

# Prevalence and risk factors for adult cataract in the Jingan district of Shanghai

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## Research article

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# Abstract

## Background

To report the prevalence of age-related cataract (ARC) in the Jingan district of Shanghai and analyze the risk factors for ARC.

## Methods

During March to June in 2010, a cross sectional study was conducted in a community selected by stratified cluster sampling in the Jingan district of Shanghai. Residents aged 40 and older were recruited and investigated by questionnaire and ophthalmic examination.

## Results

A total of 2894 subjects aged 40 years and above were included in our study. 948 people (32.8%) were diagnosed with cataract including 845 with bilateral cataract and 292 with moderate and severe visual impairment (low vision). There were significant differences in the risk of cataract among different age groups and genders. The multivariable Logistic analysis suggested that the prevalence of cataract increased with age. Persons at lower risk for ARC were those with higher education status (OR=0.722), with refractive error (OR=1.352), and those who used computers for 3-8 hours every day (OR=0.592).

## Conclusion

Age, refractive error, education level and daily time of using computers have a certain correlation with ARC.

## Background

According to the report of the World Health Organization, cataract is the leading cause of visual impairment in the world, accounting for most of blindness (51%).<sup>[1]</sup> China has entered into an aging society and Shanghai is the city with the highest degree of aging in China. It is estimated that in 2010, the population aged 60 and over was 3.4697 million (15.07%) in Shanghai, based on the statistics of the sixth national census. Due to the trend of an increasingly aging population, the incidence of age-related cataract (i.e. senile cataract) has increased significantly in China, which has seriously affected the physical and mental health and quality of life of patients. Therefore, senile cataract has become an important public health problem in China. There is a wide range of possible risk factors for age-related cataract (ARC), including increasing age, ultraviolet B exposure, smoking, drinking, estrogen, steroid hormone, antioxidant, diabetes, hypertension and body mass index.<sup>[2]</sup> This report was an exploration of the relationship between ARC and potential risk factors.

## Methods

## Study population

Jingan District is located in the center of Shanghai, covering an area of 7.62 square kilometers. In the sixth national census, the permanent population of the district in 2010 was 246788. Residents aged 40 and older in a community of a street in Jingan district were enrolled in this study. All the participants were informed of the purpose and contents of the investigation in detail and signed the informed consent form before enrollment in the study.

All the subjects were investigated with demographic details and medical history including eye diseases and eye symptoms by questionnaire. In addition, the living and working conditions were also collected in this survey. Ophthalmic examination included measurements of presenting and best corrected visual acuity (BCVA), and external and anterior segment examination at the slit lamp biomicroscope.

## Diagnostic criteria

Presence of cataract was investigated through evaluation for cataract symptoms and clinical signs. Cataract was defined using diagnosis criteria in the following instances: lens opacities; aphakia eyes or eyes with intraocular lens after cataract surgery; pinhole vision  $< 0.7$ , excluding low vision caused by other eye diseases. Either the patients with unilateral cataracts or with bilateral cataracts were recorded as cataract patients.

Using WHO criteria, visual acuity was categorized as follows: normal vision (BVCA  $\geq 20/63$ ), bilateral low vision (BCVA  $< 20/63 \geq 20/400$  in the better eye) and bilateral blindness (BCVA  $< 20/400$  in the better eye). [3]

## Statistical analysis

Statistical analysis was carried out using SPSS, v 17.0 (IBM/SPSS, Inc., Chicago IL).

We used t-test, chi-square test to analyze the univariate association of each risk factor with cataract and multivariable logistic regression to access the independent associations for each risk factor. Odds ratios (OR), and 95% confidence intervals (95% CI) were presented and differences were considered statistically significant when  $P < 0.05$ .

# Results

## Baseline characteristics of the subjects

Table 1 shows the baseline characteristics of participants in this study. A total of 2894 people were recruited, of which 1056 (36.5%) participated in the study were male and 1838 (63.5%) were female. The oldest was 98 years old and the youngest was 40, with an average age of  $62.9 \pm 10.8$  years. Except for three Hui people, the rest were Han. 78.6% (2275) of the participants were married, followed by 404 (14.0%) people who were widowed. The majority of participants (64.7%) completed the secondary

education only, while 20.8% of them were illiterate or completing primary education only, and 14.5% of them had college education. The number of people who did not use computers and air conditioners every day was 1987(68.7%) and 2401(83.0%) respectively, suggesting that there was only a small number of the elder people who used computers and air conditioners. On the contrary, only a few people did not watch televisions every day. The number of people who watched TV within 8 hours every day accounted for 93.6%. People who were smoking and drinking accounted for 16.3% and 13.9% respectively. There were 1104 participants (38.1%) with hypertension and 386 (13.3%) with diabetes. Nearly half of the subjects had ametropia.

**Table 1. Baseline Characteristics of Participants (n=2894)**

Variable		N=2894	%
Gender	Male	1056	36.5
	Female	1838	63.5
Ethnic	Han	2891	99.9
	others	3	0.1
Marital status	Married	2275	78.6
	Divorced	95	3.3
	Widowed	404	14.0
	Never married	120	4.1
Education	None/primary school only	601	20.8
	Secondary school	1872	64.7
	University	421	14.5
Smoking	Yes	472	16.3
	No	2421	83.7
Drinking	Yes	402	13.9
	No	2491	86.1
Time of using computer	No	1987	68.7
	1~2h/d	516	17.8
	3~8h/d	358	12.4
	>8h/d	33	1.1
	No	123	4.3
Time of using Television	1~2h/d	1190	41.1
	3~8h/d	1518	52.5
	>8h/d	63	2.2
	No	2401	83.0
Time to use air conditioners	1~2h/d	275	9.5
	3~8h/d	188	6.5
	>8h/d	30	1.0
	No	1104	38.1
Hypertension	Yes	1104	38.1
	No	1789	61.8
Diabetes	Yes	386	13.3
	No	2507	86.6
Infectious diseases	Yes	1	0.0
	No	2892	99.9
Refractive error	Yes	1398	48.3
	No	1495	51.7
Ocular trauma	Yes	49	1.7
	No	2844	98.3
Contact lenses	Yes	4	0.1
	No	2889	99.8

### Epidemiological characteristics of cataract

The prevalence of cataract by age groups and gender was shown in Table 2. Among the 2894 individuals who enrolled in the study, 948 (32.8%) were diagnosed with cataract including 845 adults with binocular

cataract and 103 adults with monocular cataract. The prevalence of cataract in adults 60-69 years old was 29.9%, about 6 times of that in adults 40-49 years old (5.0%), and the prevalence of cataract in adults 70-79 years old was 12.9%. There was significant difference in the prevalence of cataract among different age groups ( $X^2 = 629.5$ ,  $P < 0.001$ ). The prevalence of cataract in men and women was 33.1% and 32.5% respectively, while no significant difference was found between different genders ( $X^2 = 0.113$ ,  $P = 0.737$ ).

**Table 2. Prevalence of Cataract Stratified by Age, Gender in the Jingan district of Shanghai**

Groups	No. of participants	%	Cataract	
			n	%
<b>Age (years)</b>				
40-49	241	8.3	12	5.0
50-59	1038	35.9	160	15.4
60-69	777	26.8	232	29.9
70-79	598	20.7	372	62.2
≥80	240	8.3	172	71.7
<b>Gender</b>				
Male	1056	36.5	350	33.1
Female	1838	63.5	598	32.5
Total	2894	100	948	32.8

### The distribution of visual acuity

Among the 2894 subjects who underwent ophthalmic examination, 2884 were examined for bilateral visual acuity and 10 could not provide reliable visual acuity answers because of various reasons (Table 3). There were 2577 people with normal vision, 292 with low vision, and 15 people with bilateral blindness, accounting for 89.4%, 10.1% and 0.5% respectively.

Among the subjects 40 to 49 years of age, 93.3% of the people had normal vision and only 6.7% had low vision. With increasing age, the number of people with normal vision decreased gradually. Among the adults 80 years of age or older, the people who had normal vision and low vision accounted for 72.0% and 27.6%, respectively. There were significant differences in the distribution of visual acuity among different age groups ( $X^2 = 84.420$ ,  $P < 0.001$ ).

The number of people who had normal vision, low vision and blindness in men accounted for 91.4%, 8.3% and 0.3% respectively, compared to that in women for 88.2%, 11.1% and 0.7% respectively. The differences in the distribution of visual acuity between men and women were significant ( $X^2 = 7.696$ ,  $P = 0.021$ ).

**Table 3. Age- and Gender-Specific Prevalence of Bilateral Visual Impairment Using the Definition of the World Health Organization**

Groups	No. of participants	Normal vision		Low Vision		Blindness	
		No.	%	No.	%	No.	%
Age (years)							
40 ~49	240	224	93.3	16	6.7	/	/
50 ~59	1035	952	92.0	77	7.4	6	0.6
60 ~69	775	714	92.1	57	7.4	4	0.5
70 ~79	595	515	86.6	76	12.8	4	0.7
≥80	239	172	72.0	66	27.6	1	0.4
Gender							
Male	1054	963	91.4	88	8.3	3	0.3
Female	1830	1614	88.2	204	11.1	12	0.7
Total	2884	2577	89.4	292	10.1	15	0.5

### Risk factors for cataract

The risk factors for cataracts were evaluated by univariate and multivariable analysis (Table 4). The result of univariate regression showed that the increasing age was associated with higher odds of having cataract, which was similar to the result of multivariable regression. The risk of cataract increased 11.6% (95% CI, 10.6% - 12.6%) when age increased every year. There was no significant difference in the risk of cataract between men and women (OR = 1.121, 95% CI: 0.891% - 1.411%). The risk of cataract was approximately four times (95% CI: 2.272% - 5.459%) higher in the widowed than in the unmarried. However, after adjusting for age, the risk of cataract was significantly reduced in the widowed. No significant difference was found between the widowed and the unmarried, which may be because the widowed were generally older than the other.

The results of univariate regression analysis showed that those completing secondary education and above had lower odds ratios compared to those who were illiterate or completing primary school only. Although the difference between people with secondary and primary school education was no longer significant after adjusting for age, the risk of people with college education was lower than those with primary education (OR = 0.722, 95% CI: 0.537% - 0.972%). Based on the multivariable analysis, there was no obvious association between the education level and cataract.

Using univariate analysis, the risk of cataract was lower in people who used computers every day than in people who did not use computer. The risk of cataract in people who used computers every day for 3-8 hours after age adjustment was 0.592 times higher than that in people who did not use computers. There was no significant association between the daily use of television and the risk of cataract. Although not statistically significant, the risk of cataract was lower in people who used air conditioning every day than in people who did not.

Using univariate regression, hypertension and diabetes were risk factors for cataract, which increased the risk of cataract by 59.6% and 79.3%, respectively. However, there was no statistical significance after adjusting for age. The difference between the people who were smoking or drinking and those who were not was not significant after adjusting for age. Using multivariable analysis, only refractive error (OR =

1.352; 95% CI: 12.7% – 62.2%) was independent risk factor for cataract. The univariate analysis showed that people who had a history of ocular trauma and wore contact lenses had a higher risk of cataract than those who did not, although there was no significant difference.

**Table 4. Univariate and Multivariable Association Analysis of Risk Factors for Cataract.**

Risk factors	Univariate Analysis		After Adjusting for Age		Multivariate Analysis		
	OR	95% CI	OR	95% CI	OR	95% CI	
Age	1.116	1.106-1.126			1.107	1.094-1.120	
Gender (female)	0.973	0.823-1.143	1.130	0.940-1.358	1.121	0.891-1.411	
Marital status	Never married	1	1		1		
	Married	0.925	0.620-1.382	0.796	0.509-1.246	0.845	0.537-1.330
	Divorced	0.745	0.405-1.373	0.819	0.416-1.612	0.858	0.432-1.706
	Widowed	3.522	2.272-5.459	0.976	0.529-1.610	0.949	0.568-1.583
Education	Primary school or illiterate	1	1		1		
	Secondary school	0.275	0.227-0.333	0.835	0.659-1.057	0.901	0.703-1.154
	University/college	0.363	0.279-0.471	0.722	0.537-0.972	0.850	0.613-1.179
Time of using computer	No	1	1		1		
	1~2h/d	0.485	0.388-0.606	0.921	0.718-1.181	0.987	0.761-1.280
	3~8h/d	0.269	0.198-0.366	0.592	0.425-0.825	0.617	0.438-0.869
	>8h/d	0.352	0.145-0.856	0.938	0.375-2.349	1.050	0.411-2.682
Time of using Television	No	1	1		1		
	1~2h/d	0.901	0.612-1.325	0.998	0.631-1.577	1.024	0.641-1.636
	3~8h/d	0.794	0.542-1.164	0.971	0.617-1.528	1.017	0.639-1.619
	>8h/d	0.748	0.390-1.436	0.870	0.410-1.847	0.857	0.399-1.841
Time of using air conditioners	No	1	1		1		
	1~2h/d	0.554	0.413-0.743	0.782	0.560-1.090	0.789	0.562-1.108
	3~8h/d	0.504	0.352-0.722	0.849	0.561-1.266	0.864	0.576-1.295
	>8h/d	0.568	0.243-1.328	0.869	0.331-2.282	0.858	0.324-2.276
Hypertension		1.596	1.363-1.870	0.975	0.810-1.172	0.942	0.779-1.139
Diabetes		1.793	1.442-2.229	1.211	0.943-1.556	1.183	0.915-1.530
Smoking		0.754	0.606-0.938	1.089	0.850-1.394	1.164	0.866-1.566
Drinking		0.809	0.640-1.019	0.966	0.741-1.257	0.971	0.720-1.309
Refractive error		1.944	1.660-2.276	1.346	1.124-1.612	1.352	1.127-1.622
Ocular trauma		1.092	0.603-1.976	1.367	0.711-2.628	1.275	0.659-2.469
Contact lenses		0.684	0.071-6.580	4.394	0.452-42.754	5.664	0.555-57.773

## Discussion

In this study, we investigated 2894 subjects over 40 years old in Jingan District of Shanghai, 948 (32.8%) of whom were diagnosed with cataract. Cataract was significantly more prevalent in older age groups. Huang et al. reported that the prevalence of cataract in the elderly is 39.86% in Beixinjing area of Shanghai, which was consistent with the result in our study (32.8%).[4] In a study by Zheng et al., the prevalence of cataract in people older than 60 years in urban areas of Shanghai in 1997 was 46.8%, slightly higher than that in our present study.[5] Our study showed that age is an important risk factor for cataract, which was consistent with other studies, suggesting that cataract may be associated with the natural aging of lens and the long-term exposure to potential risk factors.[6, 7]

It has been found that the antioxidants and antioxidant enzymes in eyes will be significantly reduced after 40 years old, resulting in the inability to effectively protect the eyes. Apart from that, the protective pigment 3-hydroxycaninuric acid in the eyes will be converted into phototoxic yellow uric acid, which may do harm to the lens.[8]

Refractive error has been proved as an independent risk factor for cataract. A cross-sectional study in Singapore showed that myopia (< 0.5d) was closely related to increased incidence of nuclear cataract (OR = 4.99) and posterior subcapsular cataract (OR = 1.34).[9] In addition, the development of cataract can also lead to refractive error of eyes.

Many epidemiological studies on cataract have demonstrated a correlation between low education level and cataract.[10, 11] In our study, as in other studies, people with higher education were at lower risk of cataract even after adjustment for age. A study in the United States reported that people with high education level had a lower risk of moderate nuclear opacity than those with low education level (OR = 0.64), and also had a significantly lower risk of moderate cortical cataract (OR = 0.74).[2] The relationship between education level and cataract is still unknown, but previous studies have suggested that it may associate with confounding factors, including ocular ultraviolet-B exposure, health status, disease and nutrition.[6] Malnutrition has been proven as an independent risk factor for cataract.[12] The proportion of vegetables rich in antioxidants in the diet of people with low education level was significantly lower than that of people with high education level, and the intake of antioxidants can significantly reduce the risk of cataract.[13] A study by Valero et al. demonstrated that dietary intake of vitamins C, E and selenium were associated with decreased odds for cataract.[14]

Daily time of using computers is a potential risk factor for cataract. The age-adjusted prevalence of cataract was found lowest in people who used computers every day for 3-8 hours. This may be closely related to the educational level and occupation of the majority of the elderly in this study. The educational level of people who used computers every day for 3-8 hours was higher than those did not use computers. The risk of cataracts is similar between people who used computers excessively (more than 8 hours a day) and people who didn't use computers, which suggested that excessive use of the eye was harmful to the eye more than other protective effects.

The limitation of the current study was that the cataract patients who had taken measures to avoid possible risk factors after diagnosis were also included in the survey, which may lead to decreasing of the

incidence of potential risk factors for cataract and even the opposite results of previous studies.

## Conclusions

In conclusion, our study investigated the prevalence of ARC in the Jingan district of Shanghai and analyzed the risk factors for ARC. We provided evidence that a higher prevalence was associated with older age, refractive error, illiteracy and using computers for a long time. Thus, we suggested public health organizations pay attention to raising public awareness of the risk factors for cataract, so as to avoid refractive errors due to excessive use of eyes, delay the onset of cataract and advance the control of the occurrence and development of the disease.

## Abbreviations

ARC: Age-related cataract

BCVA: Best corrected visual acuity

CI: Confidence intervals

OR: Odd ratios

SPSS: The Statistical Package for Social Sciences

## Declarations

### Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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## **Contributions**

YJ and YS were responsible for conception and design. XY and JX took responsibility for the statistical analysis and interpretation of the results. YS and XY involved in writing and reviewing of the manuscript. YL and JX advised on the design and analyses and gave suggestions on revision of article. All authors read and approved the final manuscript.

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## **Ethics declarations**

## **Ethical approval and consent to participate**

This study was approved by the Ethics Committee of Eye & ENT Hospital of Fudan University (Shanghai, China). Written informed consent was achieved from all participants before enrolled to this study.

## **Consent for publication**

Not Applicable.

## Competing interests

The authors declare that they have no competing interests.

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