other developed countries such as Japan,[32,33] the USA,[34] and Australia.[35,36] Comparing our study with other studies conducted in China, the prevalence of MSVI and blindness was similar to that reported in the Liwan Eye Study[37] and the Taiwan Shihpai Eye Study,[38] which enrolled people living in urban areas, but lower than that reported in Taizhou,[10] Harbin,[38] and the Nine Province Eye Survey,[9] which enrolled people living in rural areas. Differences in demographic characteristics may contribute to the differences in epidemiology of MSVI and blindness because we enrolled a cohort in suburban Shanghai. Owing to the increasing age of the Chinese population, and the increasing number of elderly people, there is an urgent need for a fundamental eyecare system that takes into account the rapid economic and social growth in China.

In our study, women were more likely to suffer vision impairments than men. This result is consistent with that reported in other eye studies conducted in China and other countries.[8,9,16,39,40] The reasons

Table 3
Causes of bilateral moderate and severe visual impairment and blindness defined according to the World Health Organization criteria (per person).

	MSVI	Blindness	MSVI and Blindness Combined
Cataract	80 (47.9)	6 (20.7)	86 (43.9)
Myopic macular degeneration	43 (25.7)	9 (31.1)	52 (26.5)
Age-related macular degeneration	25 (15.0)	2 (7.0)	27 (13.8)
Glaucoma and other optic atrophy	5 (3.0)	4 (13.8)	9 (4.6)
Diabetic retinopathy	5 (3.0)	2 (7.0)	7 (3.6)
Other posterior segment eye disease	3 (1.8)	2 (7.0)	5 (2.5)
Amblyopia	3 (1.8)	–	3 (1.5)
Posterior capsular opacification	–	1 (3.4)	1 (0.5)
Atrophy of the eyeball or prosthetic eye	–	1 (3.4)	1 (0.5)
Uveitis	–	1 (3.4)	1 (0.5)
Unknown eye disease	3 (1.8)	1 (3.4)	4 (2.1)
Subjects	167 (100)	29 (100)	196 (100)

MSVI = moderate and severe visual impairment; – = data not available
Data are no. (%).

Table 4
Causes of monocular moderate and severe visual impairment and blindness defined according to the World Health Organization Criteria (per eye).

	MSVI	Blindness	MSVI and Blindness Combined
Cataract	156 (39.4)	12 (10.6)	168 (33.0)
Myopic macular degeneration	66 (16.6)	16 (14.2)	82 (16.1)
Age-related macular degeneration	66 (16.6)	12 (10.6)	78 (15.3)
Glaucoma and other optic atrophy	13 (3.3)	12 (10.6)	25 (4.9)
Diabetic retinopathy	13 (3.3)	2 (1.8)	15 (2.9)
Other posterior segment eye disease	42 (10.7)	34 (30.1)	76 (14.9)
Amblyopia	31 (7.7)	1 (0.9)	32 (6.3)
Posterior capsular opacification	3 (0.8)	1 (0.9)	4 (0.8)
Atrophy of the eyeball or prosthetic eye	0 (0.0)	10 (8.8)	10 (2.0)
Uveitis	1 (0.3)	1 (0.9)	2 (0.4)
Cornea opacity	4 (1.0)	7 (6.2)	11 (2.2)
Aphakia	0 (0.0)	1 (0.9)	1 (0.2)
Unknown eye disease	1 (0.3)	4 (3.5)	5 (1.0)
Eyes	396 (100)	113 (100)	509 (100)

MSVI = moderate and severe visual impairment; – = data not available
Data are no. (%).

for these differences are complex and can be attributed to various social, economic, cultural, and biological factors. In many developing communities, women face significant obstacles due to limited exposure to the outside world, and they are often excluded from financial decision-making. These factors can lead to disparities in access to healthcare, education, and employment opportunities, which can have long-term effects on health outcomes. Because the prevalence of MSVI and blindness was proven to be associated with female gender and older age,[8,41,42] this represents an important target for alleviating vision impairment and gender equity.

In 2020, cataract was the first or second leading cause of blindness and MSVI in all regions of the world.[43] In our study, cataract was the leading cause of bilateral and monocular vision impairment, accounting for approximately 30% of cases of MSVI and blindness. In certain developing areas, cataract continues to be the leading cause of blindness,[44–46] whereas in some developed areas, cataract is the primary cause of MSVI but not blindness.[17,32,36,47] Our study further revealed that cataract was the primary cause of both bilateral and monocular vision impairment among elderly individuals, indicating that the current rate of cataract surgery and treatment of preventable causes of blindness remains inadequate for those aged 75 years and above. We believe that it is important to address this issue by ramping up cataract surgery rate. However, other steps were needed to be taken to improve eye care services for the elderly, such as providing education about eye health and regular eye exams. We believe that actions for the prevention and treatment of vision impairment should be implemented in China.

The progressive emergence of causes such as MMD particularly in China, as a significant contributor to the burden of vision impairment, warrants an update.[48] Studies suggest that the prevalence of myopia is notably higher in China than in Western nations, and is increasing rapidly in East Asia.[17,49] MMD accounted for 12.5% of cases of vision impairment in the Taiwan Shihpai Eye Study[17], 32.7% of cases of MSVI and 7.7% cases of blindness in the Beijing Eye Study,[44] 8.3% of cases of vision impairment in the Liwan Eye Study,[37] and 11.2% of cases of vision impairment in the Handan Eye Study.[16] In our study, MMD was the second most common cause (25.7%) of bilateral MSVI and the leading cause of bilateral blindness (31.1%). Among adults aged 65–74 years, MMD was the primary cause of total bilateral MSVI and blindness, accounting for 43.1% and 34.7%, respectively. These findings underscore the need to monitor and address the increasing prevalence of MMD among middle-aged and older adults. In addition, we compared the difference in BCVA versus PVA by age, and found the gap narrowed as the age increased (data not shown). For individuals over the age of 80, the proportion of MMD also relatively decreases, indicating that MMD may not have a great impact on individuals in this age group.

The prevalence of AMD is increasing rapidly with the development of economy and society and the improvements of medical resources.[50] As reported previously, AMD is the leading cause of blindness in white people,[35,36] although the age-standardized prevalence of blindness due to AMD decreased by almost 30% from 1990 to 2020, which was probably associated with the widespread clinical introduction of anti-vascular endothelial growth factor therapy for exudative AMD.[51] In our study, AMD was the third leading cause of bilateral MSVI and blindness (13.8%) and monocular MSVI and blindness (15.3%). Among adults aged ≥ 80 years, AMD was the second leading cause of bilateral MSVI and blindness (16.4%). These data are similar to those of other eye studies in China and Asia. For example, Huang et al. reported that AMD (15.58%) was the second most common cause of blindness among adults aged ≥ 60 years in the Shanghai Beixinjing community.[49] Because of the recent increase in prevalence of AMD in suburban China, AMD and other posterior segment eye diseases warrant more attention in basic ophthalmic care settings.

Our study has several strengths, including a sizable sample size, the implementation of standardized protocols to ensure accurate assessment of the prevalence and causes of vision impairment, stringent criteria that enable comparisons with other studies, and a comprehensive examination of the major causes of vision impairment across different age groups using the new WHO age classification system. However, our study is subject to certain limitations. Severe lens opacities in elderly individuals may have hindered our ability to detect significant retinal diseases or glaucoma, potentially resulting in the underestimation of some posterior eye diseases. Furthermore, our definitions of vision impairment were restricted to distance visual acuity, with no evaluation of near visual impairment or the visual field, which may have led to an underestimation of uncorrected refractive errors, glaucoma, or other forms of optic atrophy.

To summarize, the Pujiang Cohort Eye Study highlights the continued prevalence of vision impairment as a significant public health concern in mainland China. Cataract emerges as the primary cause of vision impairment and should be a priority in eye care. MMD was identified as a leading cause of vision impairment among adults aged 65–74 years. Additionally, the high proportion of vision impairment caused by AMD and other posterior segment eye diseases deserves more attention.

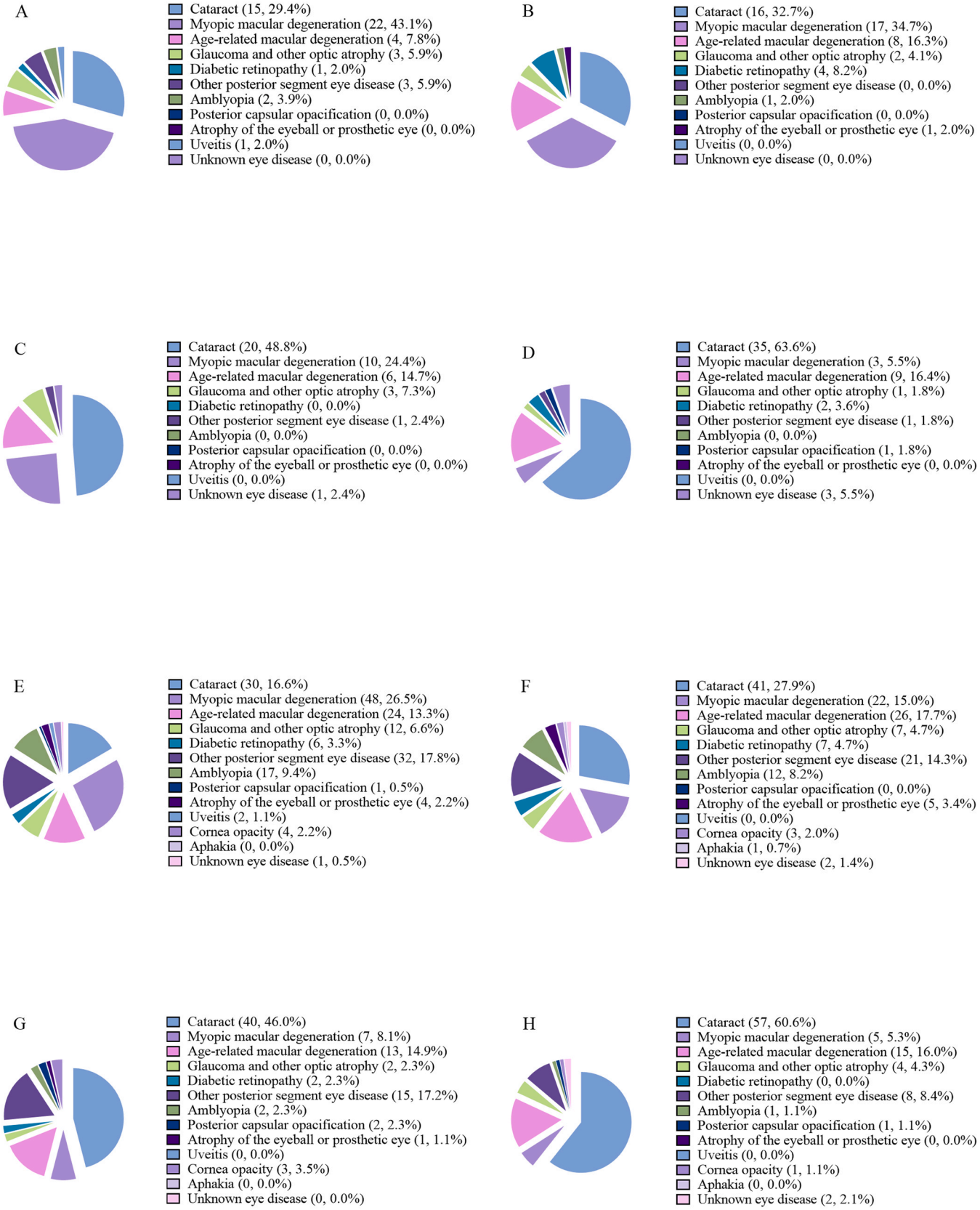

Fig. 3. Distribution of causes of vision impairment defined according to World Health Organization standards in different age-groups. (A–D) Causes of bilateral vision impairment causes in adults aged 65–69 years (A), 70–74 years (B), 75–79 years (C), and ≥ 80 years (D). (E–H) Causes of monocular vision impairment in adults aged 65–69 years (E), 70–74 years (F), 75–79 years (G), and ≥ 80 years (H).

Ethics statement

This study involves human participants and was approved by The Institutional Review Board at Eye & ENT Hospital of Fudan University (2021092). Participants gave informed consent to participate in the study before taking part.

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Synopsis

Cataract is still the primary cause of vision impairment in elderly Chinese people; however, the prevalence trend of vision impairment is gradually changing with increased aging of the population and accelerated urbanization.

Patient consent for publication

Consent obtained directly from patient(s).

Declaration of Competing Interest

None of the authors has any conflicts of interest to disclose.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.apjo.2023.100002.

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