Prevalence of Diabetes Mellitus and Diabetic Retinopathy in Filipino vs Caucasian Americans: A Retrospective Cross-Sectional Epidemiologic Study of Two Convenience Samples

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Objectives: To compare the prevalence of diabetic retinopathy in Filipino and Caucasian Americans in two clinic populations.

Design: Retrospective cross-sectional epidemiologic study of two convenience samples.

Participants and Setting: Five hundred twelve Filipino and 600 Caucasian patients aged 40 years or older examined by two community-based comprehensive ophthalmology clinics during a one-year period.

Results: The prevalence of self-reported type 2 diabetes mellitus among Filipino (F) and Caucasian Americans (C) was 40.6% and 24.8%, respectively ($P<.001$). In the subpopulation with type 2 diabetes mellitus ($n=375$: 208 Filipino; 149 Caucasian), there was a statistically insignificant higher prevalence of diabetic retinopathy among Filipino diabetics compared to Caucasians (F vs C: all forms of diabetic retinopathy, 24.5% vs 16.8%, $P=.08$; non-proliferative retinopathy, 17.3% vs 12.8%, $P=.24$; proliferative retinopathy, 7.2% vs. 4.0%, $P=.21$). In multivariate analyses of the diabetic subpopulation, Filipino ethnicity was not a significant predictor of diabetic retinopathy.

Conclusions: Filipino Americans may have a higher prevalence of type 2 diabetes mellitus and diabetic retinopathy than Caucasian Americans. Among those with type 2 diabetes, however, Filipino Americans were not found to be more likely to show manifestations of diabetic retinopathy than Caucasian Americans. (*Ethn Dis.* 2012;22[4]:459–465)

Key Words: Filipino American, Diabetes, Diabetic Retinopathy

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Introduction

According to the 2000 United States Census Report, 2.4 million Filipinos reside in the United States, making this group the largest Southeast Asian and second largest Asian subpopulation in the country.[1] Previous studies have shown that Filipinos residing in both the Philippines and the United States have a high prevalence of type 2 diabetes mellitus.[2–9] The prevalence of diabetic retinopathy among those of Filipino ancestry residing in the United States and in other parts of the world, however, remains unknown.

A literature search conducted in October 2011 with Ovid MEDLINE® (1948–2011) using the "or" operator to combine the medical subject heading term, Philippines, with the key words, Philippines, Philippine, Filipino, and Filipino American, yielded 8,262 citations. A search combining the medical subject heading term, diabetic retinopathy, with the key word, diabetic retinopathy, yielded 20,123 citations. Using the "and" operator to combine the latter search with the Filipino search yielded 2 citations on diabetic retinopathy in Filipinos, neither of which estimated the prevalence of diabetic retinopathy in this population.[10,11]

Diabetic retinopathy is a leading cause of new cases of blindness in people aged 20 to 74 years in the United States.[12] It is generally classified as non-proliferative when there are only intraretinal microvascular changes resulting from altered retinal vascular permeability and vessel closure. The more advanced form of diabetic retinopathy, its proliferative phase, develops due to non-perfusion of closed vessels and is characterized by the formation of new vessels, fibrous tissues, or both. Clinically significant macular edema can be present in both phases due to disruption of the normal blood-retinal barrier.[12] Preserving sight in diabetic patients hinges on routine examinations to detect early signs of retinopathy and glycemic control.[13]

The aim of this retrospective study was to make a preliminary assessment of the prevalence of diabetic retinopathy among Filipino Americans compared to Caucasian Americans in two community-based comprehensive ophthalmology clinics.

Methods

Sampling

Sampling commenced after receiving institutional review board approval

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Table 1. Diagnostic criteria: the AAO's proposed Diabetic Retinopathy Severity Scale[15]

Proposed Disease Severity Level	Findings Observable on Dilated Ophthalmoscopy
No apparent retinopathy	No abnormalities
Mild[a] non-proliferative diabetic retinopathy	Microaneurysms only
Moderate[a] non-proliferative diabetic retinopathy	More than just microaneurysms but less than severe non-proliferative diabetic retinopathy
Severe[a] non-proliferative diabetic retinopathy	Any of the following: more than 20 intraretinal hemorrhages in each of 4 quadrants; definite venous beading in 2+ quadrants; prominent intraretinal microvascular abnormalities in 1+ quadrant and no signs of proliferative retinopathy
Proliferative diabetic retinopathy	One or more of the following: neovascularization, vitreous/preretinal hemorrhage

AAO, American Academy of Ophthalmology.
[a] Mild, moderate, and severe non-proliferative diabetic retinopathy diagnoses as well as non-proliferative diabetic retinopathy diagnoses whose stages were not documented were retrospectively reclassified under one diagnosis.

from the University of California, San Francisco. Convenience samples were taken from two private comprehensive ophthalmology clinics in California: Clinic A, in Vallejo, and Clinic B, in Daly City. These clinics are located in counties whose Filipino American populations are among the largest in the United States.[14]

Sampling was conducted by random selection of 30 weeks from the 2008 calendar year and reviewing charts from patients who were seen during the sampled weeks. In an effort to diminish the impact of seasonal variability in the analysis, either two or three weeks were sampled from each month of the year. The subject's self-description as documented in the free response new-patient questionnaire was used to determine classification into either the Filipino or Caucasian American study group. One thousand one hundred thirteen patients aged 40 years or older (513 Filipino, 600 Caucasian) were sampled in the two clinics. One patient, who was classified into the Filipino group and later found to be a tourist without a social security number, was excluded, thus leaving a total of 1112 subjects for the analysis. Of these, 533 subjects were sampled from Clinic A (252 Filipinos, 281 Caucasians), and 579 were sampled from Clinic B (260 Filipinos, 319 Caucasians).

Data Collection

Dilated fundus examination was performed prospectively by co-authors MH and AA on all patients with indirect slit-lamp biomicroscopy using a 90-diopter handheld lens followed by indirect ophthalmoscopy using a 20-diopter handheld lens.

Medical records were reviewed retrospectively for past medical history as documented in a closed-ended patient questionnaire, which included whether or not the patient had type 2 diabetes mellitus and hypertension previously diagnosed by a physician. Questionnaires were completed by patients on the date of their initial eye examination and were reviewed by MH and AA for changes during subsequent follow-up visits. Medical records were also reviewed for best-corrected visual acuity, refractive error, slitlamp biomicroscopic and indirect ophthalmoscopic findings, ocular diagnoses, use of ophthalmic medications, previous ophthalmic history, family ophthalmic history, age, and sex. Insurance information was recorded and used to classify subjects as either Medicaid recipients or non-recipients. Medicaid was used as a proxy indicator of low socioeconomic status.

Diagnostic Criteria

Diabetic retinopathy was diagnosed according to the American Academy of Ophthalmology's proposed international clinical diabetic retinopathy severity scale (Table 1).[15] This scale was designed to facilitate communication between clinicians in everyday practice in lieu of more detailed but less practical scales used in clinical trials and is based on consensus among experts as well as evidence from the Early Treatment Diabetic Retinopathy Study[16] and the Wisconsin Epidemiologic Study of Diabetic Retinopathy.[17,18]

Retrospective Study Design

The study's retrospective design influenced, to a large extent, the methods used for sampling, establishing diagnostic criteria, and conducting statistical analyses. Data from two convenience samples, each from a clinic located in a different geographic region of the San Francisco Bay Area, were collected and analyzed. These clinics' ophthalmologists (MH and AA) were experienced ophthalmologists who completed residency training at the same institution (University of California, San Francisco) and did not pursue postgraduate fellowship training in retina or any other subspecialty. However, biomicroscopy of the fundus was not standardized, and thus measurements of inter-observer variance between mild, moderate, and severe non-proliferative diabetic retinopathy (Table 1) as well as

Table 2. Demographics and clinical parameters, pooled and stratified by clinic

Parameter	Filipino	Caucasian	*P*[a]
Pooled	*n*=512	*n*=600	
Age, yrs, mean ± SD, range	65.5 ± 12.5, 40–97	64.1 ± 13.1, 40–100	.07[b]
Female, %, 95% CI	65.4, 61.2–69.7	58.0, 54.0–62.0	.01[c]
Medicaid[d], %, 95% CI	39.1, 34.7–43.4	18.8, 15.6–22.0	<.001[c]
BCVA, logMAR, mean ± SD, range	.21 ± .4, .0–3.0	.16 ± .3, −.1–3.0	<.001
SE, D, mean ± SD, range	−.1 ± 2.2, −18.0–5.4	−.7 ± 2.7, −15.8–6.6	.002
Hypertension, %, 95% CI	67.8, 63.7–71.9	57.2, 53.2–61.2	<.001[c]
Type 2 DM, %, 95% CI	40.6, 36.2–45.0	24.8, 21.3–28.3	<.001[c]
Clinic A, Vallejo, California	*n*=252	*n*=281	
Age, yrs, mean ± SD, Range	66.5 ± 12.3, 41–97	62.1 ± 13.2, 40–98	<.001[b]
Female, %, 95% CI	61.1, 54.9–67.3	55.9, 49.9–61.9	.22[c]
Medicaid[d], %, 95% CI	57.1, 50.8–63.5	32.4, 26.7–38.0	<.001[c]
BCVA, logMAR, mean ± SD, range	.23 ± .4, .0–3.0	.15 ± .4, −.1–3.0	.001
SE, D, mean ± SD, range	.3 ± 1.6, −8.0–5.4	−.1 ± 1.7, −7.3–4.8	.01
Hypertension, %, 95% CI	66.3, 60.3–72.3	58.7, 52.8–64.6	.07[c]
Type 2 DM, %, 95% CI	40.5, 34.2–46.8	29.2, 23.7–34.7	.01[c]
Clinic B, Daly City, California	*n*=260	*n*=319	
Age, yrs, mean ± SD, range	64.6 ± 12.6, 40–94	66.0 ± 12.8, 41–100	.20[b]
Female, %, 95% CI	69.6, 63.8–75.4	59.9, 54.4–65.4	.02[c]
Medicaid[d], %, 95% CI	21.5, 16.4–26.7	6.9, 4.0–9.8	<.001[c]
BCVA, logMAR, mean ± SD, range	.20 ± .3, .0–2.0	.17 ± .3, .0–3.0	.08
SE, D, mean ± SD, range	−.6 ± 2.5, −18.0–3.4	−1.3 ± 3.2, −15.8–6.6	.04
Hypertension, %, 95% CI	69.2, 63.4–75.0	55.8, 50.2–61.4	.001[c]
Type 2 DM, %, 95% CI	40.8, 34.6–47.0	21.0, 16.4–25.6	<.001[c]

BCVA, best corrected visual acuity; CI, confidence interval; D, diopter; DM, diabetes mellitus; IOP, intraocular pressure; logMAR, logarithm of the minimum angle of resolution; SD, standard deviation; SE, spherical equivalent of the refractive error; VCDR, vertical cup-to-disc ratio.

[a] *P* are by Mann-Whitney *U* test unless otherwise specified.

[b] *P* are by Student's *t* test.

[c] *P* are by Pearson's χ^2 test.

[d] Medicaid was used as a proxy indicator of low socioeconomic status.

clinically significant macular edema were not amenable to assessment. All forms of non-proliferative diabetic retinopathy were therefore retrospectively reclassified with a binary variable reflecting whether or not non-proliferative diabetic retinopathy was present. The diagnosis of macular edema was not incorporated into the analysis.

Statistics

Data from the right eye were included in the analysis for patients with symmetric documentation of diabetic retinopathy as well as for patients without diabetic retinopathy; data from the eye with more severe diabetic retinopathy was included for those with asymmetric disease. Best-corrected visual acuity recorded on the Snellen scale was converted to logarithm of minimal angle resolution (logMAR) for analysis as a continuous variable. Spherical equivalent representing refractive error was calculated by adding half of the cylinder to the sphere.

All statistical analyses were conducted at the .05 significance level and with SPSS 17.0 software (SPSS, Chicago, Illinois). Confidence intervals for proportions were calculated using Microsoft Office Excel 2007 (Microsoft Corporation, Redmond, Washington). Means were compared using the Student's *t* test when the data exhibited a normal distribution and with the Mann-Whitney *U* test for distributions that appeared non-normal. Correlations between binary variables were evaluated using Pearson's χ^2 test.

Multiple logistic regression analyses were used to adjust for confounding factors. Univariate models were fit using age, sex, ethnicity, Medicaid status, best-corrected visual acuity, spherical equivalent of the refractive error, and hypertension as predictors; multivariate models were then fit using significant predictors from the univariate analyses. Regardless of whether or not they were deemed to be significant, the variables age, sex, and ethnicity were included in the models. Multivariate analyses were only conducted on the subpopulation with type 2 diabetes mellitus.

RESULTS

Demographics and Clinical Parameters

Table 2 summarizes the demographic and clinical parameters of all study subjects. Overall, there was no significant difference in age between the two groups (F vs C: 65.5 vs 64.1 years, *P*=.07), but Filipinos had approximately a 7% larger proportion of females (F vs C: 65.4% vs 58.0%, *P*=.01) and about double the proportion of Medicaid recipients relative to Caucasian Americans (F vs C: 39.1% vs 18.8%, *P*<.001). Both groups

Table 3. Diabetic retinopathy in all participants and the diabetic subpopulation

Diagnosis	Filipino	Caucasian	P[c]
All participants	n=512	n=600	
Any diabetic retinopathy	10.0, 7.3–12.7	4.2, 2.5–5.9	<.001
Non-proliferative[a]	7.0, 4.7–9.3	3.2, 1.7–4.7	.003
Proliferative[b]	2.9, 1.3–4.5	1.0, .1–1.9	.02
Diabetic subpopulation	n=208	n=149	
Any diabetic retinopathy	24.5, 18.4–30.6	16.8, 10.5–23.1	.08
Non-proliferative[a]	17.3, 11.9–22.7	12.8, 7.1–18.5	.24
Proliferative[b]	7.2, 3.4–11.0	4.0, .5–7.5	.21

Data are %, 95% CI.

[a] Diagnosed according to the American Academy of Ophthalmology's proposed international clinical diabetic retinopathy disease severity scale in the presence of microaneurysms, intraretinal hemorrhages, definite venous beading, prominent intraretinal microvascular abnormalities *and no* signs of proliferative retinopathy.

[b] Diagnosed according to the American Academy of Ophthalmology's proposed international clinical diabetic retinopathy disease severity scale in the presence of neovascularization or vitreous/preretinal hemorrhage.

[c] *P* are by Pearson's χ^2 test.

were older and had a larger proportion of females in comparison to the United States population, which according to the 2010 United States Census data had a median age of 37.2 years and was 50.8% female.[19] Filipinos had slightly worse visual acuity by logMAR (F vs C: slightly worse than 20/30 Snellen vs slightly better than 20/30 Snellen, $P<.001$) and showed slightly less myopia than Caucasians ($P=.002$). All sampled subjects completed the patient questionnaire. Filipinos demonstrated approximately a 10% and 15% higher prevalence of hypertension ($P<.001$) and type 2 diabetes mellitus ($P<.001$) than Caucasians, respectively.

Diabetic Retinopathy Cases

Table 3 details the association between diabetic retinopathy and ethnicity. Overall, the prevalence of all forms of diabetic retinopathy among Filipinos was approximately twice as high compared to the prevalence among Caucasians (F vs C: 10.0% vs 4.2%, $P<.001$). The prevalence of non-proliferative diabetic retinopathy was also twice as high among Filipinos (F vs C: 7.0% vs 3.2, $P=.003$), and the prevalence of proliferative diabetic retinopathy was almost three times as high among Filipinos (F vs C: 2.9% vs 1.0%, $P=.02$).

In the subpopulation with type 2 diabetes mellitus ($n=375$: 208 Filipino; 149 Caucasian), there was a statistically insignificant higher prevalence of diabetic retinopathy among Filipino diabetics compared to Caucasians (F vs C: all forms of diabetic retinopathy, 24.5% vs 16.8%, $P=.08$; non-proliferative retinopathy, 17.3% vs 12.8%, $P=.24$; proliferative retinopathy, 7.2% vs. 4.0%, $P=.21$) (Table 3).

Multivariate Analyses

Table 4 details the association between diabetic retinopathy and Filipino ethnicity after adjusting for covariates in the subpopulation with type 2 diabetes mellitus. Best-corrected visual acuity (OR: 3.1, $P=.001$) was a significant univariate predictor of any diabetic retinopathy, and the multivariate model showed that Filipino ethnicity was not a significant predictor in diabetics (OR 1.6, $P=.12$) (Table 4A). Univariate analyses of non-proliferative diabetic retinopathy yielded no significant predictors (all $P>.05$), and the multivariate analysis showed that Filipino ethnicity was not a significant predictor of non-proliferative diabetic retinopathy ($P=.21$) (Table 4B). Univariate analyses of proliferative diabetic retinopathy showed that best-corrected visual acuity (OR: 4.6, $P<.001$) was a significant univariate predictor, and the multivariate model showed that Filipino ethnicity was not predictive of proliferative diabetic retinopathy in diabetics ($P=.25$) (Table 4C).

DISCUSSION

This retrospective study with convenience sampling of two community-based comprehensive ophthalmology clinics is the first to estimate the prevalence of diabetic retinopathy in Filipinos. Our results suggest that Filipino Americans have a higher prevalence of diabetic retinopathy in conjunction with a higher prevalence of type 2 diabetes mellitus compared to Caucasian Americans, but that after controlling for their increased prevalence of type 2 diabetes mellitus, Filipino Americans do not have a proportionally greater prevalence of diabetic retinopathy, among those with diabetes, than Caucasian Americans.

Previous studies have described Filipinos' increased risk for type 2 diabetes mellitus[2–9] and its cardiovascular complications,[20] as well as the fluorescein angiography findings in diabetic maculopathy among Filipinos.[10] To the best of our knowledge, no study has determined whether or not Filipinos, like other minority groups in the United States,[21–23] have a high prevalence of retinal sequellae related to the disease. Based on this study's results and

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Table 4. Multivariate analysis of diabetic retinopathy in the diabetic subpopulation, *n*=357

Parameter	Odds Ratio, 95% CI	*P*[a]
A. Any diabetic retinopathy		
Age, one-year increase	.98, .96–1.00[b]	.07
Male sex	1.1, .7–2.0[b]	.61
Filipino ethnicity	1.6, .9–2.7[b]	.12
Worsening BCVA by logMAR	3.1, 1.6–5.9	.001
B. Non-proliferative		
Age, one-year increase	1.00, .97–1.02[b]	.77
Male sex	1.2, .7–2.2[b]	.51
Filipino ethnicity	1.5, .8–2.7[b]	.21
C. Proliferative		
Age, one-year increase	.95, .91–.99[b]	.03
Male sex	.9, .3–2.4[b]	.84
Filipino ethnicity	1.9, .7–5.4[b]	.25
Worsening BCVA by logMAR	4.6, 2.2–9.9	<.001

BCVA, best corrected visual acuity; CI, confidence interval; logMAR, logarithm of the minimum angle of resolution.

[a] *P* values are by multiple logistic regression in which the binary outcome is either A. any diabetic retinopathy, B. non-proliferative diabetic retinopathy, or C. proliferative diabetic retinopathy.

[b] Age, sex, and ethnicity were forced into the multivariate model irrespective of their significance in univariate analyses.

Filipino Americans' high prevalence of type 2 diabetes mellitus, which is comparable to that seen in Latino Americans,[6] we postulate that the prevalence of diabetic retinopathy among Filipino Americans in the general United States population is higher than that found in Caucasian Americans and may approach that observed among some Latino American groups.[22,23] Due, in part, to the study's retrospective design and convenience sampling, however, we caution against generalizing the prevalence of diabetes and diabetic retinopathy observed among Filipino Americans in this study to other Filipino populations; we also caution against comparing our results to similar studies of other minority groups.[22–24] Prospective population-based studies are needed to confirm our preliminary findings.

Given the size of the Filipino American population[1] and its rapid rate of growth,[25,26] a high prevalence of diabetic retinopathy among Filipinos may have important public health implications. In addition to emphasizing the need for ophthalmologic care, accurate assessment of the prevalence of, and risk factors for, diabetic retinopathy in Filipino Americans may catalyze culturally appropriate diabetes screening and prevention programs directed at this population. Filipino Americans are already known to be at higher risk of hypertension relative to other Asian American groups in the United States.[27]

As with any retrospective design, selection bias was a significant concern in our study, particularly given that we employed clinic-based sampling. In light of each clinic-based sample being subject to a different set of biases, which were difficult to quantify retrospectively, we employed two convenience samples in an effort to strengthen the study findings. Subset analyses of the data from Clinic A corroborated those from Clinic B, and analyses of the data from each clinic also corroborated observations in the pooled sample.

In addition to potential bias related to the demographic profiles of the clinics' catchment areas, sampling may have been systematically influenced by referral patterns. It was not possible to confirm subjects' initial reasons for ophthalmologic evaluation from available medical records in most circumstances. Furthermore, although the medical record commonly documented insurance status, it could not be determined to what extent subjects' insurance providers affected access to ophthalmologic care, be it because they were insured privately, received Medicaid and their copayments were waived, or as a result of other unknown factors.

As a result of reclassifying mild, moderate, and severe cases of non-proliferative diabetic retinopathy into a binary variable (ie, the presence or absence of non-proliferative diabetic retinopathy), potential associations between Filipino ethnicity and advanced stages of non-proliferative diabetic retinopathy could not be evaluated. The analysis, by excluding data on macular edema, did not allow for assessment of a potential association between Filipino ethnicity and this finding, either. While information on macular edema and the severity of non-proliferative diabetic retinopathy was available in the medical record, it would not have been valid to include it in the analyses because two observers ascertained this information and inter-observer variance was not amenable to retrospective measurement. From both a clinical and a public health perspective, identifying such associations would be of substantial interest because of the progressively higher risk of vision loss from more advanced stages of non-proliferative diabetic retinopathy and macular edema.[28,29] Future studies may benefit from measuring diabetic retinopathy and macular edema according to reproducible "gold-standard" criteria previously used in population-based studies, such as the Early Treatment Diabetic Retinopathy Study's adaptation of the modified Airlie House diabetic retinopathy classification system, which could not be implemented in this study due to the constraints of a retrospective design.

Blood pressure, blood glucose, hemoglobin A1c, and duration of being diagnosed with type 2 diabetes mellitus

were not available in the charts of the ophthalmology practices sampled and as a result, patients' systemic diagnoses could not be verified or further analyzed. In the absence of these data, in particular hemoglobin A1c levels and duration of diabetes, it is not known to what extent, if at all, these variables influenced our observations that diabetic retinopathy was not significantly associated with Filipino ethnicity in the diabetic subpopulation. It may be beneficial for future studies to define type 2 diabetes mellitus and systemic comorbidities according to accepted clinical criteria not only to control for the possibility of recall bias, which may have affected the results of this study, but also to permit analysis of potential associations between diabetic retinopathy and varying degrees of severity of these conditions.

Future studies may also uncover important associations by accounting for genealogy and migration to fully evaluate the effect of genetic and environmental factors. This may be especially important because of the history of Spanish and American influence in the Philippines.

In summary, this retrospective study with convenience sampling of two community-based comprehensive ophthalmology clinics suggests that Filipino Americans may have a higher prevalence of diabetic retinopathy associated with their already known high prevalence of diabetes mellitus relative to Caucasian Americans. Filipino diabetics were not found, however, to be more likely to have diabetic retinopathy than Caucasian diabetics. Further prospective studies of Filipino Americans are needed to validate our findings as well as to accurately determine the prevalence, incidence, progression, and risk factors associated with diabetic retinopathy in this understudied yet large and rapidly growing population in the United States.

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