Racial Disparity of Eye Examinations Among the U.S. Working-Age Population With Diabetes: 2002–2009

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Diabetes Care 2014;37:1321–1328 | DOI: 10.2337/dc13-1038

OBJECTIVE

Diabetes care differs across racial and ethnic groups. This study aimed to assess the racial disparity of eye examinations among U.S. adults with diabetes.

RESEARCH DESIGN AND METHODS

Working-age adults (age 18–64 years) with diabetes were studied using data from the Medical Expenditure Panel Survey Household Component (2002–2009) including the Diabetes Care Survey. Racial and ethnic groups were classified as non-Hispanic whites and minorities. People reporting one or more dilated eye examination were considered to have received an eye examination in a particular year. Eye examination rates were compared between racial/ethnic groups for each year, and were weighted to national estimates. Multivariate adjusted odds ratios (aORs) and 95% CIs for racial/ethnic difference were assessed annually using logistic regression models. Other influencing factors associated with eye examination were also explored.

RESULTS

Whites had consistently higher unadjusted eye examination rates than minority populations across all 8 years. The unadjusted rates increased from 56% in 2002 to 59% in 2009 among whites, while the rates in minorities decreased from 56% in 2002 to 49% in 2009. The largest significant racial gap of 15% was observed in 2008, followed by 11%, 10%, and 7% in 2006, 2009, and 2005, respectively ($P < 0.05$). Minorities were less likely to receive eye examination (2006: aOR 0.75 [95% CI 0.57–0.99]; 2008: 0.61 [0.45–0.84]).

CONCLUSIONS

The racial/ethnic differences in eye examinations for patients with diabetes have persisted over the last decade. National programs to improve screening and monitoring of diabetic retinopathy are needed to target minority populations.

Diabetic retinopathy is the major cause of blindness among adults 20–74 years of age (1). From 2005 to 2008, 4.2 million people with diabetes aged ≥40 years had diabetic retinopathy, and of these, almost 0.7 million (4.4% of those with diabetes) had advanced diabetic retinopathy that could lead to severe vision loss (2). Diabetes-related blindness can negatively impact a patient's quality of life and costs the U.S. approximately $500 million annually (3).

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Received 1 May 2013 and accepted 11 January 2014.

This sight-threatening complication of diabetes has been shown to disproportionately affect racial and ethnic minority populations. One study of people with type 2 diabetes aged 40–69 years, found a 50% prevalence of diabetic retinopathy among black participants compared with 19% among white participants (4). Native Americans have also been found to have higher rates of retinopathy than whites (5). Lee et al. (6) found that the rates of eye problems due to diabetes are 56% higher for Hispanics than whites. Some inconsistent results have been shown in the literature. One study of underserved populations showed that the prevalence of diabetic retinopathy is not significantly different among ethnic groups (whites, blacks, Hispanics, and Asians) (7).

Risk of vision loss due to diabetic retinopathy can be reduced by early detection and timely treatment, as well as effective control of serum glucose level and blood pressure (8,9). Among high-risk (e.g., elderly) populations, early detection and treatment of diabetic retinopathy is also cost-effective (3,10–12). Annual eye examinations are recommended by the American Diabetes Association guidelines (12) and the American Academy of Ophthalmology (13). Moreover, receipt of an annual eye examination is used as one of the Health Employer Data and Information Set indicators of quality of care in the U.S. (14). However, compliance with the practice guidelines is suboptimal, and differs by racial and ethnic groups (15,16). Racial and ethnic minority patients are not only more likely to have worse glycemic control, but also are less likely to be screened for diabetic retinopathy than their white counterparts (16–18).

Few data are available on racial/ethnic disparities in eye examinations over time in multiethnic populations with diabetes mellitus. This study aimed to compare the national rates of eye examination received across different racial/ethnic groups among patients with diabetes mellitus in the U.S. from 2002 to 2009.

RESEARCH DESIGN AND METHODS

Data Source

A nationally representative sample of the U.S. noninstitutionalized population was examined using the Medical Expenditure Panel Survey (MEPS) data over the years 2002–2009. The MEPS, which contains diversified sources of data on health care use and expenditure, is a set of large-scale surveys of families and individuals, their medical providers, and employers across the U.S. The Household Component of MEPS contains information for individual household members on demographic characteristics (e.g., age, gender, marital status, race/ethnicity, education, region of residence, and family economic status), health status (e.g., diabetes diagnosis), and health insurance coverage. Additionally, a diabetes-specific self-administered questionnaire—Diabetes Care Survey (DCS)—was completed by the respondents with diabetes. The DCS collected information on disease care and management, including the following: A1C tests received, feet checked for sores or irritations, eye examinations in which the pupils were dilated, diabetes-related kidney problems, and antidiabetic treatments received. Relevant to this study, we obtained information on dilated eye examinations from the DCS survey by the self-report question asking whether the respondent had undergone a dilated eye examination during the particular survey year (19).

Variables

People with diabetes were defined as those who had received a diabetes diagnosis from a health professional. In this study, the eye examination was used as the process measurement of primary care for diabetes mellitus. People with at least one dilated eye examination were considered to have received proper screening for diabetic retinopathy within that year. The eye examination rate among patients in whom diabetes had been diagnosed was calculated for each year (2002–2009).

Self-reported race and ethnicity were used to define a respondent as non-Hispanic white or minority (all other than non-Hispanic white, including but not limited to black, American Indian/Alaska native, Asian, native Hawaiian/Pacific islander, or multiple races reported). Any type of insurance coverage reported in a year was recorded as the respondent having health insurance. Education was classified into the following four levels based on the highest degree gained: no degree (i.e., education lower than high school or reported as "Refused"/"Don't know"), General Educational Development (GED), high school diploma, and bachelor degree and above. Education level was further dichotomized to above or below high school/GED education for multivariate analysis. Census regions were used (i.e., Northeast, Midwest, West, and South). Family economic status was captured based on reported annual family income and was dichotomized to above or below the poverty level of the respective year. Public, private, and other insurance types were categorized for multivariate analyses. Public insurance includes TRICARE, Medicare, Medicaid/State Children's Health Insurance Program, and other public hospital/physician programs. Private insurance includes specific private insurance sources, such as employer/union group insurance, nongroup, and other group private insurance. The age of respondents was reported as the mean and SD and was then dichotomized using 45 years of age as the cutoff in multivariate regression models.

Statistical Analysis

In this study, cross-sectional descriptive statistics were reported on population characteristics in 2002 (the first year of availability of the DCS) and 2009 (the latest year for which data were available at the time of this study). In agreement with the National Healthcare Quality and Disparities Report publications and the Agency for Healthcare Research and Quality, disparities were defined as "all differences among populations in measures of health and healthcare" (20). Pearson χ^2 tests were used to compare the differences in unadjusted rates between racial and ethnic groups within each respective year. All statistics were weighted to national estimates. Finally, multivariate logistic regression models were used to assess the "residual racial difference," which is the cross-sectional multivariate adjusted difference between racial/ethnic categories in eye examination for each year reported as adjusted odds ratio (aOR) with 95% CI. Age, gender, education level, marital status, health insurance status, family economic status, and residential census region were adjusted in logistic regression models. A sensitivity analysis for insurance subgroups (insured and uninsured) was performed for eye examination rates in the years 2002–2009. All analyses were

performed using SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

Population characteristics in 2002 and 2009 are presented in Table 1. Approximately 60% of the population with diabetes was non-Hispanic white in 2002. About 70% of non-Hispanic whites, compared with 54% of minorities, were married in 2002. In 2002, about half of the population had a high school diploma in both groups. A higher percentage of the population with no degree was shown in minorities, while more whites possessed college degrees or higher degrees. Insurance coverage rate was 91% in non-Hispanic whites, which was 7% higher than that in minorities in 2002. Only 10% of non-Hispanic white families were below the poverty level compared with 21% of minority families in 2002. The southern region had the highest prevalence of diabetes for both racial/ethnic groups; however, minorities (43%) still showed 4% higher prevalence of diabetes than non-Hispanic whites (39%). In the West, minorities (27%) had an 11% higher prevalence of diabetes than whites (16%); while in the Midwestern region, the prevalence of diabetes was 15% higher among whites (27%) than minorities (12%). From 2002 to 2009, marriage rates and insurance coverage rates dropped in both groups. The marriage rate decreased by 5% among whites and decreased by 2% among minorities. The minority group experienced a 4% decline in insurance coverage, and non-Hispanic whites had a 1% drop. The percentage of individuals with a family income below the poverty level increased to 13% among non-Hispanic white families and to 23% in minority families in 2009.

Figure 1 presents the unadjusted eye examination rates for the years 2002–2009. In all 8 years, the unadjusted eye examination rate of the minority populations was lower than that of the non-Hispanic white population. The racial and ethnic gap appears to widen in a general trend, especially in recent years. For non-Hispanic whites, the crude eye examination rate increased from 56% in 2002 to 59% in 2009. Among the minority populations, the crude rates ranged from 48% (in 2008) to 56% (in 2004) and showed a downward trend in recent years beginning in 2005. The differences in the rates ranged from a high of 15% in 2008 to a low of 0.09% in 2002. Except for the year 2007 ($P = 0.06$), these differences were all statistically significant from 2005 to 2009 (P values <0.05).

The racial/ethnic difference and other influencing factors associated with eye examination rates were examined annually using multivariate logistic regression models (Table 2). Controlling for age, gender, education, marital status, insurance coverage, family income, and census region, the racial differences were still statistically significant in 2006 and 2008 with aORs of 0.75 (95% CI 0.57–0.99; $P = 0.04$) and 0.61 (0.45–0.84; $P < 0.01$), respectively.

Table 2 also presents the associations between other influencing factors and eye examination rate. Compared with a younger working-age group (18–45 years old), older working-age respondents (>45 years old) with diabetes were more likely to receive an eye examination for all years except 2006 and 2009. The health insurance coverage (public or private compared with no insurance) was associated with an increased eye

Table 1—Demographic characteristics of working-age patients with diabetes in 2002 and 2009

	2002		2009	
Variables	Non-Hispanic white	Minority	Non-Hispanic white	Minority
Unweighted (*n*)	508	564	459	817
Weighted, *N* (%)	4,930,497 (59.62)	3,339,669 (40.38)	6,990,337 (59.29)	4,800,294 (40.71)
Age, mean (SD), years	51.52 (0.37)	50.11 (0.40)	52.63 (0.36)	50.57 (0.35)
Sex (%)				
Male	55.38	46.25	51.94	45.47
Female	44.62	53.75	48.06	54.53
Marital status (%)				
Married	70.37	53.75	65.18	51.85
Not married	29.63	46.25	34.82	48.15
Education (%)				
No degree*	13.78	30.93	9.86	27.13
GED	8.15	4.56	4.59	4.90
High school†	49.53	42.15	52.53	46.2
Bachelor's‡	28.53	22.36	33.02	21.77
Insurance (%)	90.60	83.24	89.52	78.87
Family economic status (%)				
Below poverty line	9.97	20.59	12.52	23.46
Above poverty line	90.03	79.41	87.48	76.54
Region (%)				
Northeast	17.47	17.74	18.95	17.26
Midwest	26.98	12.29	25.05	12.53
South	39.30	42.59	36.84	46.49
West	16.24	27.37	19.16	23.72

*No specific level of education was recorded on the survey. †High school diploma with or without ≥1 year of college. ‡College degree or higher.

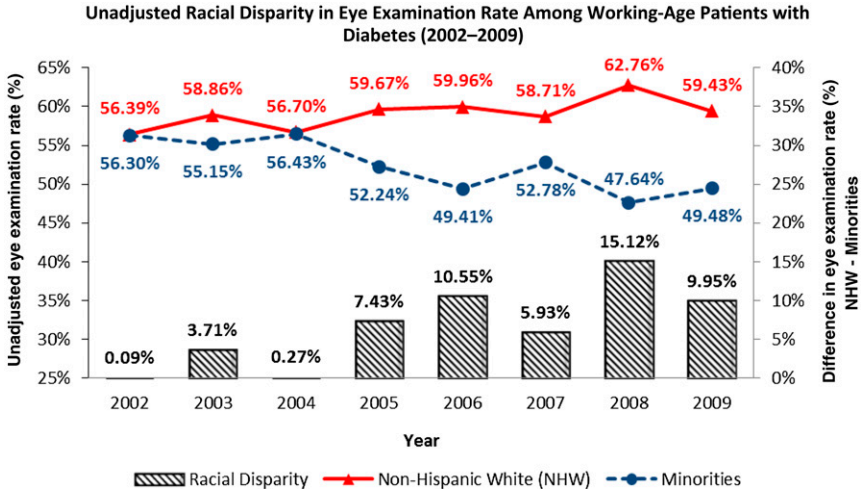

Figure 1—Unadjusted racial disparities in eye examination rate among working-age patients with diabetes (2002–2009).

examination rate for all of the study years, except for coverage of public insurance in 2007. The significant associations for public insurance were estimated in a range of aORs of 1.67 (95% CI 1.02–2.73) in 2003 to 2.69 (1.71–4.21) in 2006. The estimated associations for private insurance with eye examination ranged from 1.89 (1.16–3.07) in 2007 to 3.50 (2.27–5.41) in 2005. Male patients with diabetes were found to have a higher eye examination rate than female counterparts in 2003 (aOR 1.42 [95% CI 1.02–1.96]) and 2008 (1.41 [1.06–1.89]). Compared with those with no degree, diabetic patients with at least a high school diploma were more likely to have had an examinations in 2003 (1.45 [1.03–2.04]) and 2009 (1.63 [1.14–2.33]). Residential region in the Midwest, South, or West compared with the Northeast presented very few significant results of associations with eye examination rates. Only patients in the South in 2007 and 2008, and patients in the West in 2007 had significantly lower eye examination rates than those in the Northeast. Marital status and family income level were not found to be associated with eye examination in patients with diabetes for all the study years.

We performed a subgroup sensitivity analysis on insurance coverage to examine the influence of overall health insurance (insured vs. uninsured) on eye examination between racial/ethnic groups (Table 3). Among the insured patients, the eye examination rates differed between non-Hispanic whites and minorities in 2005, 2006, 2008, and 2009. However, no statistically significant differences were found between non-Hispanic whites and minorities among individuals in the uninsured population in all study years, except for 2006.

CONCLUSIONS

To the best of our knowledge, this study is the first to describe racial/ethnic differences in eye examination rates using a nationally representative sample over 8 years (2002–2009). The crude rates (55–57%) found in this study were consistent with the national average rate reported by the Health Employer Data and Information Set (e.g., 58% in 2009) (21). Previous studies on the racial/ethnic disparities in the U.S. were found to be very limited in recent reviews (6,22). Using the MEPS 2000 data, Lee et al. (6) found differences in outpatient services and prescription drug use patterns across racial/ethnic groups. However, most of the diabetes care measures were not significantly different among the three racial and ethnic groups (white, African American, and Hispanic adults). Our results of the earlier years (0.09–0.27% differences in eye examination rates from 2002 to 2004) show no significant differences in the rates between non-Hispanic whites and minorities, which were consistent with those in the study by Lee et al. (6), and other studies using the third National Health and Nutrition Examination Survey data (17,23), and a sample of veterans in the Department of Veterans Affairs health care system (24). In recent years (2005–2009), we found significant racial and ethnic differences in eye examination rates with a diverging trend. We observed a slight increase in the eye examination rate among non-Hispanic whites since 2004, in contrast to a more marked decrease in the rate among minorities. This results in a recent widening gap between these two racial and ethnic groups. The residual differences found in multivariable regression models after controlling for other relevant influencing factors persisted in the years of 2006 and 2008.

Patient, provider, and health care system factors may contribute to the disparities in diabetic retinopathy screening observed in this study. Health insurance coverage and benefit design may have a direct effect on self-monitoring behavior, especially for costly screenings, such as eye examinations, which often require specialists to perform the examinations. In this study, health insurance coverage, with either public or private insurance, was identified as the most significant factor for receiving an eye examination. The Andersen model has emphasized that the utilization of health care services is associated with health insurance status (25). In particular, some of the study respondents who were of working age (18–64 years old) were uninsured or not sufficiently insured (e.g., no vision coverage), and had lost their insurance coverage due to unemployment during the recent economic recession starting in late 2007

Table 2—Multivariate analysis of factors associated with eye examination among working-age diabetic population 2002–2009

Variables	2002		2003		2004		2005		2006		2007		2008		2009	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Race (ref: NHW)	1.26	(0.96–1.65)	1.07	(0.79–1.46)	1.24	(0.90–1.71)	0.96	(0.71–1.29)	0.75	(0.57–0.99)	1.00	(0.75–1.33)	0.61	(0.45–0.84)	0.80	(0.60–1.07)
Age (ref: 18–45 years)	1.96	(1.44–2.67)	1.83	(1.32–2.51)	1.89	(1.40–2.55)	1.54	(1.13–2.10)	1.28	(0.93–1.75)	1.60	(1.21–2.12)	1.48	(1.06–2.06)	1.30	(0.94–1.80)
Female sex (ref: F)	1.09	(0.82–1.45)	1.42	(1.02–1.96)	1.05	(0.76–1.46)	1.10	(0.79–1.53)	1.21	(0.93–1.58)	1.18	(0.91–1.53)	1.41	(1.06–1.89)	1.22	(0.95–1.57)
Marital status (ref: unmarried)	1.28	(0.97–1.70)	1.11	(0.81–1.53)	1.00	(0.74–1.36)	0.95	(0.67–1.34)	1.12	(0.82–1.53)	1.03	(0.79–1.35)	1.15	(0.84–1.57)	1.15	(0.83–1.59)
Education (ref: no degree)	1.41	(0.96–2.08)	1.45	(1.03–2.04)	1.38	(0.99–1.93)	1.28	(0.87–1.90)	1.19	(0.88–1.60)	1.25	(0.95–1.65)	1.05	(0.72–1.54)	1.63	(1.14–2.33)
Insurance (ref: none)																
Public	1.77	(1.12–2.79)	1.67	(1.02–2.73)	2.46	(1.48–4.08)	1.73	(1.01–2.95)	2.69	(1.71–4.21)	1.65	(0.97–2.79)	2.37	(1.41–3.98)	2.61	(1.61–4.24)
Private	2.33	(1.52–3.59)	1.91	(1.23–2.99)	2.59	(1.65–4.08)	3.50	(2.27–5.41)	3.33	(2.12–5.24)	1.89	(1.16–3.07)	2.36	(1.48–3.75)	2.76	(1.78–4.27)
Poverty line (ref: under)	1.18	(0.78–1.78)	1.44	(0.93–2.23)	1.12	(0.69–1.83)	1.37	(0.90–2.11)	1.02	(0.64–1.62)	1.44	(0.97–2.15)	1.23	(0.78–1.93)	0.89	(0.62–1.27)
Region (ref: Northeast)																
Midwest	0.74	(0.47–1.14)	1.33	(0.79–2.24)	1.28	(0.75–2.17)	0.76	(0.48–1.19)	0.94	(0.56–1.56)	0.87	(0.57–1.33)	0.64	(0.38–1.08)	1.29	(0.77–2.16)
South	0.79	(0.56–1.10)	0.96	(0.65–1.42)	1.04	(0.69–1.57)	0.68	(0.42–1.08)	0.67	(0.42–1.08)	0.62	(0.43–0.91)	0.58	(0.37–0.90)	1.08	(0.69–1.70)
West	0.75	(0.49–1.15)	0.74	(0.47–1.15)	1.10	(0.70–1.75)	0.77	(0.47–1.25)	1.12	(0.69–1.81)	0.62	(0.39–0.68)	0.68	(0.42–1.12)	1.40	(0.84–2.34)

F, female; NHW, non-Hispanic white; OR, odds ratio; ref, reference.

(26). The recent recession may have exacerbated the health disparity across the racial/ethnic groups because the minority groups were more vulnerable to be severely affected by the recession (27,28). Our study also observed that the insurance coverage decreased over the years; however, the minorities have been affected to a larger degree. Furthermore, minorities still had worse performances on eye examination than non-Hispanic whites within the insured population. This sensitivity analysis suggests that simply expanding health insurance coverage to minority patients may not fully address the racial/ethnic disparity in diabetes preventive care, even after the Affordable Care Act is implemented in 2014. For example, patients' attitudes toward diabetes retinopathy screening and referral by health care providers are important factors in the uptake of diabetes retinopathy screening services (29). The geographically differential distribution of ophthalmologists and optometrists may affect diabetes retinopathy screening. A study of the distribution of ophthalmologists showed that no more than 20% of them selected nonmetropolitan practice locales (30). Areas without vision care professionals reported fewer dilated eye examinations (31). Last, the landscape of preventive services (e.g., insurance coverage and benefit design) will change with the imminent implementation of the Affordable Care Act in the U.S. Further research on monitoring and examining the reasons behind the racial and ethnic differences may lead to the timely development of effective strategies to reduce racial/ethnic disparities in diabetes care.

Screening guidelines have been developed by national professional groups such as the American Diabetes Association (12) and the American Academy of Ophthalmology (13). The recommendations are that patients with type 1 diabetes should have an initial dilated examination within 5 years of the onset of diabetes. Patients with type 2 diabetes may have retinopathy at the time of diagnosis and should have an initial dilated examination at the time of diagnosis. A follow-up eye examination should be conducted yearly. In clinical settings, methods of screening for diabetic retinopathy include direct and indirect ophthalmoscopy, stereoscopic color film fundus photography, and mydriatic or

Table 3—Stratified eye examination rates by insurance status and races/ethnicities: 2002–2009

	Insured diabetic patients eye examination rate			Uninsured diabetic patients eye examination rate		
Year	Non-Hispanic whites (%)	Minorities (%)	*P* value	Non-Hispanic whites (%)	Minorities (%)	*P* value
2002	58.89	59.43	0.87	32.32	40.37	0.23
2003	60.45	58.17	0.50	42.75	36.01	0.23
2004	58.88	60.18	0.75	29.54	36.78	0.15
2005	62.89	55.77	0.04	31.57	32.60	0.87
2006	62.02	54.41	0.03	38.06	24.09	<0.01
2007	60.35	55.07	0.09	43.24	39.35	0.49
2008	64.80	52.53	<0.01	39.60	28.50	0.11
2009	62.32	54.06	0.02	34.94	32.38	0.64

nonmydriatic photography. Different from other diabetes screening procedures (A1C tests and foot examinations), a unique barrier to the eye examination exists as the procedure typically requires an ophthalmologist or optometrist to perform pupil dilation and ophthalmoscopy.

Diabetic retinopathy is not only a severe complication of diabetes leading to vision loss, but is also an important indicator to predict other complications, such as diabetes nephropathy (32). Diabetic retinopathy is the complication that may presage other complications due to the strong linkage of suboptimal monitoring or treatment of diabetes. Therefore, detection of diabetic retinopathy is not only beneficial for preventing or minimizing the risk of vision loss but also meaningful because it indicates inadequate diabetes management. Maximizing the effort to improve diabetes-related vision care for racial and ethnic minority patients can lead to an overall decrease in diabetic retinopathy disparity. Public health interventions are necessary on a large scale to preserve vision in minority communities; it is also essential that individual health care providers better understand the impact of diabetic retinopathy on minority communities and the available interventions to reduce its impact.

Recognizing the importance of diabetic retinopathy complications, several countries have implemented national screening programs such as the National Plan for Screening in the U.K. (33) and the Ophdiat program in France (34). The Diabetic Eye Screening Programme in the U.K. offers annual digital fundus photography for all patients with diabetes over the age of 12 years regardless of their socioeconomic status or ethnicity (33). The U.K. population screening was found to reduce the likelihood of eye disease in patients with diabetes (35). In addition, new screening methods using nonmydriatic retinal cameras have been implemented recently to improve the early detection and monitoring of diabetic retinopathy (36). Using a dilation procedure as the gold standard is suggested by the American Diabetes Association guideline (37). The sensitivity of digital and polaroid film nonmydriatic retinal cameras were 86.2% and 84.1% respectively, while their specificity was only 71.2%. Therefore, this technique can be often considered when a dilated eye examination cannot be conducted (38).

Within the context of the current diabetes management strategies and new screening technologies, the U.S. needs to address how it can reorganize its health care delivery system to improve diabetic retinopathy screening services for patients with diabetes. More ambitiously, increased use of community-based outreach should be considered for minority populations, who are at a higher risk of diabetes and its complications. Future studies should focus on the underlying causes of these racial and ethnic differences in preventive care. Prospective studies to explore the dynamic effects of changes in health insurance coverage and other socioeconomic factors over time are warranted.

Study Limitations

Several limitations of the study should be noted. First, the eye examinations received were self-reported and may be subject to recall bias. The information collected by MEPS only focused on the dilated eye examinations, but not on other new tests conducted without dilation. Regarding the fact that the dilated eye examination is still considered to provide the most information and is used commonly by ophthalmologists and optometrists, the rates should be most relevant to the quality of care for diabetes. Some important factors such as the duration, type, and severity of diabetes, which are critical factors for disease severity adjustment in comparing differences in diabetic retinopathy screening, were not collected in the survey. Second, some sample selection criteria may affect our results. Individuals with undiagnosed diabetes were not included in the MEPS. Patients with diabetes in the U.S. in 2011 include 7.0 million undiagnosed people and 79 million prediabetic people (2). Therefore, racial and ethnic disparities for individuals with undiagnosed diabetes, which might be more substantial than for those with diagnosed diabetes, are still unknown. Given that the increasing prevalence of diabetes is projected to reach 36 million individuals in 2030 (39), the diabetes epidemic poses a challenge to the provision of eye care in the U.S. Finally, the cross-sectional analytical framework was used in this study, and causality could not be established.

This study has primarily adopted the disparity definition suggested by the Agency for Healthcare Research and Quality. The definition is simply measuring differences in the means of racial/ethnic groups. The unadjusted difference includes the intrinsic factors, which cannot be removed by improving health care systems and techniques. An alternative definition of racial/ethnic disparity, the residual direct effect, has also been assessed secondarily in this study, by adjusting for measurable variables such as age, gender, education, insurance coverage, family economic status, marital status, and residential region.

The Institute of Medicine has recommended an alternative definition of racial/ethnic disparity, which is estimated by eliminating the influence on the overall difference by health care needs or preferences of racial/ethnic groups (40). The MEPS has the limitation of estimating health care needs and preferences.

Summary

Our study provides insight into racial and ethnic differences and influencing factors in diabetic retinopathy screening over the last decade. From 2002 to 2009, Americans with diabetes who were from racial and ethnic minority populations had consistently lower crude eye examination rates than their white counterparts. Although health insurance coverage was consistently associated with differences in eye examination rates across the study period, the observed racial and ethnic differences have persisted even with insurance coverage.

Duality of Interest. No potential conflicts of interest relevant to this article were reported.

Author Contributions. Q.S. researched the data and wrote the manuscript. Y.Z. wrote, reviewed, and edited the manuscript. V.F. reviewed the manuscript and contributed to the discussion. M.K.-W. reviewed and edited the manuscript. L.S. wrote, reviewed, and edited the manuscript. L.S. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Prior Presentation. Part of the study results was presented as a podium presentation at the American Public Health Association Annual Meeting & Exposition, San Francisco, CA, 27–31 October 2012.

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