Prevalence of Age-Related Macular Degeneration in an Elderly Urban Chinese Population in China: The Jiangning Eye Study

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Submitted: May 28, 2014
Accepted: August 6, 2014

Citation: Ye H, Zhang Q, Liu X, et al. Prevalence of age-related macular degeneration in an elderly urban Chinese population in China: The Jiangning Eye Study. *Invest Ophthalmol Vis Sci*. 2014;55:6374–6380. DOI:10.1167/iovs.14-14899

Purpose. To describe the prevalence of AMD in an elderly urban Chinese population in China.

Methods. A population-based, cross-sectional study was conducted using a cluster random sample of residents aged 50 years or older living in the Jiangning Road Subdistrict, Jing'an District, Shanghai, China. All participants underwent a standardized interview and comprehensive eye examinations, including digital retinal photography and spectral-domain optical coherence tomography (OCT) examinations of both eyes between November 2012 and February 2013. Trained graders assessed the presence and severity of AMD lesions based on a modified version of the Wisconsin Age-Related Maculopathy Grading System.

Results. Of the 2044 subjects who participated (82.5% response rate), 2005 had fundus photographs and OCT results of sufficient quality for grading of AMD signs. Early and late AMD were present in 206 (10.3%) and 23 (1.1%) participants, respectively. After age standardization, the prevalence of early AMD in Chinese persons aged 50 years or older was 9.5% (95% confidence interval [CI], 8.2–10.8) and that of late AMD was 1.0% (95% CI, 0.5–1.5).

Conclusions. The prevalence of early and late AMD in this urban Chinese sample was higher than that reported in the Beijing and Handan studies. Age-related macular degeneration is highly prevalent among the elderly urban Chinese population in mainland China.

Keywords: age-related macular degeneration, prevalence, epidemiology

中国城市老年人群中年龄相关性黄斑变性的流行病学调查：江宁眼病研究

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摘要

目的：探讨上海市静安区江宁街道 50 岁以上人群中年龄相关性黄斑变性（AMD）的流行病学调查。

方法：基于人群的横断面研究设计，对上海市静安区江宁街道 50 岁以上人群采用整群随机抽样，2012 年 11 月～2013 年 2 月抽样对象进行问卷调查及常规眼

部检查，包括双眼眼底照像以及 OCT 检查，基于 Wisconsin Age-Related Maculopathy Grading System (WARMGS)标准进行 AMD 的诊断及严重程度评判。

结果：实际受检 2044 人（82.5%应答率），其中 2005 人的眼底照像和 OCT 结果符合 AMD 诊断及分级所需标准。诊断为早期和晚期 AMD 分别为 206 人（10.3%）和 23 人（1.1%）。在年龄标准化后，中国 50 岁以上人群中的早期 AMD 患病率为 9.5%（95%置信区间：8.2%-10.8%），晚期 AMD 患病率为 1.0%（95%置信区间：0.5%-1.5%）。

结论：上海市静安区江宁街道人群中 AMD 的患病率高于先前报道的北京和邯郸眼病研究结果，AMD 在中国城市老年人群中较为普遍。

关键词：年龄相关性黄斑变性；患病率；流行病学

Age-related macular degeneration (AMD) is the leading cause of visual impairment among the elderly in developed countries, and as of 2010, it has been responsible for approximately 5% of all blindness globally.[1–3] To date, the introduction of novel therapeutic options (e.g., use of anti-VEGF agents) has offered remarkable clinical benefits for patients with neovascular AMD.[4] However, because these benefits are associated with an increased financial burden of providing care for these patients, accurately determining the epidemiology of AMD is important in order to develop preventive measures for this disease.[5,6]

Mainland China comprises one-fifth of the world's population with 1.34 billion people, including 178 million persons aged 60 years and above, and a substantial increase in the number of older persons is expected in the next few decades.[7] Although the epidemiology of AMD has been well described in many Western populations,[8–10] few studies have reported the epidemiology of AMD in mainland China.[11–14] The results of two previous studies, the Beijing Eye Study and the Handan Eye Study, indicated that the prevalence of early and late AMD in mainland Chinese persons was relatively lower than in white populations.[12–14] However, an increasing number of recent studies have reported a prevalence similar to or higher than that of white populations in Chinese persons in Taiwan[15,16] and Singapore[17] and in nearby Asian populations,[6,18] as well as in American Chinese individuals.[19] In addition, both of the previous studies were conducted in rural or suburban areas of Northern China; no studies were conducted in the urban populations or in other regions of mainland China.

Therefore, we performed a population-based study to describe the age- and sex-specific prevalence of early and late AMD in the city of Shanghai, which is the largest city by population in China. The findings gained will provide new insights into the epidemiology of AMD in urban Chinese populations and may be helpful in planning public health strategies for patients with AMD in the future.

Methods

Study Population

The Jiangning Eye Study, a population-based, cross-sectional study of Chinese urban elders aged 50 years and older living in the Jiangning Road Subdistrict, Jing'an District, Shanghai, China was conducted to investigate prevalence and risk factors of eye diseases. Shanghai sits on the Yangtze River Delta on China's eastern coast, and is the largest Chinese city by population in the world. In 2012, the gross domestic product per capita in Shanghai exceeded US $13,000, which approaches the level of developed countries.[20] The Jiangning Road Subdistrict is situated in the center of downtown Shanghai. According to the official household registration of local Health & Family Planning Commission in 2011, the total number of eligible residents aged 50 years and older in Jiangning was 30,341. After excluding vacant households, 2478 residents were randomly selected using a stratified, clustered, and multistage sampling technique, with probabilities proportionate to the size of the population of each cluster. The sample size calculations were based on an estimated prevalence of AMD of 5.5% with 95% confidence interval and a precision of ±0.011 and a design effect of 1.2, and allowing for a response rate of 80%.[11–14,21] Of the 2478 randomly selected individuals, 2044 (82.5%) participated in the ophthalmic examination between November 2012 and February 2013. Informed written consent was obtained from all participants before enrollment. The study complied with the guidelines in the Declaration of Helsinki, and ethics approval was received from the Medical Ethics Committee of the Xinhua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine (Shanghai, People's Republic of China).

Study Procedures

All examinations were carried out in temporary clinics among the community houses. A detailed interviewer-administrated

Table 1. Demographic Characteristics by Presence or Absence of Early and Late AMD in the Jiangning Eye Study

Characteristic	No AMD, $n = 1776$	AMD		
		Total, $n = 229$	Early AMD, $n = 206$	Late AMD, $n = 23$
		Mean (SD)		
Age, y*	64.0 (9.5)	70.4 (11.0)	69.9 (10.9)	75.5 (11.1)
Body mass index, kg/m^2	24.0 (3.2)	23.9 (3.3)	23.9 (3.2)	24.4 (4.0)
Systolic BP, mm Hg*	137.7 (19.4)	142.6 (19.8)	142.4 (19.9)	144.7 (19.8)
Diastolic BP, mm Hg	74.4 (11.1)	74.6 (11.1)	74.8 (11.1)	73.0 (11.4)
Pulse rate, BPM	81.7 (11.7)	81.3 (11.3)	81.2 (11.5)	82.4 (10.2)
		Number (%)		
Male*	761 (42.8)	116 (50.7)	100 (48.5)	16 (69.6)
Married	1757 (98.9)	223 (97.4)	200 (97.1)	23 (100)
High school or higher education	981 (55.2)	117 (51.1)	110 (53.4)	7 (30.4)
Current cigarette smoker, ≥20 pack-years	374 (21.1)	49 (21.4)	43 (20.9)	6 (26.1)
Alcohol consumption, ≥20 g/d	309 (17.4)	48 (21.0)	44 (21.4)	4 (17.4)
Aspirin	48 (2.7)	5 (2.2)	3 (1.5)	2 (8.7)
Vitamin	166 (9.3)	19 (8.3)	18 (8.7)	1 (4.3)
Axial myopia, axial length ≥ 25.0 mm*	423 (23.8)	26 (11.4)	25 (12.1)	1 (4.3)
Glass wear	894 (50.3)	108 (47.2)	98 (47.6)	10 (43.5)
Cataract surgery, at least 1 eye*	84 (4.7)	20 (8.7)	17 (8.3)	3 (13.0)
Self-reported medical history				
Hypertension	690 (38.9)	97 (42.4)	85 (41.3)	12 (52.2)
Hyperlipemia*	138 (7.8)	8 (3.5)	8 (3.9)	0
Diabetes mellitus	201 (11.3)	31 (13.5)	26 (12.6)	5 (21.7)
Stroke*	222 (12.5)	43 (18.8)	38 (18.4)	5 (21.7)

BP, blood pressure.
* $P < 0.05$, significant difference between the AMD (total) and non-AMD groups.

questionnaire was conducted to collect information about medical history (e.g., hypertension, diabetes, hyperlipemia, and stroke), cigarette smoking (defined as current, past, and never), alcohol consumption (defined as yes or no), current medication use (e.g., aspirin, vitamin), socioeconomic status factors (e.g., marital status, final education level and income level), ocular status or history (e.g., history of eye surgery, glasses or contact lens prescriptions). Pulse rate, systolic and diastolic blood pressure (BP) were measured in a standard manner after 5 minutes of rest with a digital automatic BP monitor. Body mass index was calculated as body weight (kilograms) divided by body height (meters) squared.

The eye examinations were conducted according to a standardized protocol that included visual acuity measurement with Early Treatment Diabetic Retinopathy Study (ETDRS) charts and recorded in each eye separately with best corrected acuity, autorefraction (KR-8900; Topcon, Tokyo, Japan), noncontact tonometry (CT-80A; Topcon), slit-lamp biomicroscopy (SL-1E; Topcon), indirect ophthalmoscopy (YE6F; 66 Vision, Suzhou, China), optical measurement of axial length, keratometry, anterior chamber depth, and white-to-white (IOL Master; Carl Zeiss, Jena, Germany), corneal thickness measurement (A-Scan model SW-1000, Suoer, Tianjin, China), and spectral-domain optical coherence tomography (SD-OCT; Topcon 3D OCT-2000; Topcon). Lens opacities were graded by slit-lamp biomicroscopy according to the Lens Opacities Classification System III (LOCS III). Fundus photography was undertaken with a 45° 16.2-megapixel digital nonmydriatic fundus camera (integrated high resolution fundus camera of Topcon 3D OCT-2000; Topcon) in a darkened room. At least two photography fields were obtained from each eye: one centered at the fovea and the other at the optic disc. Digital images of fundus photographs were communicated and analyzed with IMAGEnet digital imaging system and integrated software package of 3D OCT-2000 (Topcon).

Grading of Images

Grading of AMD was based on a modified version of Wisconsin Age-Related Maculopathy Grading System (WARMGS).[22–24] Features of AMD were classified into five mutually exclusive grades: grade 0 (no early or late AMD); grade 1, soft distinct drusen (≥63 μm) only or pigmentary irregularities only; grade 2, soft indistinct (≥125 μm) or reticular drusen only or soft distinct drusen (≥63 μm) with pigmentary irregularities; grade 3, soft indistinct (≥125 μm) or reticular drusen with pigmentary irregularities; grade 4, either choroidal neovascularization (CNV; presence of any of the following: serous or hemorrhagic retinal or RPE detachment, subretinal neovascular membrane, and periretinal fibrous scar) or geographic atrophy (GA; well-demarcated area of retinal pigment atrophy with visible choroidal vessels). Early AMD was defined as grades 1 to 3 and late AMD as grade 4.

Two experienced graders initially assessed photographs for AMD signs independently in a masked fashion. Before grading was initiated for all subjects, intergrader and intragrader agreements were assessed using the κ statistic on a random subset of 50 eyes. For intergrader agreement, the κ of presence of soft distinct drusen, number of large drusen, and presence of retinal pigment abnormalities were 0.88, 0.76, and 0.64, respectively. For intragrader agreement, the κ for two graders were high for all these three features (all $\kappa \geq 0.61$). All cases with positive findings were further adjudicated by a retinal specialist. All questionable lesions and all eyes classified as late AMD were discussed and adjudicated by the results of OCT. Any lesions considered to be due to other causes such as myopia and inflammatory disease were excluded. When CNV and GA were both present in the same eye, we classified the eye as CNV. When both eyes of a participant had lesions of different severity, AMD was defined according to the worse eye.

Table 2. Prevalence of Early and Late AMD and its Specific Lesions by Sex and Age in the Jiangning Eye Study

Age Group, y	*N* at Risk	Soft Indistinct Drusen/ Reticular Drusen		Soft Distinct Drusen		Pigment Abnormalities		Early AMD		Late AMD	
		n	%	*n*	%	*n*	%	*n*	%	*n*	%
Men											
50–59	297	7	2.4	24	8.1	17	5.7	22	7.4	1	0.3
60–69	321	13	4.0	43	13.4	35	10.9	38	11.8	3	0.9
70–79	159	11	6.9	20	12.6	18	11.3	20	12.6	6	3.8
80–95	100	10	10.0	23	23.0	14	14.0	20	20.0	6	6.0
Total population	877	41	4.7	110	12.5	84	9.6	100	11.4	16	1.8
P value for trend*		$P = 0.001$		$P < 0.001$		$P = 0.007$		$P = 0.001$		$P < 0.001$	
Age-standardized prevalence, %†								10.2 (8.2, 12.2)		1.4 (0.6, 2.2)	
Women											
50–59	460	8	1.7	32	7.0	27	5.9	24	5.2	1	0.2
60–69	351	10	2.8	23	6.6	21	6.0	23	6.6	2	0.6
70–79	196	13	6.6	30	15.3	22	11.2	34	17.3	2	1.0
80–95	121	7	5.8	22	18.2	17	14.0	25	20.7	2	1.7
Total population	1128	38	3.4	107	9.5	87	7.7	106	9.4	7	0.6
P value for trend*		$P = 0.001$		$P < 0.001$		$P = 0.001$		$P < 0.001$		$P = 0.058$	
Age-standardized prevalence, %†								8.8 (7.1, 10.5)		0.6 (0.1, 1.1)	
Both sexes											
50–59	757	15	2.0	56	7.4	44	5.8	46	6.1	2	0.3
60–69	672	23	3.4	66	9.8	56	8.3	61	9.1	5	0.7
70–79	355	24	6.8	50	14.1	40	11.3	54	15.2	8	2.3
80–95	221	17	7.7	45	20.4	31	14.0	45	20.4	8	3.6
Total population	2005	79	3.9	217	10.8	171	8.5	206	10.3	23	1.1
P value for trend*		$P < 0.001$		$P < 0.001$		$P < 0.001$		$P < 0.001$		$P < 0.001$	
Age-standardized prevalence, %†								9.5 (8.2, 10.8)		1.0 (0.5, 1.5)	

* *P* value for test of trend for age.
† Estimated prevalence (95% CI) for projection by age-standardized to the China 2010 census population.

Statistical Analysis

The overall age- and sex-specific prevalence (%) of AMD and its individual signs were calculated. Age-standardized prevalence was estimated using direct standardization of the study samples to the Chinese population at the 2010 Chinese census ([in the public domain] http://www.stats.gov.cn/english/Statisticaldata/CensusData/rkpc2010/indexch.htm). The Student's *t*-test and χ^2 test were used to compare demographic characteristics between participants with and without AMD. Logistic regression analysis was performed to determine risk factors for early and late AMD using odds ratio (OR) estimates with 95% confidence intervals (CI). For multivariate analysis, we included risk factors with *P* less than 0.05 in the age-adjusted model (sex,

Table 3. Age- and Multivariate-adjusted ORs of Risk Factors for the Development of Early and Late AMD in the Jiangning Eye Study

Risk Factor	Early AMD				Late AMD			
	Age Adjusted		Multivariate Adjusted		Age Adjusted		Multivariate Adjusted	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Age, per 1 y			1.06 (1.04–1.07)	0.000†			1.11 (1.06–1.16)	0.000†
Male	1.24 (0.93–1.67)	0.147	1.12 (0.79–1.59)	0.533	2.83 (1.15–6.97)	0.024*	2.62 (0.98–7.04)	0.055
Body mass index	0.99 (0.95–1.04)	0.721			1.06 (0.94–1.19)	0.381		
Smoking	1.34 (0.93–1.95)	0.118	1.08 (0.69–1.67)	0.746	2.58 (0.95–7.00)	0.062	1.69 (0.56–5.11)	0.350
Alcohol	1.52 (1.05–2.19)	0.025*	1.36 (0.90–2.07)	0.144	1.33 (0.44–4.01)	0.616	0.72 (0.22–2.31)	0.577
Hypertension	0.90 (0.66–1.21)	0.483			1.20 (0.52–2.77)	0.675		
Diabetes mellitus	0.98 (0.63–1.54)	0.945			1.78 (0.64–4.92)	0.268		
Hyperlipemia	0.45 (0.22–0.94)	0.034*	0.48 (0.23–1.01)	0.054	Omitted‡		Omitted‡	
Stroke	1.03 (0.69–1.53)	0.903			0.90 (0.32–2.55)	0.849		
Glass wear	0.99 (0.74–1.33)	0.936			0.92 (0.40–2.14)	0.850		
Axial myopia	0.46 (0.30–0.72)	0.001†	0.47 (0.30–0.73)	0.001†	0.17 (0.02–1.30)	0.089	0.17 (0.02–1.30)	0.089
Cataract surgery	1.00 (0.57–1.77)	0.999			1.16 (0.32–4.19)	0.816		

Multivariate adjustment was made for age, sex, smoking, alcohol, hyperlipemia, and axial myopia.
* $P < 0.05$.
† $P < 0.01$.
‡ Hyperlipemia was omitted because none was found among subjects with late AMD.

Table 4. Crude and Age-Standardized Prevalence of Early and Late AMD Among Chinese From the Jiangning and Other Eye Studies

	Shihpai Study 1999–2000, $N = 1058$	Beijing Study 2001, $N = 4376$	Handan Study 2006–2007, $N = 6581$	Singapore Chinese Study 2009–2011, $N = 3312$	Puzih Study 2010–2012, $N = 673$	Jiangning Study 2012–2013, $N = 2005$
Region	Taiwan	Beijing	Handan	Singapore	Taiwan	Shanghai
Setting	Urban	43.8% Rural	Rural	Urban	Urban	Urban
Age, range, y	65–85+	40–75+	30–70+	40–85	65–80+	50–80+
Age, mean (SD)	71.8 (4.8)	56.1 (10.5)	51.8 (11.7)	59.7 (9.9)	74.1	64.8 (9.9)
Crude prevalence, %						
Early AMD	9.2	5.1	3.0	7.3	15.0	10.3
Late AMD	1.9	0.3	0.1	0.8	7.3	1.1
Adjusted prevalence, %*						
Early AMD (age $\geq$ 50)	11.1†	N/A	4.6	8.2‡	14.8†	9.5
Late AMD (age $\geq$ 50)	2.7†	0.3	0.1	1.0‡	6.7†	1.0

Grading of AMD in four studies was all based on WARMGS or its modified system.

* Adjusted prevalence in persons older than 50 years was estimated by using a direct standardization method, with the 2010 Chinese population as a reference.

† All aged greater than 65 years. The according adjusted prevalence in the Jiangning survey of early AMD and late AMD is 14.4% and 1.9%, respectively.

‡ Including those aged 50 to 85. The according adjusted prevalence in the Jiangning survey of early AMD and late AMD is 9.1% and 0.8%, respectively.[12–16]

alcohol consumption, hyperlipemia, and axial myopia) and also well-established risk factors (age and smoking habit). Statistical analysis was performed using a commercially available statistical software package (SAS; SAS Institute, Inc., Cary, NC, USA). All *P* values were two-sided and were considered statistically significant when the values were less than 0.05.

Results

Of 2478 eligible subjects identified for this study, 2044 (82.5% response rate) underwent an eye examination in a temporary clinic established within the community. Of those individuals, 2005 had fundus photographs and OCT results of sufficient quality for grading of AMD signs; the age (±SD) was 64.8 (±9.9) years, and 56.3% were women. The age distribution of this study population was 50 to 59, 757 (37.8%); 60 to 69, 672 (33.5%); 70 to 79, 355 (17.7%), and 80 years or older, 221 (11.0%).

The demographic characteristics of the study population by the presence or absence of early and late AMD are shown in Table 1. Persons with AMD were significantly older than those without AMD ($P < 0.001$). Men outnumbered women among AMD cases ($P = 0.025$). Systolic BP and the proportions of cataract surgery history and stroke were significantly higher in AMD group compared with those without AMD ($P < 0.001$, $P = 0.010$ and 0.008, respectively), whereas the proportion of axial myopia and hyperlipemia were significantly lower in AMD group ($P < 0.001$ and $P = 0.019$, respectively).

The crude prevalence rates of early AMD in men, women, and the entire study sample were 11.4%, 9.4%, and 10.3%, respectively (Table 2). The crude prevalence rates of late AMD in men, women, and the entire study sample were 1.8%, 0.6%, and 1.1%, respectively. Both early and late AMD increased with age ($P < 0.001$). After age standardization to the Chinese population (2010 census), the prevalence rates of early AMD in Chinese men and women and in all Chinese populations in mainland China were estimated to be 10.2%, 8.8%, and 9.5%, respectively; the corresponding prevalence rates of late AMD were 1.4%, 0.6%, and 1.0% (Table 2).

Table 2 also lists the prevalence of specific early and late AMD signs. There were significant age-related trends in the prevalence of soft drusen and pigmentary abnormalities (*P* value for trend, all $P < 0.001$). Geographic atrophy and neovascular AMD were found in 14 (0.70%) and 9 (0.45%) of the 2005 subjects, respectively. Bilateral AMD signs were seen in 71 (34.5%) of the 206 early AMD cases and in 3 (13.0%) of the 23 late AMD cases.

The results of age- and multivariate-adjusted logistic regression analyses of risk factors for the development of early and late AMD are shown in Table 3. After adjusting for age, alcohol consumption was a significant risk factor for the development of early AMD (OR, 1.52, 95% CI, 1.05–2.19), and in males was a significant risk factor for late AMD (OR, 2.83, 95% CI, 1.15–6.97). However, hyperlipemia (OR, 0.45, 95% CI, 0.22–0.94) and axial myopia (OR, 0.46, 95% CI, 0.30–0.72) were significant protective factors for early AMD. In multivariate analysis, older age was significantly associated with both early and late AMD (per 1-year increase, OR, 1.06, 95% CI, 1.04–1.07, and OR, 1.11, 95% CI, 1.06–1.16, respectively), whereas axial myopia was still associated negatively with early AMD (OR, 0.47, 95% CI, 0.30–0.73).

Discussion

This population-based study reports on the prevalence of AMD in an elderly Chinese population in an urban setting in mainland China and shows that early AMD was present in 10.3% and late AMD in 1.1% of the study sample. After age standardization to the China 2010 population, the prevalence rates of early and late AMD in mainland Chinese individuals 50 years of age or older were estimated to be 9.5% and 1.0%, respectively.

We have summarized the prevalence rates of AMD among Chinese populations using data from previous studies in Table 4. The age-standardized prevalence of early and late AMD in the present study was similar to that reported in the Singapore Chinese Eye Study (9.1% vs. 8.2% and 0.8% vs. 1.0%, respectively).[17] For participants aged greater than 65 years, the age-standardized prevalence of early AMD (14.4%) more closely reflected the results of the Puzih Eye Study (14.8%),[16] while the prevalence of late AMD (1.9%) was a little lower than that reported in the Shihpai Eye Study (2.7%).[15]

Although mainland China has the largest population in the world and a substantial increase in the number of older persons is expected, reports regarding the epidemiology of AMD in mainland Chinese populations are relatively rare. A

previous study carried out in another block in Shanghai in 2002 reported a higher prevalence rate of AMD (15.5% of 1023 subjects older than 50 years old had AMD and 1.9% had exudative AMD) than our results indicated.[11] However, this study applied ophthalmoscopy diagnosis and was based on the Chinese Ophthalmologic Society definition of AMD. The differences in photographic and grading techniques and the definition of AMD make it difficult to compare the two studies. To our knowledge, there are only two other population-based studies in mainland China that have reported results regarding the prevalence of AMD based on a commonly used classification and grading system (Table 4). In the Beijing Eye Study, the crude prevalence rates of early and late AMD were 5.1% and 0.3%, respectively.[12,13] The Handan Eye Study reported a lower, crude prevalence rate of early and late AMD (3.0% for early and 0.1% for late AMD prevalence).[14] The authors suggested that Chinese populations had a relatively lower prevalence rate for AMD compared with white populations. However, the prevalence rate in our study was significantly higher than the rates in both the Beijing and Handan eye studies. Several possible reasons might explain the differences in findings between the previous two studies and our present study. First, the present study were conducted in urban populations with a higher prevalence rate of AMD, whereas the Beijing Eye Study was conducted in a partially rural population (rural part, 43.8%), and the Handan Eye Study was conducted in a rural population with the lowest prevalence rate of AMD among the four studies (Table 4). With economic/political reforms primarily targeting large metropolitan cities, there exists a great divide between urban and rural areas in mainland China after more than 3 decades of development. Possible differences between the rural and urban populations of the same race include environmental (e.g., UV exposure), lifestyle (e.g., diet, physical activity, and education), or broader healthcare factors.[25] It has been hypothesized that people growing up in a rural and self-sustained economy are less affected by AMD compared with urban residents.[26] The present sample represents a population living in a metropolitan environment exposed to Western cultures, lifestyles, and influences; it is possible that the consequent lifestyle change and westernization of the diet may have had a marked impact on the prevalence of AMD in this urban Chinese population.[25] Second, different inclusion criteria in the studies also accounted for the discrepancy. The present study recruited participants 50 years of age and older (mean age, 64.8 years), older than those of the Beijing (mean age, 56.1 years) and Handan (mean age, 51.8 years) eye studies (Table 4). The higher prevalence of AMD in the present study could have been anticipated, given that our study sample had a larger proportion of the old age group. Third, both the Beijing and Handan eye studies were conducted in populations living in Northern China, whereas the present study was conducted in Southeastern China. The discrepancy in AMD rate might be caused partly by regional differences in climate, environmental parameters, and lifestyle. Finally, all participants of the present study received SD-OCT examination. SD-OCT has the advantage of detecting and evaluating small changes in the morphology of the retinal layers and subretinal space, which is valuable in detecting AMD lesions.[27–29] The information offered by SD-OCT was used to assist in the identification and grading of AMD in the questioned cases (11 cases in the present study), which may also have increased the AMD rate in our study.

Regarding specific AMD signs, our results showed a higher prevalence of GA (0.75%) than the Beijing study (0.1%),[12] the Handan study (0%),[14] and the Shihpai study (0.09%) did.[15] It has been reported that polypoidal choroidal vasculopathy (PCV) is frequently observed in Asian patients with exudative AMD.[21] However, among nine subjects with neovascular AMD in our study, there was no highly suspected case of typical PCV lesions based on the fundus photography and OCT results. One of limitations of the present study was that fluorescein angiography or indocyanine green angiography was not performed in all subjects with late AMD, which may have led to missing atypical cases of PCV.

In the risk factors analysis, increasing age has consistently been shown to be strongly associated with increasing risk of AMD. In the present study, the prevalence of early AMD increased with age from 6.1% in the 50 to 59 range to 20.4% in participants older than 80 years. Subjects older than 80 had a nearly 12-fold higher risk of acquiring late AMD than did those aged 50 to 59. On the other hand, our finding that axial myopia was negatively associated with the prevalence of early AMD confirmed previous prevalence studies in which myopia had a protective role in AMD.[30,31] Although the precise mechanisms remain unclear, recent studies suggest that the reasons may include the decrease of scleral rigidity and intraocular concentration of VEGF in longer myopic eyes.[32–34] Many studies of white populations have reported that smoking was an important, independent, and avoidable risk factor for AMD.[35,36] However, a current habit of smoking was not associated with AMD in our study, which was in agreement with most previous Asian population studies.[15,16,26,37–39] It was possibly because there were relatively few subjects with late AMD and only current smoking status had been assessed in the present study. Further investigation is needed to identify the relationships between incidence and risk factors.

In summary, the current study suggests that AMD is highly prevalent among the elderly urban Chinese population in mainland China. The prevalence rate is higher than the rates of the Beijing and Handan eye studies. These data represent a unique insight into the planning of public health strategies for patients with AMD in the world's most populous nation, with the aging of the population and rapid industrialization of cities in China. Further investigation is needed to identify the causes of variations in the prevalence rates and the relationships between incidence and risk factors.

Acknowledgments

The authors thank Jian Zhang (Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou, China) for providing suggestions on study sampling and statistical analysis.

Disclosure: **H. Ye**, None; **Q. Zhang**, None; **X. Liu**, None; **X. Cai**, None; **W. Yu**, None; **S. Yu**, None; **T. Wang**, None; **W. Lu**, None; **X. Li**, None; **H. Jin**, None; **Y. Hu**, None; **X. Kang**, None; **P. Zhao**, None

This study was supported by the National Natural Science Foundation Project of China (81200682, 81271045, 81100655; Beijing, China), the Shanghai Outstanding Young Scientist Foundation from the Shanghai Municipal Health Bureau (XBR2011060, Shanghai, China).

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