Uncorrected near vision acuity and associated factors in a coastal province in southern China: the Fujian eye cross sectional study

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Background: Near vision (NV) is essential to visual quality of individuals, and could be affected by different factors and changed gradually with the development of society. An update estimates is needed. Our study aims to investigate the age-trends in and sociodemographic characteristics associated with uncorrected near vision acuity (UNVA) in people ≥50 years in southern China.

Methods: A population-based, cross-sectional survey on the eye health status of residents in both inland and coastal areas of Fujian Province, southern China was performed by Eye Institute and Affiliated Xiamen Eye Center of Xiamen University. People aged ≥50 years (10,044 subjects) in Fujian province were recruited according to the cluster sampling design by Fujian eye cross sectional study (FJES) group. The contents of the questionnaire survey included age, gender, education, occupation and other socioeconomic status. UNVA and slit lamp examination were performed for the participants in the field survey. Analysis of variance (ANOVA) was applied to compare the mean among groups of normally distributed parameters of UNVA and the chi-square (χ^2) test was used to compare the proportion.

Results: Among the baseline participants, 8,211 (81.8%) attended follow-up examinations. The sample had a mean age of 64.4 years [standard deviation (SD) =8.9], and 4,836 of the participants were female (58.9%). The average UNVA values for males and females were 0.29±0.18 and 0.28±0.17, respectively (P=0.000). UNVA gradually decreased with age and plateaued between 65 and 80 years old. There were significant differences in the mean values of UNVA associated with different occupations (P=0.000). UNVA was significantly different among people with different education levels (P=0.000). The average UNVA in people in coastal areas was 0.28, while that in people in inland areas was 0.29 (P=0.006). People in urban areas appeared to have better UNVA on average (0.29) than those in rural areas (0.27; P=0.000).

Conclusions: After age 50, NV was reduced gradually. Age, gender, education, occupation, income and geographical factors may affect the NV performance of adults, which should be taken into account to achieve a good management of vision quality.

Keywords: Uncorrected near vision acuity (UNVA); ageing; China; cross-sectional study

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Introduction

An estimated 216.6 million out of a global population of 7.33 billion people had moderate to severe visual impairment in 2015. Among them, 666.7 million people aged over 50 years were affected by functional presbyopia (1). The total global burden of near vision (NV) loss increased from 5.3 million disability-adjusted life years (DALYs) in 1990 to 9.8 million DALYs in 2017, corresponding to an increase of 82.4% (2). The increase of near vision impairment (NVI) was especially profound in underdeveloped countries and low-income groups.

NVI has a serious impact on human health, and numerous studies have been conducted worldwide to explore its prevalence and related factors. NVI has been associated with race, age, gender, education, health insurance, income, and level of medical care. With the increasing number of studies, additional relevant factors are gradually emerging (3). In a comparative study involving 7 countries and regions in 2012, the age- and gender-standardized prevalence rate of uncorrected NVI [visual acuity (VA) <20/40] was 49% in Dosso, 60% in Shunyi and Guangzhou, 65% in Kaski and Los Angeles, and 83% in Madurai and Durban (3). In that study, Guangzhou and Los Angeles provided samples from urban populations, Durban provided samples from a semiurban population, and the other 4 sites provided samples from rural populations. The variability in results may be due to differences in the study population age, examination environments, education levels, or other possible lifestyle factors.

In addition, with the development of society, the popularity of electronic products and close work in daily life makes a high requirement for NV in individual gradually. As middle-aged and old people are the mainly vulnerable group of NV, their vision quality deserves more attention of the society. It is necessary to investigate and identify trends of presbyopia and its potential determinants associated with changes in lifestyle. Fujian eye cross sectional study (FJES) was a survey on the eye health status of residents in Fujian Province (4), and which had geographical characteristic of coastal area, also providing advantage for relevant research. Therefore, we conducted this investigation, trying to explore the influence of coastal and inland factors as well as socio-demographic characteristics on NV. We present the following article in accordance with the SURGE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1526/rc).

Methods

Study design

The FJES is a population-based survey on the eye health of adults in Fujian Province, China. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was performed by Eye Institute and Affiliated Xiamen Eye Center of Xiamen University and approved by the Ethics Committee of Eye Institute and Affiliated Xiamen Eye Center of Xiamen University (Approval No. XMYKZX-KY-2018-001). Informed consent was taken from all participants. Participants aged ≥50 years were required for the survey, which was carried out in 2018–2019. Based on the population of Fujian Province, it was estimated that 10,044 residents would need to be recruited. In the study, a two-stage cluster sampling was designed, by initial random clusters selection and subjects random selection subsequently. All investigators have been trained uniformly to ensure the investigation consistently.

Data collection

The main contents of the FJES survey included two sections: questionnaire and examination. Age, gender, living area and socioeconomic status (education, income, occupation) were collected in questionnaire. The field survey included slit lamp examination (anterior and posterior segments examination) and uncorrected near vision acuity (UNVA). UNVA was measured at 30 cm by tumbling E chart. The scale of the chart were 0, 0.125 (20/160), 0.16, 0.20, 0.25, 0.32, 0.4 (20/50), 0.5, 0.63, and 0.8 (20/25). NVI worse than 20/40 was considered to be presenting NVI (PNVI). People were grouped according to gender as well as occupation, education level, income, urban and rural residency, and coastal and inland residency.

Statistical analysis

The process of statistical analysis was performed by Stata software (version 15.1, StataCorp LLC, College Station, TX, USA) in this study. The comparison of NV in different groups was performed by analysis of variance (ANOVA) analysis. Analysis of NVI was performed by chi-square (χ^2) test. All P values less than 0.05 by two-side were considered statistically significant.

Table 1 Distribution of the population

Groups	Total	%	Urban (%)	Rural (%)	P[1] value	Coastal (%)	Inland (%)	P[2] value
N	8,211		4,678	3,533		6,434	1,777	
Age (years)	8,211							
50–59		32.1[a]	53.3[b]	46.7		75.3	24.7	
60–69		39.8	59.6	40.4		81.0	19.0	
70–79		21.9	57.6	42.4		78.9	21.1	
80+		6.2	57.1	42.9	≤0.001[c]	75.3	24.7	≤0.001
Gender	8,211							
Male		41.1	58.7	41.3		77.9	22.1	
Female		58.9	55.8	44.2	0.009	78.1	21.3	0.430
Education	7,091							
Illiterate		18.1	37.7	62.3		90.2	9.8	
Primary school		21.4	49.3	50.7		86.0	14.0	
High school		43.7	57.8	42.2		85.1	14.9	
University		16.8	68.0	32.0	≤0.001	79.8	20.2	≤0.001
Occupation	6,537							
Mental worker		21.6	59.0	41.0		73.2	26.8	
Manual worker		16.8	31.2	68.8		92.2	7.8	
Retired		33.1	65.2	34.8		87.7	12.3	
Freelance		28.5	47.6	52.4	≤0.001	89.5	10.5	≤0.001
Income (RMB)	4,957							
<2,000		48.8	48.7	51.3		86.4	13.6	
2,000–5,000		39.3	70.2	29.8		77.0	23.0	
>5,000		11.9	67.1	32.9	≤0.001	82.5	17.5	≤0.001
Zone	8,211							
Urban		–	–	–		75.9	24.1	
Rural		–	–	–	–	81.7	18.3	≤0.001

[1], urban *vs.* rural; [2], coastal *vs*. inland; [a], proportion of the sample in the entire age group; [b], proportion of the sample in a single age group; [c], χ^2 test was carried out on different age groups between urban and rural areas. N, number; χ^2, chi-square.

Results

A total of 8,211 (81.8%) individuals were included in our study (*Table 1*). For urban and rural population, the response rates were 80.2% and 84.0% respectively, and for coastal and inland population, that were 80.3% and 87.6% respectively. The population proportion of each group was similar to that in the census population of China. As no significant difference was found in the mean UNVA for both eyes in the participants (P=0.842), only the right eye was considered in the study. The sample had a mean age of 64.4 years [standard deviation (SD) = 8.9], and 4,836 of the participants were female (58.9%). The average UNVA values in males and females were 0.29±0.18 and 0.28±0.17, respectively (P=0.000; *Table 2*).

The mean UNVA in residents gradually decreased with age (*Figure 1*). There was a significant decrease in UNVA from age 50 to 65 (P=0.000). The mean UNVA

Table 2 Comparison of mean near VA

Groups	Total		Urban		Rural		P[1] value	Coastal		Inland		P[2] value
	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD		N	Mean ± SD	N	Mean ± SD	
Age (years)												
50–59	2,583	0.34±0.19	1,370	0.33±0.18	1,213	0.35±0.20	0.089[a]	1,949	0.32±0.18	634	0.38±0.21	≤0.001
60–69	3,193	0.26±0.15	1,892	0.27±0.15	1,301	0.24±0.14	0.000	2,587	0.26±0.15	606	0.25±0.13	0.193
70–79	1,768	0.26±0.16	1,016	0.27±0.16	752	0.24±0.15	0.000	1,395	0.26±0.17	373	0.23±0.12	0.002
80+	484	0.23±0.15	273	0.26±0.16	211	0.20±0.14	0.000	363	0.24±0.15	121	0.20±0.14	0.008
P value		≤0.001[b]				≤0.001[c]					0.006	
Gender												
Male	3,192	0.29±0.18	1,854	0.29±0.17	1,338	0.29±0.19	0.960	2,490	0.29±0.17	702	0.29±0.18	0.976
Female	4,836	0.28±0.16	2,697	0.29±0.16	2,139	0.27±0.16	≤0.001	3,804	0.27±0.16	1,032	0.29±0.17	≤0.001
P value		≤0.001				≤0.001					0.006	
Education												
Illiterate	1,272	0.22±0.13	476	0.23±0.13	796	0.22±0.13	0.068	1,146	0.22±0.13	126	0.21±0.13	0.348
Primary school	1,499	0.24±0.13	732	0.25±0.13	767	0.23±0.13	0.036	1,287	0.24±0.13	212	0.23±0.14	0.375
High school	3,046	0.29±0.16	1,744	0.30±0.16	1,302	0.29±0.16	0.027	2,584	0.30±0.16	462	0.29±0.15	0.253
University	1,161	0.38±0.22	786	0.35±0.21	375	0.45±0.23	≤0.001	922	0.36±0.21	239	0.46±0.24	≤0.001
P value		≤0.001				≤0.001					≤0.001	
Occupation												
Mental worker	1,386	0.36±0.21	813	0.32±0.19	573	0.39±0.23	≤0.001	1,009	0.34±0.20	377	0.40±0.23	≤0.001
Manual worker	1,095	0.24±0.14	340	0.26±0.14	755	0.24±0.13	0.035	1,009	0.24±0.14	86	0.24±0.16	0.906
Retired	2,135	0.29±0.17	1,388	0.30±0.17	747	0.27±0.16	0.002	1,869	0.29±0.17	266	0.26±0.15	0.007
Freelance	1,843	0.26±0.14	870	0.26±0.14	973	0.24±0.13	0.003	1,648	0.25±0.14	195	0.24±0.13	0.141
P value		≤0.001				≤0.001					≤0.001	
Income (RMB)												
<2,000	2,391	0.25±0.14	1,160	0.26±0.14	1,231	0.24±0.14	0.000	2,063	0.25±0.14	328	0.25±0.15	0.869
2,000–5,000	1912	0.32±0.18	1,333	0.31±0.18	579	0.33±0.19	0.011	1,464	0.32±0.21	448	0.32±0.19	0.934
>5,000	572	0.38±0.22	381	0.35±0.20	191	0.42±0.24	0.000	484	0.36±0.21	88	0.45±0.25	0.001
P value		≤0.001				0.018					0.009	
Zone												
Urban	4,551	0.29±0.16	–	–	–	–	–	3,429	0.30±0.17	1,122	0.27±0.14	≤0.001
Rural	3,477	0.28±0.17	–	–	–	–	–	2,865	0.26±0.16	612	0.33±0.22	≤0.001
P value		≤0.001				–					0.006	

[1], urban *vs.* rural; [2], coastal *vs*. inland; [a], comparison of mean near VA in urban and rural populations of the same age; [b], comparison of mean near VA of different age groups; [c], differences between urban and rural areas for different age groups. VA, visual acuity; N, number; SD, standard deviation.

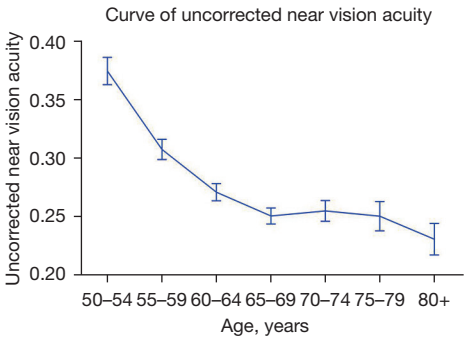

Figure 1 The trend of UNVA in the population by age. UNVA, uncorrected near vision acuity.

then plateaued at approximately 0.25 between 65 and 80 years old. After age 80, the loss of UNVA increased again (P=0.015).

There was significant statistical difference in the mean UNVA values between males and females (0.29 *vs.* 0.28; P=0.000). The mean values of UNVA varied among different occupations. Among them, the average UNVA of participants involved in mainly indoor or office work was 0.36, which was significantly different from that in mainly outdoor or manual workers (0.24; P=0.000). The difference between outdoor workers and freelancers was not obvious (0.24 *vs.* 0.25; P=0.295). There were obvious differences in the mean UNVA values between retirees (0.29) and other occupations (P=0.000). With respect to education level, it was found that UNVA significantly differed for varying levels of education (P=0.000). The average UNVA in illiterate participants was 0.22, while UNVA in participants with an university education was 0.39. There were also significant differences in the mean UNVA between coastal and inland residents (P=0.027). The average UNVA in people in coastal areas was 0.28, while that in people in inland areas was 0.29 (P=0.006). People in urban areas appeared to have better UNVA on average (0.29) than those in rural areas (0.27; P=0.000).

The percentage of participants with PNVI was 68.58%. More people living in rural areas suffered from severe PNVI (70.48%) than those living in urban areas (67.13%; P=0.001). There was no significant difference between coastal or inland areas in the PNVI rate (68.26% *vs.* 69.72%; P=0.247).

Discussion

Our previous research had elaborated on the design and general characteristics of FJES study (4), while in this study, we systematically assessed UNVA based on occupation, education level, income level, and geographic factors. Overall, the mean UNVA was 0.29, and there were various differences in UNVA on the basis of different sociodemographic factors.

In urban residents, average NV was better than that in those living in rural areas. Few previous studies have compared urban and rural areas in the same region. In the adjacent region of Guangzhou, southern China, the prevalence of uncorrected NVI (VA <20/40) was reported to be approximately 60% in urban populations (3). This result was consistent with our study, which found that rural residents had a higher rate of PNVI (64.5%) than urban residents. In rural areas in northern China, the prevalence of functional presbyopia (NV <20/50 improved by 1 line with correction = among people aged 40 years or older was 67.3% (5), which was similar to the results in the rural populations of our FJES-based study in southern China. The rural-urban difference may be attributable to limited access to eye care services in rural areas (6). Similarly, in our study, urban residents generally had higher incomes and education levels than rural residents, suggesting that they had better access to health education and medical care. This may explain why urban dwellers had better UNVA than rural dwellers.

A high prevalence of NVI among older persons has been found in many countries. In Nepal in southern Asia, the prevalence of uncorrected near visual impairment (vision of 20/40 or worse) in the population aged 35 years and over was found to be 66.1% (7). According to an US study carried out between 1999 and 2008, a total of 13.6% of participants aged ≥50 years had PNVI (8). Another study found that NVI affected approximately 1/3 of indigenous Australian adults aged 40 years and over in 2016. This result was lower than that in other studies; however, the population in their study was younger than that of other studies, which may explain the relatively low prevalence (9). In Tanzania, Africa, which has a primarily rural-based population, a total of 61.7% of eligible participants aged 40 years and older were affected by presbyopia in 2006 (10).

The effect of geographic factors on the vision of residents, including coastal and inland location, was explored in our study. There were significant differences in UNVA between coastal and inland residents. Residents who lived inland had better UNVA than coastal residents. This difference could be a reflection of limited accessibility to medical services in remote and rural locations (11).

Additional possible reasons, including underlying lifestyle and economic differences, need to be further studied (12).

Our results showed that UNVA decreased with age, similar to the findings of previous studies (3,8). Interestingly, in our study, we found that UNVA plateaued for many years around the ages of 50 and 60 after a sharp decline. This indicated that after a certain age, as near work gradually decreased, the physiological state of the eye relaxed and reached equilibrium, and UNVA remained stable. After the age of 80, UNVA started to deteriorate again, suggesting that ageing became a dominant factor. In the age range of 50–60, residents in coastal areas had worse UNVA. However, the results were completely reversed in the older groups. Urban residents generally had better UNVA at all ages except ages 50–60, when rural residents had better UNVA. All these differences indicate that daily work affects the degree of UNVA. After the age of 60, NV tasks gradually decrease, and other factors may begin to affect UNVA (8).

Women appeared to have worse UNVA than men. Higher rates of PNVI among women were also found in India and Nigeria (13,14). In contrast, Lu *et al.* did not observe any gender differences in the prevalence of presbyopia in northern China (15). There was little difference in UNVA between urban and rural populations for males. However, for females, urban and coastal residency were associated with worse UNVA. Gender plays an important role in vision function (16).

Occupations were generally divided into four groups in this study. People in the first group (mainly office and indoor workers) had relatively good UNVA, the second and third groups had relatively poor UNVA, and the fourth group had moderate UNVA. The second and third groups mostly performed physical labour. The fourth group comprised the retired population. Accordingly, the results suggested that UNVA may be related to refractive status and work habits (17).

There was a significant correlation between education level and UNVA (18). With improvement in education level, the mean UNVA of participants gradually increased. Among the participants with an university education, UNVA in urban residents was lower than that in rural residents, while for participants with a high school education or below, UNVA in urban residents was higher than that in rural residents. It is speculated that the overall level of education among residents of rural areas is relatively low, and those with lower educational levels are likely to have a lower socioeconomic status and therefore have fewer eye care resources (2,8). In addition, refractive errors might also play an important role in UNVA (19). Coastal residents with a college education had worse UNVA than inland residents, suggesting that regional factors may also influence UNVA.

Income level was an important factor affecting the quality of life of residents as well as visual quality. Generally, the higher the income level, the better the UNVA. One interesting finding was that at the low-income level, urban residents had better UNVA, but at the middle and high-income levels, rural residents had better UNVA. A possible explanation is that eye care and resources are more abundant in urban than in rural areas, where many low-income people reside. Economic inequality has been shown to play a significant role in NV and PNVI in many studies (20).

We investigated the relationship between NV and geographical, social, and biological factors. Our study expounds the effects of urban, rural, coastal, and inland factors on NV in a relatively comprehensive and systematic way. However, the study also had some limitations. This study did not consider corrected NV in participants, and functional NVI (FNVI) was not analysed. In addition, the study did not address the refractive state, which has been shown to be related to UNVA (21). Finally, other studies have indicated that factors such as fundus state and cataract presence, which were not included in our study, were important factors affecting NV. These factors need to be addressed in future studies.

NVI is a notable public health concern, and the main causes leading to visual impairment are variable. Fortunately, most causes are treatable and preventable. However, over 90% of those in need of near refractive correction in rural settings do not obtain necessary spectacles (3,22). The prescription and provision of low-cost reading glasses should be considered to address this easily and immediately correctable form of vision impairment (23,24). Study has shown there is a need to improve the utilization of eye health services, particularly by those with a low education level and those with older age (9).

Conclusions

After age 50, UNVA was generally reduced. A decline in UNVA was associated with residency in coastal areas and other sociodemographic characteristics. Our investigation also indicated that differences among occupations, income levels, and geographic factors were also worthy of attention in the improvement of eye health.

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Footnote

Reporting Checklist: The authors have completed the SURGE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1526/rc

Data Sharing Statement: Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1526/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1526/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Approval for the study was granted by the Ethics Committee of Eye Institute and Affiliated Xiamen Eye Center of Xiamen University (Approval No. XMYKZX-KY-2018-001). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from all study participants.

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