Clinical Investigation of Prevalence and Associated Factors of Visual Disability among the Elderly Agricultural and Fishing Population in Taiwan: Experience at a Teaching Hospital

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Abstract: *Purpose*: To discuss the prevalence and associated factors related to visual impairment and blindness amongst the elderly agricultural and fishing population. *Methods*: A total of 6542 healthy elderly adults voluntarily admitted to a teaching hospital for a physical check-up and eye disease in Taipei, Taiwan. *Results*: The overall prevalence of visual disability (the better eye visual acuity <0.5) was 13.2%, including 12.8% of visual impairment and 0.4% of blindness. From the logistic regression, the significantly independent factors of visual disability (visual impairment plus blindness) were sex (male *vs*. female, OR=0.68, 95%CI: 0.55-0.85), age (65-74 yrs *vs*. 60-64 yrs, OR=1.49, 95%CI: 1.18-1.89, 75-84 yrs *vs*. 60-64 yrs, OR=2.77, 95%CI: 2.11-3.65, ≥85 yrs *vs*. 65-69 yrs, OR=4.76, 95%CI: 3.55-6.39), glaucoma (OR=1.51, 95%CI: 1.02-2.23), corneal diseases (OR=2.27, 95%CI: 1.69-3.05), myopic or diabetic retinopathy (OR=1.77, 95%CI: 1.29-2.42), age-related macular degeneration (OR=3.78, 95%CI: 2.36-6.05), and cataract (OR=3.22, 95%CI: 2.50-4.16). *Conclusions*: Our results revealed that visual impairment and blindness are important visual health problems in elderly agricultural and fishing population. Age-related macular degeneration, cataracts, corneal diseases, myopic or diabetic retinopathy, glaucoma, female, and increased age were the leading causes for the visual disability. Further organized preventive strategies to eye care are recommended in this sub-population.

Keywords: Visual disability, visual impairment, blindness, prevalence, elderly.

INTRODUCTION

Visual impairment is one of the major causes of disability in the United States and in Taiwan [1-3]. It has been estimated that the prevalence of visual disabilities will markedly increase during the next several decades, with an estimated 70% increase in blindness and low vision by 2020 [1,3]. The onset of visual impairment in later life alters life habits and lead to various consequences: i.e., these older people with visual impairment are prone to more restrictions than their peers, have less social interaction, increasing feeling of loneliness, and are at risk of developing depressive symptoms [4]. From the viewpoint of public health, in order to estimate the needs within the elderly population for eye related care services and to identify disease patterns, an organized eye screening regime is necessary to explore the prevalence and causes of visual impairment and blindness [5].

Visual impairment and blindness match the Wilson criteria for screening due to them both being important health problems [6] and the following are keys to improving the situation: understanding the natural history of the disease; recognizing latent or early symptomatic stage; devising an accurate, reliable, sensitive and specific test that is easy to perform, interpret and accepted; accepting treatment recognized for the disease; providing treatment as early as possible to increase effectiveness; set up policies on who should be treated; devising cost-effective diagnosis and treatment; and continuing the process of case-findings. Undoubtedly, the requirements of good

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health and appropriate training are even more necessary for the population of the agricultural and fishing industries. Long or irregular working hours may lead to adverse health effects. To the best of our knowledge, however, few clinical evidence-based studies have attempted to determine the prevalence and possible etiology of visual impairment for the elderly in the aforementioned populations of Taiwan, who are also confronting the burdens of this disorder. The purpose of this study is to explore the content of prevalence and associated factors for visual impairment and blindness amongst the elderly within the agricultural and fishing populations, as determined by the application of a healthy volunteer subjects screening program health examination in Taipei, Taiwan.

METHODS

Study Design and Sample Selection

This cross-sectional study was conducted with a total of 6,542 elder healthy occupational adults with agricultural and fishing professional fields (3,989 males and 2,553 females) voluntarily admitted to one teaching hospital in Northern Taiwan for an annual physical check-up between January 2010 and December 2010. Fasting blood samples were drawn via venipuncture from study participants by clinical nurses. Overnight-fasting serum and plasma (from whole blood preserved with EDTA and NaF) samples were kept frozen (-20°C) until ready for analysis. The face-to-face interviews together with the provision of a structured questionnaire (questions pertained to demographic details, life-style information, and personal disease history), and the determination of participant blood pressure was also conducted at the time of the participant's visit. All procedures were performed in accordance with the guidelines of our institutional ethics committee and adhered to the tenets of the Declaration of Helsinki.

The medical histories and measurements of the participants were obtained by well-trained nurses. Personal and family histories of hypertension, type 2 diabetes, cardiovascular diseases, eye-related disease, and other chronic diseases were obtained by a structured health interview questionnaire. Type 2 diabetes was defined as high fasting plasma glucose (≧126 mg/dl) or presence of diagnosis of type 2 diabetes. The study participants were asked to take off the shoes and any other belongings that could possibly add extra weight when they were weighed. Heights and weights were evaluated according to body mass index (BMI). Also the waist circumference was also measured at the level of the iliac processes and the umbilicus with a soft tape measure to estimate abdominal obesity. Blood pressures for each subject were measured twice in the sitting position with an interval of 15 minutes between the measurements, by means of standard sphygmomanometers of appropriate width, after a rest period for 30 minutes. Those who taking antihypertensive therapy were considered to be known hypertension.

Definition of Visual Impairment, Blindness, and Visual Disability

The definitions of visual impairment and blindness have been described in full elsewhere [5]. In brief, visual impairment was defined as a best-corrected visual acuity worse than 6/12 to better then 6/60 in the better-seeing eye. Blindness was defined as visual acuity of 6/60 or worse. Subjects with visual acuity were also defined as a best-corrected visual acuity worse than 6/12 in the better eye. Visual disability was defined as subjects with visual impairment or blindness.

Data Collection for Vision Care

Eye examination was a sub part of a larger screening. In this study**,** two-stage screening method for the vision care was used among elderly subjects. Firstly, subjects were measuring presenting visual acuity and performing basic eye examination. Presenting visual acuity was assessed for each eye separately using Snellen visual chart at 6-meter distance with subject's glasses or naked eyes by well trained ophthalmologists. Secondly, the ophthalmologists examined the subjects with presenting visual acuity worse than 6/12 and made records, including best-corrected visual acuities (Snellen charts at a distance of 6 meters), slit-lamp examination for anterior segment, and fundus examination through a dilated pupil. In addition, selected factors, which were responsible for or contributed to visual disability, were assessed for each eye. The causes of diseases for visual disability were divided into five main categories: glaucoma-related disease, corneal-related disease, myopia or diabetic retinopathy, age-related macular degeneration, and cataract-related disease [5]. The glaucoma-related disease was identified by either optic disc examination or a visual field test.

Data Analysis

Statistical analysis was performed using SAS for

Windows, (SAS version 9.1; SAS Institute Inc., Cary, NC, USA). Crude and gender-age adjusted odds ratios were estimated and 95% confidence intervals were used. Multiple logistic regression was also performed to investigate the independence of risk factors associated with visual disability. A p-value of <0.05 was considered to represent statistically significant difference.

RESULTS

The prevalence of visual impairment and blindness in one or both eyes among screened elderly stratified by area is shown in Table **1**. The overall prevalence of visual disability (the better eye < 6/12) was 13.2%, including 12.8% of visual impairment and 0.4% of blindness. As compared the prevalence of visual impairment and blindness in two eyes, the overall prevalence was 13.2% (including blindness in both eyes 0.4%, blindness in one eye and visual impairment in another eye 2.0%, and visual impairment in both eyes 10.8%). Furthermore, when just taking visual impairment and blindness in one eye into account, the overall prevalence was 10.9% (including blindness in one eye and normal vision in another eye 0.6% and visual impairment in one eye and normal vision in

Table 1: Age Specific Prevalence of Visual Impairment and Blindness in One or Both Eyes among Elderly Agricultural and Fishing Screened Population Subjects (n=6542)

Variable	60-64 (n=2147)		65-74 (n=2456)		75-84 (n=1613)		≥85 (n=326)		Total (n=6542)	
	no	(%)	no	(%)	no	(%)	no	(%)	no	(%)
Visual impairment and blindness in two eyes	**203**	**9.5**	**342**	**13.9**	**255**	**15.8**	**65**	**19.9**	**865**	**13.2**
1. Blindness in both eyes	4	0.2	12	0.5	8	0.5	3	0.9	27	0.4
2. Blindness in one eye and visual impairment in another eye	37	1.7	46	1.9	30	1.9	14	4.3	134	2.0
3. Visual impairment in both eyes	162	7.6	284	11.5	217	13.4	48	14.7	704	10.8
Visual impairment and blindness in one eye	**151**	**7.0**	**275**	**11.2**	**228**	**14.1**	**59**	**18.1**	**713**	**10.9**
1. Blindness in one eye and normal vision in another eye	13	0.6	10	0.4	12	0.7	4	1.2	39	0.6
2. Visual impairment in one eye and normal vision in another eye	138	6.4	265	10.8	216	13.4	55	16.9	674	10.3
Prevalence*										
1.Visual impairment	199	9.3	330	13.4	247	15.3	62	19.0	838	12.8
2.Blindness	4	0.2	12	0.5	8	0.5	3	0.9	27	0.4

*In the better eye

Table 2: The Univariate Analysis on the Visual Disability (<6/12) (Visual Impairment Plus Blindness) of Best Corrected Vision among Elderly Agricultural and Fishing Screened Population Subjects (n=6542)

Variable	Visual disability			
	unadjusted OR (95% CI)		adjusted OR (95%CI)*	
Sex (male *vs*. female)	0.71	(0.59-0.84)	----	----
Age 60-64 yrs	1.00	----	----	----
65-74 yrs	1.43	(1.18-1.67)	----	----
75-84 yrs	2.79	(2.63-2.95)	----	----
≥85 yrs	5.11	(4.80-5.44)	----	----
Hypertension (yes *vs*. no)	1.01	(0.90-1.12)	1.00	(0.81-1.22)
Diabetes (yes *vs*. no)	1.17	(0.95-1.40)	1.18	(0.97-1.43)
Glaucoma (yes *vs*. no)	1.63	(1.08-2.20)	1.49	(1.05-1.94)
Corneal diseases (yes *vs*. no)	2.21	(1.93-2.51)	2.37	(2.00-2.75)
Trauma diseases (yes *vs*. no)	2.38	(1.77-2.99)	2.30	(1.63-3.15)
Myopic or diabetic retinopathy (yes *vs*. no)	2.00	(1.51-2.48)	1.88	(1.43-2.34)
Age-related macular degeneration (yes *vs*. no)	4.77	(3.85-5.92)	4.64	(3.87-5.41)
Cataract (yes *vs*. no)	2.94	(2.01-3.89)	2.90	(2.12-3.67)

*adjusted for sex and age

another eye 10.3%). The prevalence of visual acuity significantly increased with age (p-value for trend test, p<0.0001).

Table **2** shows the crude and sex-age-adjusted odds ratio (OR) between visual disability (visual impairment plus blindness) and associated factors. Glaucoma (adjusted OR=1.49, 95%CI: 1.05-1.94), corneal diseases (adjusted OR=2.37, 95%CI: 2.00-2.75), trauma diseases (adjusted OR=2.30, 95%CI: 1.63-3.15), myopic or diabetic retinopathy (adjusted OR=1.88, 95%CI: 1.43-2.34), age-related macular degeneration (adjusted OR=4.64, 95%CI: 3.87-5.41), and cataract (adjusted OR=2.90, 95%CI: 2.12-3.67) were significantly relevant to visual disability.

The effects of independent associated factors of visual disability were examined by the multiple logistic regression model. Table **3** shows significantly independent factors of visual disability (visual impairment plus blindness). They were sex (male *vs*. female, OR=0.68, 95%CI: 0.55-0.85), age (70-74 yrs *vs*. 65-69 yrs, OR=1.49, 95%CI: 1.18-1.89, 75-79 yrs *vs*. 65-69 yrs, OR=2.77, 95%CI: 2.11-3.65, ≥80 yrs *vs*. 65-69 yrs, OR=4.76, 95%CI: 3.55-6.39), glaucoma (OR=1.51, 95% CI: 1.02-2.23), corneal diseases (OR=2.27, 95%CI: 1.69-3.05), myopic or diabetic retinopathy (OR=1.77, 95%CI: 1.29-2.42), age-related macular degeneration (OR=3.78, 95%CI: 2.36-6.05), and cataract (OR=3.22, 95%CI: 2.50-4.16).

DISCUSSION

In this study we undertook an age-based approach to estimate the morbidity of visual impairment and blindness in elderly agricultural and fishing population. The prevalence of visual disability was 13.2%. In multiple logistic regression analysis, age-related macular degeneration, cataracts, corneal diseases, myopic or diabetic retinopathy, glaucoma, female, and increased age were the independent factors for the visual disability. Due to the increased frequency of visual impairment and blindness among elderly subjects, it is useful for identifying needs for treatment and rehabilitation services, planning, and implementing comprehensive visual impairment and blindness preventive care programs [5]. Preventive health examinations are an important health promotion strategy [1,7,8]. They could help to identify diseases at an early stage, postpone the development of subsequent adverse outcomes, and significantly save healthcare resources and lives [1,7].

Direct comparisons for the prevalence of visual impairment or blindness across different populations may be inappropriate due to the heterogeneities in demographic distributions, sample sizes, and definitions of visual impairment or blindness. In Taiwan, the population-based study showed that the prevalence of correctable visual impairment (presenting visual acuity in the better eye <6/12 that improved to no impairment ≧6/12 after refractive correction) was 9.55% (95% CI:

Table 3: Multiple Logistic Regression on the Visual Disability (<6/12) (Visual Impairment Plus Blindness) of Best Corrected Vision among Elderly Agricultural and Fishing Screened Population Subjects (n=6542)

Variable	β	SE	OR	95% CI
Intercept	-2.68	0.12	----	----
Sex (male *vs*. female)	-0.38	0.11	0.68	0.55-0.85
Age 60-64 yrs	----	----	1.00	----
65-74 yrs	0.40	0.12	1.49	1.18-1.89
75-84 yrs	1.02	0.14	2.77	2.11-3.65
≥85 yrs	1.56	0.15	4.76	3.55-6.39
Hypertension (yes *vs*. no)	-0.08	0.06	0.92	0.82-1.04
Diabetes (yes *vs*. no)	0.10	0.08	1.11	0.94-1.29
Glaucoma (yes *vs*. no)	0.41	0.20	1.51	1.02-2.23
Corneal diseases (yes *vs*. no)	0.82	0.15	2.27	1.69-3.05
Trauma diseases (yes *vs*. no)	0.66	0.37	1.93	0.94-4.00
Myopic or diabetic retinopathy (yes *vs*. no)	0.57	0.16	1.77	1.29-2.42
Age-related macular degeneration (yes *vs*. no)	1.33	0.24	3.78	2.36-6.05
Cataract (yes *vs*. no)	1.17	0.13	3.22	2.50-4.16

7.97% -11.13%) [9]. Furthermore, owing to the similarities of ethnic origins among aged people in Taiwan, the possible reason may be that northern area owned better medical resources, so the elderly subjects living in the northern area could receive more comprehensive medical service for early diagnosis and avoid delayed treatment and consequently developed visual impairment or blindness [5].

It is not surprising that the prevalence of visual impairment and of blindness in this study increased greatly with age and had statistically significant trend. There were 1.49-fold, 2.77-fold, and 4.76-folds increase the risk of visual disability in aged 65-74 years, 75-84 years, and ≥85 years compared with 60-64 years, respectively. In addition, consistent with other population-based studies [5,10], females had significant higher risk to visual impairment after adjustment for other confounders. The gender difference may reveal varying distribution of the causes of visual disability among elderly in Taiwanese population [5].

Despite these important advances, cataract is the single largest cause of global blindness [11]. Cataract is the most important cause of visual loss in the world and the population of patients blind from cataract may increase to 50 million worldwide by the year 2020 [12,13]. Although recent publications have suggested specific causes, such as inadequate nutrition, aspirin use, diabetes, smoking, myopia, and inhaled steroid use with increased risk of cataracts, there are neither prospective, randomized controlled trials of nutritional supplementation delaying the progression or onset of various forms of cataract nor would these interventions be any easier than the current solution of surgery on those affected [11,14,15]. Consistent with other population-based studies, cataract was also one of the important causes of visual disability in this study [5,16,17]. The National Health Insurance Program in Taiwan supported the numbers of cataract operations and rehabilitation for cataract patients had dramatically improved in recent years, however, fear and lack of awareness for cataract subjects may be the major barriers to access among elderly sub-population.

The available data show that glaucoma is a major cause of blindness in East Asia [18]. It has been estimated that glaucoma causes blindness in approximately 10% of those affected [19]. Our results also indicated that glaucoma is one of significant factors related to visual impairment and blindness. The importance of glaucoma blindness is compounded by the fact that damage is irreversible, and may progress from "definitional" blindness (visual acuity <3/60 or severely constricted visual fields) to loss of light perception [18]. Due to glaucoma is second only to cataract among visual disorders, it is important to improve diagnostic and therapeutic approaches to open angle glaucoma and angle closure glaucoma that can be applied worldwide [19].

Myopic or diabetic retinopathy was significantly related to visual disability in this study. Vision threatening retinopathy is usually due mainly to neovascularisation in type 1 diabetes and maculopathy in type 2 diabetes [20]. Diabetic retinopathy fulfils the WHO criteria for screening in that it evolves through key recognizable stages in the progression to blindness, represents an important health problem, has valid and acceptable screening tests, and blindness can be prevented or visual decline slowed with laser photocoagulation [21]. Early screening and appropriate intervention have been demonstrated to be very effective in reducing visual impairment and blindness attributed to retinopathy [22]. One should pay more attention for renewed efforts in effective public health initiatives due to higher prevalence of chronic diseases (such as type 2 diabetes) in the elderly population [5].

After adjustment for confounders, age-related macular degeneration (OR=3.78, 95%CI: 2.36-6.05) and cornea diseases (OR=2.27, 95%CI: 1.69-3.05) were the statistically significant associated factors to visual disability. The relationship also supported earlier results from other population-based study [5,10,16,23]. Although treatments for the neovascular advanced stage of age-related macular degeneration in selected situations may reduce the risk of additional moderate or severe visual acuity loss beyond the presenting level to a treating ophthalmologist, and although other treatments for the neovascular stage under investigation may lead to even better outcomes, preventive strategies are the best chance for preserving excellent vision in individuals at risk for advanced age-related macular degeneration [24]. In addition, the surgical management of severe end-stage corneal diseases and ocular surface disorders remains difficult and challenging, with many disorders unsuitable for conventional keratoplasty, and the long-term success of newer forms of ocular surface and stem cell transplantation procedures remains in question [25].

Methodological Considerations

One of major limitations to this study was potential selection bias due to one area elderly population screened. The potential influence on the prevalence

estimated and the study-observed visual impairment and blindness -associated risk factors were inevitable. Nevertheless, we still retained sufficient statistical power to be able to effectively evaluate the various associated risk factors for visual impairment and blindness subsequent to adjustment for confounding factors given the relative large sample size. Secondly, our measurements were conducted at only a single point in time and, by clear inference, would not be able to be used to reflect long-term exposure to various demographic or biochemical aspects or factors, which might be important influencers of visual impairment and blindness. The solution to such a quandary would best be accomplished by conducting a number of prospective longitudinal analogous studies, the results of which would be expected to complement the cross-sectional findings of this study.

CONCLUSIONS

Our results revealed that visual impairment and blindness are important visual health problems in elderly agricultural and fishing population. Age-related macular degeneration, cataracts, corneal diseases, myopic or diabetic retinopathy, glaucoma, female, and increased age were the leading causes for the visual disability. Further organized preventive strategies to eye care are recommended in this sub-population.

CONFLICTS OF INTEREST

We certify that all the affiliations with or financial involvement in, within the past 5 years and foreseeable future, any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript are completely disclosed (e.g., employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, royalties).

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