Visual acuity of urban and rural adults in a coastal province of southern China: the Fujian Eye Study

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Abstract

• AIM: To evaluate the vision status and sociodemographic associations of visual acuity (VA) in an urban and rural population in a coastal province of southern China.

• METHODS: The Fujian Eye Study, a population-based cross-sectional study, was performed from May 2018 to October 2019. Totally 10 044 participants over 50 years old from all nine cities in Fujian Province were enrolled, and underwent a questionnaire and a series of standard physical and ocular examinations. VA was measured by E Standard Logarithmic Visual Acuity Chart (GB 11533-1989). Data was double entered with EpiData v3.1 for data collation and Stata/SE statistical software v15.1 was used to analyze the data.

• RESULTS: Totally 8211 (81.8%) participants were finally included and were divided into urban populations (4678 subjects), rural populations (n=3533), coastal residents (n=6434), and inland residents (1777 subjects); 4836 participants were female. The mean age was 64.39±8.87y (median 64y; range 50-98y). The mean presenting VA was 0.61±0.30 (0.23±0.27 logMAR), and the mean best corrected visual acuity (BCVA) was 0.82±0.28 (0.08±0.19 logMAR). In the multiple regression analysis, BCVA was significantly correlated with several socioeconomic and biologic factors, including age (P<0.001), education level (P<0.001), income (P=0.005), rural residency (P<0.001), inland residency (P=0.001) and refractive error (P<0.001), while sex (P=0.194) was independent with BCVA.

• CONCLUSION: Accessible services and eye health policies targeting the elderly, people with high myopia and people living in rural or inland areas are needed.

• KEYWORDS: cross sectional eye study; presenting visual acuity; best corrected visual acuity; urban and rural; coastal and inland

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INTRODUCTION

With improvements in living standards and quality of life, improvement in visual function has become a hot topic. Visual acuity (VA) examination is an important content of a complete oculo-visual evaluation and is very important in the test of amblyopia, refractive error and ocular disease[1]. One of the key objectives of Universal Eye Health: A Global Action Plan 2014-2019 is to generate evidence of the magnitude of vision impairment (VI), which affects economic and educational opportunities, reduces quality of life, and increases the risk of death of approximately 441.1 million persons[2]. Right to Sight is also a very important global project in ophthalmology, launched by WHO in 1999. The project target is set to decrease the expected doubling of blind patients worldwide by the year 2020 as a result of decrease in both mortality and fertility prevalence with the population aging rapidly in most countries[3]. Recently, many reports displayed strong association between socioeconomics and prevalence and causes of VI and blindness which attract great interest to ophthalmologist and policy makers of public eye health[4].
study just conducted from 2018-2019, and could provide the latest prevalence and related factors of VI and eye diseases. Many articles have reported the prevalence and risk factors for VA changes or VI worldwide, but few published studies have compared and analyzed VA and VI in both rural and urban regions and inland and coastal areas. Due to the specific geographic location, six cities in Fujian Province have coastlines and three cities are inland areas, differences between both rural and urban regions and inland and coastal areas can be explored at the same time. Therefore, the present Fujian Eye Study (FJES) aimed to evaluate the central VA as an important factor to visual function among rural and urban and inland and coastal populations in southern China and identify ocular and demographic associations. As we know, there are many factors that affect vision, not only the eyes, but also the physical body, even socio-economic and demographic factors. Many studies have reported the related factors a long time ago, such as age, sex, income, education, and refractive error, while these studies were not up to date and limited. In order to fill this gap in knowledge and to comprehend the vision health status and factors correlated with major eye diseases and vision loss, the research group conducted a population-based cross-sectional investigation to obtain data about the eye health situation among Chinese individuals aged 50y and above living in Fujian Province. This survey was just operated before the COVID-19 outbreak, and this may guide the eye health policy-making in future.

**SUBJECTS AND METHODS**

**Ethical Approval** The Ethics Committee of Xiamen Eye Center affiliated to Xiamen University approved the 2018-2019 FJES protocol (Acceptance number: XMYKZX-KY-2018-001) and written informed consent was obtained from all participants.

**Study Design** The FJES was a population-based, cross-sectional investigation on the public eye health status of Fujian Province, Southeast China, including both rural and urban regions and inland and coastal areas. It was carried out to identify the prevalence and related factors associated with VI and ocular diseases in residents aged 50y and above and to comprehend the differences among and obstacles to eye health service use in such areas.

The calculation formula and baseline data used in this study were elaborated in our published article. Assuming a response rate of 80%, to obtain a sufficient sample size according to previous studies, 10,044 subjects were recruited in this study. The total population of Fujian Province (which has an area of 124,000 km²) was 38.74 million (permanent population of the province at the end of 2016), including 14.10 million rural population and 24.64 million urban population, or 7.84 million inland population and 30.90 million coastal population. Therefore, 4209 rural residents and 5835 urban residents, or 2190 inland residents and 7854 coastal residents were recruited respectively.

**Recruitment Procedures** Participants underwent a comprehensive physical examination in a mobile clinic, which was set up in specific location (in community centre, administrative office or hospital). Those who could not participate in on-site examination in the screening were inquired for the consent of home visit and simple ophthalmic examination. All the technicians and clinicians were trained uniformly, and each inspection required the fixed cooperation of equipment and personnel.

The main contents of the survey include: general information (name, sex, age, telephone number, ID number, address); questionnaire (race, blood group, the socioeconomic status, disease history, living habits, etc.); presenting VA; refractive state; best corrected visual acuity (BCVA); slit lamp inspections and fundus inspections [multicolor optical coherence tomography (OCT) and non-mydriatic fundus photographs].

E Standard Logarithmic Visual Acuity Chart (GB 11533—1989) was used to measure presenting VA and BCVA at a distance of 5 meters. We followed the World Health Organization (WHO) definitions of VI with BCVA in better eye worse than 20/60 (equaled to 0.3 in E Chart) and blindness with BCVA in better eye of 20/400 or worse (equaled to 0.05 in E Chart).

**Statistical Analysis** Double data entry was performed with EpiData version 3.1 for data collation and the final data was analyzed with Stata/SE statistical software version 15.1. Data are shown as means±standard deviation (SD). Means of normally distributed parameters among different subgroups were compared using analysis of variance (ANOVA). Proportions was compared using analysis of variance (ANOVA). The relations between VA and selected potential factors was examined using multiple Logistic regression. Normally distributed parameters were compared using linear correlation. Confidence intervals (95%CI) are presented. The statistical strengths of correlations are shown as correlation coefficients (r) or odd ratio (OR) values. All P values<0.05 were defined statistically significant.

**RESULTS**

Based on the WHO definitions considering BCVA, 196 (2.88%) residents were low vision, and 31 (0.39%) residents were blind. The response rate of the whole population was 81.8% (8211 out of 10,044), and 4836 were female. Totally 43.0% of the population was from a rural area, which was similar to the rural and urban population ratio in Fujian Province (58.1% vs 41.9%), and 78.4% of the population was from a coastal area, which was also similar to the inland and coastal population ratio in Fujian Province (79.8% vs 20.2%). The response rates in the rural and urban populations were 80.2% and 83.9% respectively.
and 81.9% and 81.1% for the inland and coastal populations, respectively. The rural and urban groups varied significantly in education and income levels, as did the inland and coastal groups (Table 1).

### Visual Acuity

Only a randomly selected eye per resident among the whole study population was included in the statistical analysis. The mean presenting VA measured 0.61 (0.30). When the VA of finger counting (FC) or below were excluded, the mean presenting VA was 0.61 (0.30). When eyes with better VA were selected in the statistical analysis, the mean presenting VA was 0.68 (0.29). Expressed as the negative logarithmic value of the minimal angle of resolution (logMAR), the mean presenting VA in residents was 0.23 (0.27) logMAR units. The mean BCVA measured 0.82 (0.28). When eyes with a VA of FC or less were excluded, the mean BCVA was 0.83 (0.28). When eyes with better BCVA were selected in the statistical analysis, the mean BCVA values were 0.88 (0.24) and 0.08 (0.19) logMAR units.

### Regional Comparison

Presenting VA was statistical significantly \((P<0.0001)\) greater among the rural residents than among the urban residents [0.84 (0.27) vs 0.81 (0.29)]. The presenting VA was statistical significantly \((P=0.0460)\) greater among the coastal residents than among the inland residents [0.61 (0.30) vs 0.59 (0.30)]. Similarly, BCVA was statistical significantly \((P<0.0001)\) greater among the coastal residents than among the inland residents [0.84 (0.28) vs 0.78 (0.29); Table 1].

### Correlation of VA with Age

Presenting VA and BCVA were both significantly associated with age \((r=-0.33\) and -0.42, \(P<0.0001)\). Stratifying the present FJES population into rural residents group and urban residents group and inland residents group and coastal residents group showed similar results (urban group: \(r=-0.30\) and -0.39, \(P<0.0001)\; rural group: \(r=-0.36\) and -0.44, \(P<0.0001)\; coastal group: \(r=-0.33\) and -0.41, \(P<0.0001)\; inland group: \(r=-0.31\) and -0.46, \(P<0.0001)\). Since the rural residents subgroup was statistical significantly younger than the urban residents subgroup (Table 1), both groups were stratified by age. And as the coastal residents subgroup was significantly younger than the inland residents subgroup (Table 1), both subgroups were also randomly stratified by age. Table 2 shows the difference among age subgroups in detail.

### Table 1 Baseline characteristics of eligible participants in Fujian Eye Study

<table>
<thead>
<tr>
<th>Classification</th>
<th>Total study</th>
<th>Urban population</th>
<th>Rural population</th>
<th>Coastal population</th>
<th>Inland population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects (n)</td>
<td>8211</td>
<td>4678</td>
<td>3533</td>
<td>6434</td>
<td>1777</td>
</tr>
<tr>
<td>Females (n)</td>
<td>4836</td>
<td>2697</td>
<td>2139</td>
<td>3804</td>
<td>1032</td>
</tr>
<tr>
<td>Age (y, mean±SD)</td>
<td>64.39±8.87</td>
<td>64.4±8.66</td>
<td>64.05±9.12</td>
<td>0.0028</td>
<td>64.49±8.74</td>
</tr>
<tr>
<td>Presenting VA (mean±SD)</td>
<td>0.61±0.30</td>
<td>0.62±0.30</td>
<td>0.58±0.30</td>
<td>&lt;0.0001</td>
<td>0.61±0.30</td>
</tr>
<tr>
<td>BCVA (mean±SD)</td>
<td>0.82±0.28</td>
<td>0.84±0.27</td>
<td>0.81±0.29</td>
<td>0.0001</td>
<td>0.84±0.28</td>
</tr>
<tr>
<td>Refractive error (diopters, mean±SD)</td>
<td>0.52±2.73</td>
<td>0.51±2.69</td>
<td>0.54±2.78</td>
<td>0.68</td>
<td>0.62±2.67</td>
</tr>
</tbody>
</table>

SD: Standard deviation; VA: Visual acuity; BCVA: Best corrected visual acuity; \(P\)-value represents the statistical significance of difference between rural and urban population; \(^\text{a}\)\(P\)-value represents the statistical significance of inland population and coastal population difference.
Correlation of VA with Refractive Error  Presenting VA and BCVA were all significantly associated with refractive error ($r=-0.20$ and $-0.27$, $P<0.001$). Stratifying the whole FJES residents into rural residents group and urban residents group and inland residents group and coastal residents group showed similar results (urban group: $r=-0.22$ and $-0.20$, $P<0.0001$; rural group: $r=-0.17$ and $-0.20$, $P<0.0001$; coastal group: $r=-0.17$ and $-0.22$, $P<0.0001$; inland group: $r=-0.27$ and $-0.13$, $P<0.0001$). Correspondingly, BCVA was statistical significantly ($P<0.0001$) lower in the high myopia residents subgroup, excluding the high hyperopia residents subgroup [0.48 (0.33) vs 0.85 (0.25)], with a myopic ametropia exceeding -6.00 diopters, than in non-high myopia group. BCVA also decreased significantly with astigmatism ($r=-0.27$, $P<0.0001$). And Table 3 shows the difference among refraction groups in detail.

Correlation of VA with Education  In the whole ($r=0.15$ and 0.22, $P<0.0001$), the same as in the rural residents subgroup ($r=0.15$ and 0.25, $P<0.0001$), urban residents subgroup ($r=0.12$ and 0.17, $P<0.0001$), inland residents subgroup ($r=0.18$ and 0.35, $P<0.0001$) and coastal residents subgroup ($r=0.14$ and 0.21, $P<0.0001$), both presenting VA and BCVA were significantly associated with education level. Since the urban residents group and inland residents group had a statistical significantly higher educational background than their corresponding groups (Table 1), all the residents were stratified into different subgroups according to the educational background. Figure 1 presents the difference among educational subgroups in detail.

Correlation of VA with Income  According to the univariate analysis including the whole study population, presenting VA and BCVA were significantly ($r=-0.15$ and $-0.16$, $P<0.0001$) associated with income level. The whole study population was stratified, and the correlations of income level with presenting VA and BCVA were significant in the rural residents group ($r=-0.17$, $P<0.0013$; $r=-0.22$, $P<0.0001$) and the coastal residents group ($r=-0.16$, $P<0.0001$; $r=-0.16$, $P<0.0001$). The correlations with BCVA in the urban residents group ($r=-0.10$, $P<0.0001$) and inland residents group ($r=-0.22$, $P<0.0001$) were significant, whereas the correlations with presenting VA did not vary significantly in the urban residents group ($r=0.09$, $P=0.0867$) and inland residents group ($r=0.12$, $P=0.1185$). Figure 2 shows the difference among income subgroups in detail.

Correlation of VA with Sex and Eye  Among the FJES participants, 8063 (98.2%, 8036 out of 8211) had VA test results, including 4776 female residents and 3287 male residents, and 6823 (83.1%, 6823 out of 8211) had BCVA test results, including 4257 female residents and 2566 male residents. In the univariate analyses, presenting VA and BCVA were not significantly different between males and females [0.61 (0.31) vs 0.60 (0.29), $P=0.1151$; 0.82 (0.29) vs 0.83 (0.27), $P=0.3761$]. Moreover, there were no statistically significant difference between right eye and the left eye in presenting VA and BCVA [0.61 (0.30) vs 0.61 (0.30), $P=0.8625$; 0.82 (0.28) vs 0.83 (0.28), $P=0.4050$].

Multiple Regression Analysis  Because some of these parameters, such as age and refractive error, there was

### Table 2 Visual acuity in the age stratification subgroups among different regional residents groups in Fujian Eye Study

<table>
<thead>
<tr>
<th>Age group (y)</th>
<th>Urban group</th>
<th>Rural group</th>
<th>Coastal group</th>
<th>Inland group</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Mean±SD</td>
<td>Number</td>
<td>Mean±SD</td>
<td>Number</td>
</tr>
<tr>
<td>50-54</td>
<td>637</td>
<td>0.72±0.33</td>
<td>597</td>
<td>0.71±0.30</td>
<td>3634</td>
</tr>
<tr>
<td>55-59</td>
<td>748</td>
<td>0.71±0.29</td>
<td>625</td>
<td>0.70±0.29</td>
<td>1044</td>
</tr>
<tr>
<td>60-64</td>
<td>932</td>
<td>0.67±0.29</td>
<td>642</td>
<td>0.61±0.28</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>65-69</td>
<td>987</td>
<td>0.62±0.27</td>
<td>655</td>
<td>0.56±0.27</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>70-74</td>
<td>701</td>
<td>0.53±0.27</td>
<td>473</td>
<td>0.47±0.27</td>
<td>0.0001</td>
</tr>
<tr>
<td>75-79</td>
<td>320</td>
<td>0.49±0.25</td>
<td>272</td>
<td>0.43±0.26</td>
<td>0.0005</td>
</tr>
<tr>
<td>80+</td>
<td>277</td>
<td>0.40±0.23</td>
<td>197</td>
<td>0.35±0.24</td>
<td>0.0466</td>
</tr>
<tr>
<td>BCVA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-54</td>
<td>531</td>
<td>0.95±0.22</td>
<td>547</td>
<td>0.95±0.20</td>
<td>0.7583</td>
</tr>
<tr>
<td>55-59</td>
<td>630</td>
<td>0.93±0.21</td>
<td>555</td>
<td>0.93±0.20</td>
<td>0.8262</td>
</tr>
<tr>
<td>60-64</td>
<td>706</td>
<td>0.87±0.24</td>
<td>597</td>
<td>0.84±0.27</td>
<td>0.0335</td>
</tr>
<tr>
<td>65-69</td>
<td>768</td>
<td>0.84±0.26</td>
<td>587</td>
<td>0.80±0.28</td>
<td>0.009</td>
</tr>
<tr>
<td>70-74</td>
<td>540</td>
<td>0.74±0.27</td>
<td>436</td>
<td>0.69±0.30</td>
<td>0.0032</td>
</tr>
<tr>
<td>75-79</td>
<td>230</td>
<td>0.65±0.28</td>
<td>245</td>
<td>0.60±0.31</td>
<td>0.085</td>
</tr>
<tr>
<td>80+</td>
<td>186</td>
<td>0.52±0.27</td>
<td>177</td>
<td>0.50±0.31</td>
<td>0.5614</td>
</tr>
</tbody>
</table>

VA: Visual acuity; SD: Standard deviation; BCVA: Best corrected visual acuity. $P$-value represents the statistical significance of difference between rural and urban population; '*' $P$-value represents the statistical significance of inland population and coastal population difference.

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**Visual acuity in Fujian Eye Study**

Table 2 Visual acuity in the age stratification subgroups among different regional residents groups in Fujian Eye Study
Table 3 Visual acuity in refraction stratification subgroups in different regional residents groups in Fujian Eye Study

<table>
<thead>
<tr>
<th>Refractive error (diopters)</th>
<th>Urban group</th>
<th>Rural group</th>
<th>Coastal group</th>
<th>Inland group</th>
<th>$p$</th>
</tr>
</thead>
</table>
| Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | 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Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SD | Number | Mean±SG
Residents with high income had no difference with presenting VA and BCVA between rural and urban and inland and coastal areas. All these results suggested residents with higher education level and higher income paid more attention to the improvement of visual function.

In the Shihpai Eye Study\textsuperscript{[7]}, also a population-based eye study, there was a statistically significant increase in the prevalence of low vision ($P<0.001$) from 0.83\% among 65 to 69y age subgroup to 8.33\% among 80y or older subgroup, and there was no statistically significant difference with gender in the rate of blindness or low vision. In the Beijing Eye Study\textsuperscript{[6]}, consistent with the FJES study on southern Chinese individuals, there was also no statistically significant difference with gender in VI prevalence. Interestingly, in a Russian Ural Eye and Medical Study\textsuperscript{[17]}, an increased prevalence of moderate-to-severe VI/blindness was associated with age, male sex and educational level. The Multi-Ethnic Study in White, Chinese, Black and Hispanic Participants showed that older age was statistical significantly correlated with VI in both women and men, especially in those with lower socioeconomic status (SES), while the influences of increasing age on men were more significant than that on women\textsuperscript{[18]}. A national survey among Chinese adults found that older age, young or middle-age in males, old age in females, illiteracy, rural dwelling, non-eastern residency, single status, unemployment, and lower-income family status were associated with VI\textsuperscript{[19]}. Our study found that there was no sex difference in BCVA; nevertheless, after age stratification, women over 65y were more likely to
have VI than men. However, controversial results also exist; for example, the Gutenberg Health Study (GHS) found that VA decreased statistically significant difference with age, was higher in men than in women, was lower in those with a low socio-economic status, and had multiple underlying ophthalmological pathologies. The prevalence of VI in the GHS study individuals was 0.37%, while the prevalence of blindness was 0.05%, which was lower than that in our study. This shows that medical conditions and demographic factors can have a great impact on VI²⁹. The Brazilian Amazon Region Eye Survey showed that female sex, older age and a lower educational background were correlated with ≥6 lines of uncorrected VA impairment²¹. The Yazd Eye Study in Central Iran also found that VI was significantly associated with older age and female sex²². The Singapore Epidemiology of Eye Diseases Study found that female sex, older age, lower socioeconomic status (income and education), systemic comorbidities, diabetes and cognitive impairment were independently correlated with and increased risk of BCVA loss³⁰. A study in Lodz, Poland, revealed that increasing age and female sex were independent risk factors for VI²³. In the China Nine-Province Survey³⁰, VI and blindness were correlated with female sex, older age, geographic area (province), and lack of education for both BCVA and presenting VI. By comparison with a study in northern Chinese individuals in Beijing³⁶, and the Shihpai Eye Study³⁷, the present FJES study on southern Chinese residents in Fujian Province showed that VA did not differ by sex. Hashemi et al³⁴ reported that the major reason for the high VI prevalence in underserved Iranian villages was the lack of access to medical services. Refractive errors and cataract were responsible for nearly 80% of VI, which could be as a result of the cause of poverty in underserved villages. Our study demonstrated that age and refractive errors are the main risk factors of low vision.

Population-based studies around the world, such as the Beijing Eye Study³⁶,²⁵, the Handan Eye Study³⁴,²⁵, the Liwan Eye Study³⁶,²⁶, the Russian Ural Eye and Medical Study³⁷, the Singapore Epidemiology of Eye Diseases (SEED) Study³⁷, the Global Burden of Disease Study³⁸, the Health ABC Study³⁹, the China Health and Retirement Longitudinal Study³⁰, the Shaanxi Eye Study⁴¹, the National Eye Survey in Malaysia (NESII)⁴², the Blue Mountains Eye Study⁴³, and the Chinese American Eye Study⁴⁰, have demonstrated that age is undoubtedly the most significant factor correlated with VI; however, associations of prevalence of low vision and unilateral blindness with age and other sociodemographic factors were not assessed in the rural and urban populations and the inland and coastal populations. Our research comprehensively analyzed the correlations between VA and a variety of sociodemographic factors at different levels. In summary, our study integrated the results of life vision and corrected vision, and provided more comprehensive information for the summary of lens wearing rate and eye disease status. The present study revealed positive correlations between VA and a younger age, a higher educational level, a lower myopic refractive error, urban residency and coastal residency in southern Chinese individuals. Nearly 80% of Fujian Province are mountainous areas, with inconvenient transportation and limited economic and medical resources. In addition, the education level of rural women is generally low, as they are bound by traditional lifestyles, and their health literacy is poor. All of these factors may contribute to low vision. With large population, different geographical environment and aging problems in China, vision health still has a long way to go.

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REFERENCES

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23 Nowak MS, Smigielski J. The prevalence and causes of visual impairment and blindness among older adults in the city of Lodz, Poland. *Medicine (Baltimore)* 2015;94(5):e505.


