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Factors Associated with Prevalent Diabetic Retinopathy in Chinese Americans: The Chinese American Eye Study

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Objective: To identify factors associated with prevalent diabetic retinopathy (DR) among Chinese American adults with type 2 diabetes mellitus (T2DM), and to compare these factors to ones previously described for a population-based sample of Latinos with a higher DR prevalence.

Design: Population-based cross-sectional study.

Participants: Total of 4582 Chinese Americans aged 50 or older residing in Monterey Park, California.

Methods: Participants completed an in-home questionnaire on sociodemographic status and medical history, and a comprehensive clinical eye examination, using the same protocol implemented in the Los Angeles Latino Eye Study. Fundus photographs from 7 Early Treatment Diabetic Retinopathy Study fields were graded in a masked manner using a modified Airlie House grading system to assess presence and severity of DR. Logistic regression analyses based on a conceptual model of DR risk identified factors associated with prevalent DR.

Main Outcome Measures: Odds ratios (ORs) and 95% confidence intervals (CIs) for factors associated with DR and vision-threatening DR (VTDR).

Results: In total, 238 participants were diagnosed with any DR; 27 of these were classified as having VTDR. Both any DR and VTDR showed statistically significant positive associations with T2DM duration ($OR_{5-9\ years}$ = 1.24; $OR_{10-14\ years}$ = 2.07; $OR_{15+years}$ = 3.99), glycosylated hemoglobin (HbA_{1c}) ($OR_{6.5\%-6.9\%}$ = 1.33; $OR_{7\%-7.9\%}$ = 1.86; $OR_{8\%+}$ = 3.22), systolic blood pressure (SBP) ($OR_{per\ 10\ mmHg+}$ = 1.19), and insulin treatment ($OR_{insulin+}$ = 2.44). For VTDR, we also found novel associations with antihypertensive drugs (OR = 0.18; 95% CI = 0.06–0.61) and statins (OR: 4.96; 95% CI: 1.60–16.41). Chinese Americans and Latinos had a nearly identical DR probability based on HbA_{1c} and SBP. However, Latinos had a higher DR probability at every year of duration of T2DM (≥5 years).

Conclusions: Although we observed an overall lower DR prevalence in Chinese Americans than in Latinos (35.8% of individuals with TD2M among Chinese Americans vs. 42.0% among Latinos), our data indicate that the impact of increasing HbA_{1c} and SBP on DR probability is incrementally the same in both populations. However, increasing T2DM duration is associated with higher DR probability in Latinos than in Chinese Americans, even after controlling for other known predictors. Novel factors associated with VTDR include antihypertensive drugs and statins. However, to determine whether these drugs impact VTDR susceptibility, we need longitudinal data and more cases. *Ophthalmology Retina 2017;■:1–10 © 2017 by the American Academy of Ophthalmology*

Supplementary files available at www.ophthalmologyretina.org.

Type 2 diabetes mellitus (T2DM) is a fast-growing public health challenge in the United States, with 1.7 million new cases each year and a prevalence of 9.3%.[1] T2DM causes numerous complications, which may result in cardiovascular and kidney disease, neuropathy, and eye damage.[2] Diabetic retinopathy (DR), a common ocular manifestation of T2DM, accounts for 12% of all new cases of blindness per year in the United States, and is the leading cause of blindness for people aged 20 to 64.[3] The number of people impacted by DR in the United States is expected to increase by more than 80% by 2050,[4] having a strong negative impact on vision loss, blindness, health-related quality of life,[5] and the economy.[6] To prevent DR and to identify contributors to disparities in DR burden, we must characterize factors associated with this disease in multiethnic population-based samples. In the United States, studies have assessed factors associated with prevalent and incident DR primarily in non-Hispanic whites[7–14] and Hispanics.[15,16] There are data gaps for other racial/ethnic groups, including Chinese Americans.

As one of the fastest-growing populations in the United States,[17] Chinese Americans increased in number by nearly 40% between 2000 and 2010, from 2.9 million to 4.0 million.[18] Among participants in the National Health and

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Nutrition Examination Survey, Asian Americans (not distinguished by country of origin) were found to be particularly susceptible to T2DM, and to develop the disease at much lower body mass indexes than non-Hispanic whites, blacks, or Hispanics.[19] A similar pattern of early and high susceptibility to T2DM has been described specifically among ethnic Chinese in Hong Kong, Taiwan, and mainland China.[20] These patterns of T2DM, a precursor to DR, suggest that adequate inclusion of Chinese Americans in ophthalmic research may reveal important information on susceptibility to T2DM and DR.

As the first large, population-based study of eye health in Chinese Americans, the Chinese American Eye Study (CHES) offers the first opportunity to identify factors associated with prevalent DR and to explore factors driving disparities between DR prevalence in CHES and in a study of urban Latinos.[16] Both CHES and the Los Angeles Latino Eye Study (LALES)[16] were conducted among urban populations in Los Angeles County, California, using similar methodology. We previously reported that Chinese Americans have a DR prevalence that is higher than that among non-Hispanic whites but lower than that among Hispanics.[21] In the present study, we developed a conceptual model of factors known or hypothesized to be associated with DR or vision-threatening DR (VTDR) based on 4 categories: sociodemographic, personal health practice, health care access and utilization, and biological measures. The statistical models for DR were developed in CHES and were then applied to LALES to evaluate the relative importance of the included predictors for the 2 racial/ethnic groups. This enabled us to evaluate potential variation in risk factors influencing DR prevalence between these 2 groups.

Methods

Chinese American Eye Study

CHES is a population-based cross-sectional study designed to assess the prevalence of visual impairment, eye disease, and visual function in Chinese Americans. Participants included 4582 adults aged 50 years and older, of self-identified Chinese ancestry, residing in 10 census tracts in Monterey Park, California. Data were collected from February 2010 to October 2013. The study adhered to the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board/Ethics Committee of the University of Southern California.

Interview and Examination Procedures

Canvassers invited eligible individuals to participate in the study and then administered an in-home questionnaire covering demographics, medical and ocular histories, insurance status, access to care, and acculturation on the Suinn-Lew Asian Self-Identity Acculturation scale.[22] After completing the in-home questionnaire, participants were scheduled for a visit to the study's Local Eye Examination Center, where they received a comprehensive eye examination performed by trained ophthalmologists and a clinical interview that collected information on quality of life and visual function. The eye examination included visual acuity assessment of presenting and best-corrected vision, slit-lamp examination of anterior and posterior segment structures, and OCT imaging of the retina. Total cholesterol, high- and low-density lipoprotein, and triglycerides were measured using the Cholestech LDX system (Alene, Waltham, MA). Random blood glucose and glycosylated hemoglobin (HbA_{1c}) were measured using the Hemocue B-Glucose Analyzer (Hemocue Inc, Lake Forest, CA) and the DCA Vantage Analyzer (Siemens Healthcare, Norwood, MA), respectively. For diabetic participants, fundus photographs from the 7 standard Early Treatment Diabetic Retinopathy Study[23] stereoscopic fields were taken in each eye using a Topcon TRC digital 50EX retinal camera (Topcon Corporation, Paramus, NJ).

Risk Factor Assessment

Variables contributing to the conceptual model were obtained from the in-home and clinical questionnaires along with the eye examination. Sociodemographic factors included age, gender, country of birth (China, Taiwan, Vietnam, other), income, years of education (fewer than 12 years, 12 years or more), marital status (married/living with partner, divorced/separated/widowed, never married), and acculturation on the Suinn-Lew Asian Self-Identity Acculturation scale. Personal health practice factors included smoking (never smoked, former smoker, current smoker); alcohol consumption (never drank, former drinker, current drinker); treatment used for diabetes mellitus (DM) (oral medication, insulin, diet); use of anti-inflammatory drugs, statins, and antihypertensive drugs (never used, ever used); and, for women, use of oral contraceptives and female hormones (never used, ever used). Health care access and utilization factors included having health and vision insurance coverage, having a particular doctor or clinic, and ever being unable to access care. Biological risk factors included cataracts, the number of comorbidities, refractive error, axial length, body mass index, waist-to-hip ratio, self-reported duration of diabetes, random serum blood glucose, HbA_{1c} levels, systolic blood pressure (SBP), diastolic blood pressure, pulse pressure, mean ocular perfusion pressure, total cholesterol, low- and high-density lipoprotein, and triglycerides.

Determination of Type 2 Diabetes Mellitus

Participants were classified as having DM if they reported a prior diagnosis and were currently on a treatment regimen (oral hypoglycemic medications, insulin, or diet), or if their HbA_{1c} levels were 6.5% or above. Duration of DM was calculated as the difference between the self-reported year of diagnosis and the time of examination. In the case of participants newly diagnosed during the examination, duration was classified as 0. All definite cases of DM were considered to be T2DM if they were not being treated with insulin or they were diagnosed at age 30 or older.

Definition and Grading of Diabetic Retinopathy

In the study, DR was defined as retinopathy in participants who were determined to have DM. The fundus photographs from 7 standard fields for each eye underwent masked grading for DR at an ocular reading center in Madison, Wisconsin, using a grading protocol that was a modified version of the Early Treatment Diabetic Retinopathy Study adaption of the Airlie House classification of DR. Eyes were graded as having no DR (levels 10–13), nonproliferative DR (mild: levels 14–20; moderate: levels 31–43; severe: levels 47–53), or proliferative DR (levels 60–85). Proliferative DR and severe nonproliferative DR were classified as vision-threatening (VTDR), whereas mild and moderate nonproliferative DR were classified as non-vision-threatening (NVTDR).