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Original Article

Changes in refractive status in an elderly Chinese population in a 7-year follow-up: The Shihpai Eye Study

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Abstract

Background: Refractive error is the major cause of moderate and severe visual impairment. Visual impairment limits people's ability to perform daily tasks and affects their quality of life. Longitudinal data on the refractive status of the elderly was available only for whites and Africans. The purpose of this study was to report the 7-year incidence of myopia, hyperopia and refractive error change as well as their associated risk factors in a metropolitan elderly Chinese population.

Methods: The Shihpai Eye Study 2006 included 460/824 (55.8%) subjects (age range 72−94 years old) of 1361 participants in the 1999 baseline survey for a follow-up eye examination. Incidences were calculated for those who had emmetropia (−0.50D < spherical equivalent (SE) <+0.50D) at baseline. Refractive error change at 7 year was defined as (SE at the 7-year visit − SE at baseline).

Results: 90 (26.4%) subjects were emmetropic, 61 (17.9%) were myopic and 190 (55.7%) hyperopic. The mean refractive error was 0.49 ± 2.19 D and the average change in refractive error was −0.13 ± 1.03 D. The incidence of myopia at seven-year was 26.8 % [95% Confidence interval (C.I.): 22.8%−30.9%] and the incidence of hyperopia was 19.7% (95% C.I.: 16.1%−23.3%). Nuclear sclerosis (>Grade 2 vs. ≤Grade 2) [$p < 0.0001$; relative risk (RR): 8.94; 95% C.I.: 4.40−18.2], anterior chamber depth (mm) [$p = 0.05$; RR: 0.43; 95% C.I.: 0.18−1.01] and lens thickness (mm) [$p < 0.01$; RR: 2.35; 95% C.I.: 1.17−2.73] were significantly associated with myopic shift. On the other hand, hyperopic shift was significantly associated with cortical opacity (>Grade 2 vs. ≤Grade 2) ($p = 0.02$; RR: 1.21; 95% C.I.: 1.02−3.54).

Conclusion: In this elderly Asian population, there was on average a slight myopic shift. The incidence of myopia was comparable to population-based studies of other ethnic groups, whereas the incidence of hyperopia was substantially higher.

Keywords: Cohort; Elderly; Incidence; Population-based; Refractive error

1. Introduction

It is estimated that 285 million people are visually impaired globally. According to the World Health Organization, refractive error is the major cause of moderate and severe visual impairment. Visual impairment limits people's ability to perform daily tasks[1,2] and affects their quality of life.[3−5] Most studies on refractive error have focused on school-aged children[6,7] or young and middle-aged adults.[8,9] With increased longevity, the public health costs of refractive error-imposed morbidity such as a compromised physical functioning dimension are expected to increase.[10]

There was little data on the refractive status of the elderly in the Asian populations,[11−14] and longitudinal data was

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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available only for whites[15–19] and Africans.[20] Further, ocular biometric risk factors were not assessed in most studies. The purpose of this study was to investigate the refractive error change as well as the incidence of myopia and hyperopia in a metropolitan elderly Asian population at seven-year follow-up and their associated risk factors.

2. Methods

The Shihpai Eye Study[21] was a community-based, cross-sectional survey of vision and eye diseases among non-institutionalized subjects 65 years of age and older in Shihpai, Taipei, Taiwan. Residents 65 years of age and older were identified using the household registration system. This system officially registers personal information such as date of birth, sex, and home address, as well as family members and relations. According to the official household registration in 1999, the total number of residents 65 years and older in Shihpai was 4750; 3746 persons were eligible, and 2045 of these were randomly selected to be invited to participate in the study. Of the 2045 subjects, 1361 (66.6%) participated in both the questionnaire and eye examination. The baseline examination was conducted between July 1, 1999, and December 31, 2000. Follow-up examination of the eye condition of the fixed cohort was conducted from 25 March, 2006, and ended 31 December, 2007. We planned to invite the 1361 participants in the baseline examination for the follow-up study. A structured questionnaire similar to the baseline survey[21] was conducted by intensively trained interviewers. The questionnaire obtained information on demographics (age, sex, locality, marital status, and education). Height and weight were measured and body mass index was calculated by the formula weight in kilograms divided by the square of the height in meters (kg/m^2). Personal medical history was assessed by a checklist. Participants were asked whether they had been diagnosed with a chronic disease such as diabetes (yes/no) by a physician. Cigarette smoking history was scored as smoker, passive smoker, ex-smoker, or never-smoker. Alcohol consumption was limited to wine and hard alcohol and was scored as no consumption (or frequency of alcohol consumption only once a week) or habit of alcohol consumption (frequency of alcohol consumption more than once a week). Subjects who were interviewed were invited to participate in a comprehensive ophthalmic examination conducted at the Taipei Veterans General Hospital. Ophthalmologists conducted the examinations according to a standardized protocol. Informed consent was obtained from each subject after explaining to them the purpose and procedure of the study. The survey followed the tenets of the Declaration of Helsinki.

This study was approved by the Institutional Review Board of the Taipei Veterans General Hospital.

2.1. Definitions

Spherical equivalent (SE) was used to calculate refractive error and was defined as (spherical power+ 1/2 cylinder power). Emmetropia was defined as SE $\geqq -0.5$ D and $\leqq +0.5$ D. Myopia was defined as SE <-0.5 D and hyperopia $>+0.5$ D.

Incidence of myopia and hyperopia were defined as development of myopia or hyperopia at the 7-year follow-up visit when baseline refraction was emmetropic.

Change in refraction at 7 years was defined as (SE at the 7-year visit − SE at baseline). A refractive change of >-0.5 D was considered myopic shift. A refractive change of $>+0.5$ D was considered hyperopic shift.

Three major types of age-related cataracts (nuclear, cortical, and posterior subcapsular) were assessed based on the Lens Opacity Classification system III (LOCS III) by one ophthalmologist at the slit-lamp under maximum dilatation with tropicamide. Subjects were categorized as having an age-related cataract if any type of opacity with an LOCS III grade >2 was present in one or both eyes. We chose grade >2 as the cutoff, because this grade was used in our prevalence[21] and incidence[22] analysis. Anterior chamber depth, lens thickness and axial length were measured by A-scan; central corneal thickness was measured using ultrasound pachymetry.

2.2. Statistical analysis

Dependent variables in the analysis were changes in refractive status (myopic shift and hyperopic shift). Independent variables tested were age ($\geq$80 years vs. 72–79 years), sex (male vs. female), education (high school and above vs. secondary school and below), marital status (with spouse vs. single, separated, divorced or widowed), body mass index ($\geqq$25 vs. $<$25), history of hypertension (yes vs. no), diabetes (yes vs. no), cardiovascular disease (yes vs. no), stroke (yes vs. no), history of smoking (yes vs. never; quitted vs. never) and alcohol drinking (yes vs. no). Ocular variables evaluated included nuclear sclerosis (>2 vs. $\leqq 2$), cortical opacity (>2 vs. ≤ 2), posterior subcapsular opacity (>2 vs. $\leqq 2$), anterior chamber depth (mm), lens thickness (mm), central corneal thickness (um) and axial length (mm). Univariate analysis was performed to test for an association between each independent variable and dependent variable by chi-square analysis for categorical variables and Student's t-test for continuous variables. Generalized estimating equations were used to fit the best model for independent variables. Gender, age, and other independent variables were analyzed in the multivariate models. A P value of <0.05 was considered to be statistically significant in the multivariate model. Since the correlation between the left and the right eye showed similar results ($r = 0.82$), only the results from the right eye was reported. Statistical analysis was performed by the Statistical Analysis System (SAS 6.12; SAS Institute, Cary, NC) software.

3. Results

Of the 1361 participants who attended the baseline examination in the 1999 study, 205 (15.1%) were dead before the follow-up study began, 301 (22.1%) had moved away, and