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Barriers to Eye Care Among People Aged 40 Years and Older With Diagnosed Diabetes, 2006–2010

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Abstract

OBJECTIVE—We examine barriers to receiving recommended eye care among people aged 40 years with diagnosed diabetes.

RESEARCH DESIGN AND METHODS—We analyzed 2006–2010 Behavioral Risk Factor Surveillance System data from 22 states ($n = 27,699$). Respondents who had not sought eye care in the preceding 12 months were asked the main reason why. We categorized the reasons as cost/lack of insurance, no need, no eye doctor/travel/appointment, and other (meaning everything else). We used multinomial logistic regression to control for race/ethnicity, education, income, and other selected covariates.

RESULTS—Among adults with diagnosed diabetes, nonadherence to the recommended annual eye examinations was 23.5%. The most commonly reported reasons for not receiving eye care in the preceding 12 months were “no need” and “cost or lack of insurance” (39.7 and 32.3%, respectively). Other reasons were “no eye doctor,” “no transportation” or “could not get appointment” (6.4%), and “other” (21.5%). After controlling for covariates, adults aged 40–64 years were more likely than those aged 65 years (relative risk ratio [RRR] = 2.79; 95% CI 2.01–3.89) and women were more likely than men (RRR = 2.33; 95% CI 1.75–3.14) to report “cost or lack of insurance” as their main reason. However, people aged 40–64 years were less likely than those aged 65 years to report “no need” (RRR = 0.51; 95% CI 0.39–0.67) as their main reason.

CONCLUSIONS—Addressing concerns about “cost or lack of insurance” for adults under 65 years and “no perceived need” among those 65 years and older could help improve eye care service utilization among people with diabetes.

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Diabetes affects 27 million people in the U.S., and if current trends continue, between one in five and one in three adults will have diabetes by 2050 (1). Diabetic retinopathy is the leading cause of new cases of vision impairment and blindness among people with diabetes, and among people with diabetes, 28.5% have diabetic retinopathy (2). A previous study analyzed data from the National Health and Nutrition Examination Survey (NHANES) from 1999 to 2002 and from 2005 to 2008, and found that in the U.S., vision impairment related to diabetes increased by 20% over less than a decade (3). Blindness due to diabetes costs the nation, annually, approximately \$500 million in health care and associated costs (4). The efficacy and effectiveness of screening for diabetic retinopathy among individuals with diabetes is well established (5).

To prevent vision loss, yearly eye examinations are recommended for people with diabetes, beginning at the time of diagnosis of type 2 diabetes or after 5 years of type 1 diabetes, with increasing frequency depending on severity of eye disease (6). Although regular comprehensive eye examinations are critical for early detection, timely treatment, and maintaining vision health (7), people with diabetes have been receiving this recommended eye care at suboptimal levels (8–10). In the U.S., Medicare covers an annual eye examination for those with diabetes (11), and most health insurance covers medical eye examination and payment for eye diseases such as diabetic retinopathy, cataract, and glaucoma (12). However, 25–47% of those with diabetes do not have yearly eye examinations (8,9).

To develop interventions that increase the use of preventive eye care, we need to better understand why people do not seek care. We analyzed data from the Behavioral Risk Factor Surveillance System (BRFSS) to estimate the prevalence of not having an eye examination in the preceding 12 months, to describe the reasons reported by those without seeking eye care, and to identify factors associated with these reasons.

RESEARCH DESIGN AND METHODS

Data Source and Sample

The BRFSS is an annual state-based random-digit-dialed telephone survey of the noninstitutionalized U.S. civilian population (13). The BRFSS was designed to provide information on sociodemographics, chronic illness, health behaviors, and access to health care. The BRFSS also includes optional modules that states may choose to add. We analyzed data from the BRFSS from the 22 states (Alabama, Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Indiana, Iowa, Kansas, Maryland, Massachusetts, Missouri, Nebraska, New Mexico, New York, North Carolina, Ohio, Tennessee, Texas, West Virginia, and Wyoming) that conducted the Visual Impairment and Access to Eye Care Module (vision module) at least once between 2006 and 2010. Our sample included 27,699 respondents aged ≥ 40 years with diagnosed diabetes. Median state response rates (the percentage of persons among all eligible persons in states administering the BRFSS during that period who completed the interview) ranged from 50.6 to 54.6%; median state cooperation rates (the percentage among all eligible persons who were contacted who completed interview) ranged from 75.2 to 79.7% (14).

Measures

We classified respondents as having diagnosed diabetes if they answered “yes” to the question, “Have you ever been told by a doctor or other health care provider that you have diabetes?” Women who indicated gestational diabetes mellitus that resolved upon delivery were not considered to have diabetes. We categorized people as having visited an eye care professional in the preceding 12 months if they answered “within the past month” or “within the past year” to the question, “When was the last time you had your eyes examined by any doctor or eye-care provider?” Those who indicated times longer than one year were considered to have not visited an eye care provider in the preceding 12 months. Persons who had not visited an eye care professional in the preceding 12 months were asked the main reason why they had not done so; respondents were only allowed to indicate one main reason. We classified their responses into four categories: 1) cost or lack of insurance; 2) no need, consisting of “have not thought of it” and “no reason to go”; 3) no eye doctor/travel/appointment, consisting of “do not have/know an eye doctor,” “too far/no transportation,” and “could not get an appointment”; and 4) other.

Covariates included age (40–64 years, and 65 years and older); sex; race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Hispanic, or non-Hispanic persons of “other” races); educational attainment (less than high school, high school, more than high school); income (<\$35,000 or \$35,000); health insurance coverage at the time of survey (“yes” or “no”); eye insurance coverage at the time of survey (“yes” or “no”); any self-reported eye disease (glaucoma, age-related macular degeneration, diabetic retinopathy, or cataract); time since diagnosis of diabetes (<5, 5–14, or 15 years); ever had diabetes education (“yes” or “no”); and have ever taken diabetes medicines (“yes” or “no”). Self-reported vision impairment was defined using two questions: “How much difficulty, if any, do you have in recognizing a friend across the street?” and “How much difficulty, if any, do you have reading print in newspapers, magazines, recipes, menus, or numbers on the telephone?” We classified those who answered “a little difficulty,” “moderate difficulty,” “extreme difficulty,” “unable to do because of eyesight,” or “blind” to either question as having vision impairment (“yes” or “no”). To control for possible differences by year and state, we included year and state variables in the models.

Analytic Methods

First, we examined the characteristics of the population aged 40 years with diagnosed diabetes, separated by those who had made an eye care visit in the preceding 12 months and those who had not. Then among those not seeking eye care, we estimated how responses to the question about main reasons for not seeking eye care were distributed by selected sociodemographic, clinical, and diabetes-related characteristics. We used Wald χ^2 statistics to test whether the main reason was independent of each characteristic. Finally, using multinomial logistic regression, for each barrier to eye care, we calculated an adjusted relative risk ratio (RRR), which is the ratio of two probabilities (e.g., “cost or lack of insurance” vs. “no need” [reference group]). This model controlled for age, sex, race/ethnicity, education, income, health insurance coverage, eye insurance coverage, any known eye disease, time since diagnosis of diabetes, diabetes education, diabetes medication, vision impairment, state of residence, and survey year.

All analyses were conducted using survey procedures in Stata 12.1 to account for the BRFSS's complex sampling design. Analyses were weighted to account for individual selection probabilities, nonresponse, and poststratification. We considered the results of hypothesis tests significant when the *P* value was <0.05.

RESULTS

Table 1 presents characteristics of the study population. From 2006 to 2010, 23.5% (95% CI 22.6–24.4) of persons aged 40 years with diagnosed diabetes had not sought eye care in the preceding 12 months. Among those with diabetes not seeking eye care, nearly 51% were women, 30% were aged 65 years, 15.1% were non-Hispanic blacks, 11.3% were Hispanics, 62.2% reported annual income <\$35,000, 33% reported vision impairment, and 35.6% had known eye diseases. Among those who sought eye care, nearly 51% were men, 45.8% were 65 years, 15.4% were non-Hispanic blacks, 9.2% were Hispanics, nearly half reported annual income <\$35,000, 25.0% reported vision impairment, and 55.5% reported known eye diseases.

Of those who reported not seeking eye care in the preceding 12 months, 39.7% reported “no need,” 32.3% reported “cost or lack of insurance,” 6.4% reported “no eye doctor, no transportation, or could not get an appointment,” and 21.5% reported other reasons (Table 2). Cost or lack of insurance was most often the main reason given by women (40.1%), persons aged 40–64 years old (38.5%), Hispanics (38.4%), those with incomes <\$35,000 (42.1%), persons with less than a high school education (40.3%), those not using diabetes medication (42.0%), and those with vision impairment (45.3%). In contrast, “no need” was the reason most commonly given by men (49.6%), persons 65 years or older (51.3%), non-Hispanic whites (42.2%), non-Hispanic blacks (38.8%), those with incomes greater than \$35,000 (51.6%), persons with at least a high school education (42.5%), those not using diabetes medication (35.0%), and those without vision impairment (47.3%). However, any known eye disease and diabetes education were not associated with any reason given.

Table 3 shows the results from multinomial logistic regression modeling of the main reason for not seeking eye care. After adjusting for covariates, adults aged 40–64 years, women, people with an income of <\$35,000, and people with vision impairment were more likely to report “cost or lack of insurance” versus “no need” as a main reason for not seeking eye care (RRR = 3.13, 95% CI 2.19–4.47; RRR = 3.12, 95% CI 2.32–4.20; RRR = 2.88, 95% CI 2.03–4.09; and RRR = 3.14, 95% CI 2.35–4.22, respectively). In contrast, people with health insurance coverage and eye care coverage were less likely to report “cost or lack of insurance” versus “no need” as a main reason (RRR = 0.36, 95% CI 0.23–0.56, and RRR = 0.28, 95% CI 0.21–0.38, respectively). Females versus males (RRR = 3.60; 95% CI 2.11–6.16), Hispanics versus non-Hispanic whites (RRR = 3.52; 95% CI 1.50–8.25), people with time since diabetes diagnoses 15 years versus time <5 years (RRR = 2.11; 95% CI 1.08–4.11), those with versus those without diabetes medication (RRR = 1.88; 95% CI 1.06–3.32), and those with versus those without vision impairment (RRR = 2.19; 95% CI 1.34–3.58) were more likely to report “no eye doctor/travel/appointment” versus “no need” as the main reason for not seeking eye care.

The reasons given for not seeking eye care among those with diagnosed diabetes varied among the 22 states (Fig. 1). “Cost or lack of insurance” as the main reason cited for not seeking eye care ranged from 12.6% (95% CI 6.6–22.5, Massachusetts) to 50.0% (95% CI 41.2–58.7, Tennessee). Those reporting “no need” ranged from 27.0% (95% CI 20.6–34.5, Tennessee) to 56.6% (95% CI 46.0–66.6, New Mexico). “No eye doctor/travel/appointment” as the main reason for barriers to eye care ranged from 1.2% (95% CI 0.4–3.7, Missouri) to 13.4% (95% CI 6.4–26.0, Maryland) (Supplementary Data).

CONCLUSIONS

Nearly one in four people aged 40 years with diagnosed diabetes have not sought eye care in the preceding 12 months. More than one-third of people with diagnosed diabetes who did not receive eye care reported “no need” as a main reason, and another one-third reported cost or lack of health insurance coverage. People reporting barriers to receiving eye care were highly associated with sociodemographic factors, health insurance coverage, time since diagnosis of diabetes, diabetes medication, and vision impairment. Our estimated percentage of people receiving eye care in the past year is consistent with the estimate in another study. Ali et al. analyzed data from the BRFSS and found the proportion of persons aged 18 years with diabetes who had received an annual eye examination declined from 75.1% in years 1999–2002 to 73.5% in years 2007–2010 (9). The estimate of Ali et al. is slightly lower than ours, which may be due to differences in the dataset or differences in the age range of the sample. Among those with diagnosed diabetes overall, we found the perception of “no need” to be the main reason for not seeking eye care, followed by “cost or lack of health insurance.” Eye problems often have no early signs or symptoms; therefore one of the possible reasons for reporting “no need” as the main reason could be the lack of knowledge about how diabetes affects the eyes and the need for a regular eye examination to prevent vision loss (15,16). Another possible reason could be lack of reminders from physicians. Having a physician reminder was associated with increased eye care visits and subsequent better eye health (17). Therefore intervention to increase the awareness of the need for an annual eye examination might improve eye health among people with diabetes who reported “no need” as the reason. In addition, people with diabetes tend to come from families with diabetes and might also remind family members and others in their community of the need to have a regular eye examination.

Our study indicated that the reason given for not seeking eye care differed between age categories. We found that those who reported “no need” as a barrier were most likely to be aged 65 years, whereas those who reported “cost or lack of health insurance” were most likely to be aged 40–64 years. Medicare covers one eye examination every 12 months for people who have diabetes (11). Thus it was not surprising that we found that adults aged 65 years indicated “cost or lack of health insurance” as their main reason for not seeking eye care more often than did their older counterparts. However, although adults aged 65 years have the highest prevalence of vision impairment (18), a large proportion reported “no need” as the main reason for not seeking eye care. Older adults might not be aware of their vision impairment, because symptoms progress slowly or they might consider vision impairment to be a normal part of aging (19).

Men and women reported different main reasons for not seeking eye care. Men were more likely than women to report “no need” to seek eye care; women were more likely to report “cost or lack of insurance” as their main reason. These results agree with prior studies and may reflect women having had less financial access to care than men, and men are less likely to use health care services (20,21).

“Cost or lack of insurance” appears to be a major barrier to seeking eye care for low-income persons. Those with low income were less likely to report “no need” as the main reason for not seeking care. Instead, “cost or lack of insurance” was the reason most commonly given by low-income persons. Previous studies demonstrated that persons in the low-income population were less able to cover out-of-pocket costs (22,23).

Of note, respondents with visual impairment were more likely to report “cost or lack of insurance” as a barrier and less likely to report “no need.” This persisted even after adjustment for covariates (including age and income). Our results were consistent with previous studies that have found “cost or lack of health insurance” was a barrier for people with vision impairment (8,24). “No need” and a general lack of awareness about the importance of eye examination are another barrier for eye care (12,25) in people with diabetes, who are at increased risk of developing vision impairment or vision loss (3,26). Thus diabetes eye health education programs or interventions that increase the awareness of the need for eye care among people with diabetes may be important in preventing vision loss (18,27).

We also found racial/ethnic differences in barriers to getting eye care. Hispanics were more likely to report “no eye doctor/travel/appointment” as the main reason for not seeking eye care. In a study examining barriers to eye care among Hispanics, those not seeking eye care were more likely to lack health insurance, to have had no routine physical examination in the past year, to be less educated, and to have an A1C level <9.0%, putting them at increased risk for complications of diabetes (28). Another study also demonstrated that cost, availability of services, and convenience of accessing care were main barriers to obtaining eye care among Hispanics (29).

We found that those with a longer time since diagnosis of diabetes were more likely to report “no eye doctor/travel/appointment” as the main reason for not seeking eye care. Previous studies have shown that the likelihood of developing diabetes-related complications, including vision problems, increases along with time since diagnosis of diabetes (26,30). Owsley et al. (31) conducted focus groups among African Americans to examine the perceived barriers to eye care and found that clinic accessibility was the primary barrier to care. Interventions may target those persons for whom it has been longer since diagnosis of diabetes, and improving the accessibility of eye care might work to decrease vision problems among people with diabetes. We found no evidence that the lack of diabetes education was associated with any specific reason for not seeking eye care. Diabetes education is an opportunity to increase awareness, and therefore one might have expected fewer “no need” responses among people who had participated in diabetes education. Increasing the amount of information about the need for regular comprehensive eye care that is included in diabetes education curricula might increase awareness of the need for eye examinations. Because lack

of physician reminder was associated with less use of eye care, reminder/recall systems might help further.

Barriers to receiving eye care among people with diagnosed diabetes varied between states. Among the 22 states including the BRFSS vision module during the study period, the estimated percentage of respondents reporting “cost or lack of insurance” as the main reason for not seeking eye care was lowest for adults in Massachusetts, the state with the smallest proportion of residents without health insurance (32). According to one report from 1997 to 1999, the prevalence of dilated eye examinations every 2 years among people with diabetes were lowest in Georgia, Illinois, Indiana, and Michigan and highest in Florida and several states in the Midwest (33). Even within states, there are differences among rural and urban counties. Chou et al. (34) have shown that people who lived in a county with low density of eye care providers experienced reduced likelihood of having annual dilated eye examination. In Arkansas, a previous study showed that fewer rural residents reported having eye insurance coverage and dilated eye exams within the previous year (35). In a study that examined Medicare claims data from 1999 to 2001, Arkansas was found to have the lowest diabetic eye examination rate across all states (36). Given the geographic variation in eye care, state-specific strategies may be a more appropriate approach to intervention. Surveys such as BRFSS that provide state-level data can help planners understand potential areas of unmet health care needs.

The findings in this report are subject to several limitations. First, BRFSS data are self-reported and therefore subject to recall and social desirability bias. Second, given a response of “no diabetes,” BRFSS data cannot be used to distinguish between “persons without diabetes” and those with undiagnosed diabetes; approximately 27% of those with diabetes are unaware of their condition (37). Third, the correlation between perceived and clinically diagnosed vision impairment is unknown. Fourth, these results are not representative of the entire U.S., because only 22 states and no U.S. territories administered the optional vision module at least once during the study period. Similarly, not all states conducted the vision module the same number of times over the study period, thereby overrepresenting states that conducted it more often in our sample. Fifth, people without telephones, who live in cell-phone-only households, who are institutionalized, or whose disabilities are so severe they cannot use the phone were not represented in our sample. Although there could be nonresponse bias (median state response rates were approximately 50%), BRFSS data are subject to poststratification to make weighted respondent demographics match state demographics (38). Notwithstanding these limitations, major strengths of our study are the BRFSS's large sample sizes in each survey year that can provide stable estimates of our study outcomes. BRFSS is the only survey that provides state-level data on vision, eye health, and use of access to eye care services. In addition, the BRFSS vision module is unique in including detailed questions on individual barriers to eye care services and offering the resultant data to the public health community, which is widely familiar with the BRFSS survey.

Increasing eye care utilization, reducing vision impairment, and improving quality of life among people with diabetes are public health priorities. Having eye insurance coverage does not guarantee eye care service utilization. However, not having eye insurance coverage

places members of an already vulnerable population of persons with diagnosed diabetes (those with low income, people aged 40–64 years, and women) at increased risk for vision loss by increasing their likelihood of not receiving eye care. Thus targeting interventions toward low-income individuals, adults aged 40–64 years, and those without health insurance coverage may promote eye care among those with diabetes who perceive cost of/no health insurance as a barrier to eye care. Moreover, public health interventions aimed at heightening awareness among both adults aged 65 years and health care providers might increase utilization rates among people with diabetes. By illustrating some primary reasons why people with diabetes do not seek eye care, findings from this study can help shape the development of targeted interventions and dissemination of effective public health messages to promote eye care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Boyle JP, Thompson TJ, Gregg EW, Barker LE, Williamson DF. Projection of the year 2050 burden of diabetes in the US adult population: dynamic modeling of incidence, mortality, and prediabetes prevalence. *Popul Health Metr.* 2010; 8:29. [PubMed: 20969750]
2. Zhang X, Saaddine JB, Chou CF, et al. Prevalence of diabetic retinopathy in the United States, 2005-2008. *JAMA.* 2010; 304:649–656. [PubMed: 20699456]
3. Ko F, Vitale S, Chou CF, Cotch MF, Saaddine J, Friedman DS. Prevalence of nonrefractive visual impairment in US adults and associated risk factors, 1999-2002 and 2005-2008. *JAMA.* 2012; 308:2361–2368. [PubMed: 23232894]
4. [22 February 2013] The high cost of diabetes and diabetes complications [article online]. 2012. Available from <http://www.diabetesleadershipinitiative.com/assets/high-cost-of-complications-white-paper.pdf>.
5. Fong DS, Gottlieb J, Ferris FL 3rd, Klein R. Understanding the value of diabetic retinopathy screening. *Arch Ophthalmol.* 2001; 119:758–760. [PubMed: 11346406]
6. American Diabetes Association. Standards of medical care in diabetesd2012. *Diabetes Care.* 2012; 35(Suppl. 1):S11–S63. [PubMed: 22187469]
7. Javitt JC, Aiello LP, Chiang Y, Ferris FL 3rd, Canner JK, Greenfield S. Preventive eye care in people with diabetes is cost-saving to the federal government. Implications for health-care reform. *Diabetes Care.* 1994; 17:909–917. [PubMed: 7956643]
8. Elish NJ, Royak-Schaler R, Passmore SR, Higginbotham EJ. Knowledge, attitudes, and beliefs about dilated eye examinations among African-Americans. *Invest Ophthalmol Vis Sci.* 2007; 48:1989–1994. [PubMed: 17460251]
9. Ali MK, Bullard KM, Saaddine JB, Cowie CC, Imperatore G, Gregg EW. Achievement of goals in U.S. diabetes care, 1999-2010. *N Engl J Med.* 2013; 368:1613–1624. [PubMed: 23614587]
10. [25 July 2013] The state of health care quality 2012 [article online]. 2012. Available from <http://www.ncqa.org/Portals/0/State%20of%20Health%20Care/2012/SOHC%20Report%20Web.pdf>.

11. Medicare's coverage of diabetes supplies & services [article online]. Available from <http://www.medicare.gov/pubs/pdf/11022.pdf>. Assessed 8 April 2013
12. Zhang X, Lee PP, Thompson TJ, et al. Health insurance coverage and use of eye care services. *Arch Ophthalmol*. 2008; 126:1121–1126. [PubMed: 18695107]
13. [3 March 2012] Behavioral Risk Factor Surveillance System. Available from <https://www.cdc.gov/brfss/>.
14. BRFSS annual survey data. [26 April 2013] Summary data quality reports. 2006-2010 BRFSS. Available from http://ftp.cdc.gov/pub/Data/Brfss/2010_Summary_Data_Quality_Report.pdf.
15. Schoenfeld ER, Greene JM, Wu SY, Leske MC. Patterns of adherence to diabetes vision care guidelines: baseline findings from the Diabetic Retinopathy Awareness Program. *Ophthalmology*. 2001; 108:563–571. [PubMed: 11237912]
16. Muñoz B, O'Leary M, Fonseca-Becker F, et al. Knowledge of diabetic eye disease and vision care guidelines among Hispanic individuals in Baltimore with and without diabetes. *Arch Ophthalmol*. 2008; 126:968–974. [PubMed: 18625945]
17. Alexander RL Jr, Miller NA, Cotch MF, Janiszewski R. Factors that influence the receipt of eye care. *Am J Health Behav*. 2008; 32:547–556. [PubMed: 18241139]
18. Buch H, Vinding T, La Cour M, Appleyard M, Jensen GB, Nielsen NV. Prevalence and causes of visual impairment and blindness among 9980 Scandinavian adults: the Copenhagen City Eye Study. *Ophthalmology*. 2004; 111:53–61. [PubMed: 14711714]
19. U.S. Preventive Services Task Force. Screening for impaired visual acuity in older adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2009; 151:37–43. [PubMed: 19581645]
20. Nelson DE, Thompson BL, Bland SD, Rubinson R. Trends in perceived cost as a barrier to medical care, 1991-1996. *Am J Public Health*. 1999; 89:1410–1413. [PubMed: 10474561]
21. Ladwig KH, Marten-Mittag B, Formanek B, Dammann G. Gender differences of symptom reporting and medical health care utilization in the German population. *Eur J Epidemiol*. 2000; 16:511–518. [PubMed: 11049093]
22. Schoen C, Osborn R, Doty MM, Bishop M, Peugh J, Murukutla N. Toward higher-performance health systems: adults' health care experiences in seven countries, 2007. *Health Aff (Millwood)*. 2007; 26:w717–w734. [PubMed: 17978360]
23. McWilliams JM, Zaslavsky AM, Meara E, Ayanian JZ. Health insurance coverage and mortality among the near-elderly. *Health Aff (Millwood)*. 2004; 23:223–233. [PubMed: 15318584]
24. Centers for Disease Control and Prevention (CDC). Reasons for not seeking eye care among adults aged 40 years with moderate-to-severe visual impairment—21 States, 2006-2009. *MMWR Morb Mortal Wkly Rep*. 2011; 60:610–613. [PubMed: 21597453]
25. Lee DJ, Lam BL, Arora S, et al. Reported eye care utilization and health insurance status among US adults. *Arch Ophthalmol*. 2009; 127:303–310. [PubMed: 19273794]
26. Fong DS, Aiello L, Gardner TW, et al. American Diabetes Association. Retinopathy in diabetes. *Diabetes Care*. 2004; 27(Suppl. 1):S84–S87. [PubMed: 14693935]
27. Javitt JC. Preventing blindness in Americans: the need for eye health education. *Surv Ophthalmol*. 1995; 40:41–44. [PubMed: 8545801]
28. Paz SH, Varma R, Klein R, Wu J, Azen SP. Los Angeles Latino Eye Study Group. Noncompliance with vision care guidelines in Latinos with type 2 diabetes mellitus: the Los Angeles Latino Eye Study. *Ophthalmology*. 2006; 113:1372–1377. [PubMed: 16769120]
29. Unzueta M, Globe D, Wu J, Paz S, Azen S, Varma R. Los Angeles Latino Eye Study Group. Compliance with recommendations for follow-up care in Latinos: the Los Angeles Latino Eye Study. *Ethn Dis*. 2004; 14:285–291. [PubMed: 15132216]
30. Donaghue KC, Fairchild JM, Craig ME, et al. Do all prepubertal years of diabetes duration contribute equally to diabetes complications? *Diabetes Care*. 2003; 26:1224–1229. [PubMed: 12663601]
31. Owsley C, McGwin G, Scilley K, Girkin CA, Phillips JM, Searcey K. Perceived barriers to care and attitudes about vision and eye care: focus groups with older African Americans and eye care providers. *Invest Ophthalmol Vis Sci*. 2006; 47:2797–2802. [PubMed: 16799016]

32. Long SK, Masi PB. Access and affordability: an update on health reform in Massachusetts, fall 2008. *Health Aff (Millwood)*. 2009; 28:w578–w587. [PubMed: 19477874]
33. Arday DR, Fleming BB, Keller DK, et al. Variation in diabetes care among states: do patient characteristics matter? *Diabetes Care*. 2002; 25:2230–2237. [PubMed: 12453966]
34. Chou CF, Zhang X, Crews JE, Barker LE, Lee PP, Saaddine JB. Impact of geographic density of eye care professionals on eye care among adults with diabetes. *Ophthalmic Epidemiol*. 2012; 19:340–349. [PubMed: 23088291]
35. Kilmer G, Bynum L, Balamurugan A. Access to and use of eye care services in rural Arkansas. *J Rural Health*. 2010; 26:30–35. [PubMed: 20105265]
36. Weingarten JP Jr, Brittman S, Hu W, Przybyszewski C, Hammond JM, Fitzgerald D. The state of diabetes care provided to Medicare beneficiaries living in rural America. *J Rural Health*. 2006; 22:351–358. [PubMed: 17010033]
37. 2011 National diabetes fact sheet. Centers for Disease Control and Prevention; Atlanta: 2011. Available from <http://www.cdc.gov/diabetes/pubs/factsheet11.htm>. [25 April 2013]
38. Schneider KL, Clark MA, Rakowski W, Lapane KL. Evaluating the impact of non-response bias in the Behavioral Risk Factor Surveillance System (BRFSS). *J Epidemiol Community Health*. 2012; 66:290–295. [PubMed: 20961872]

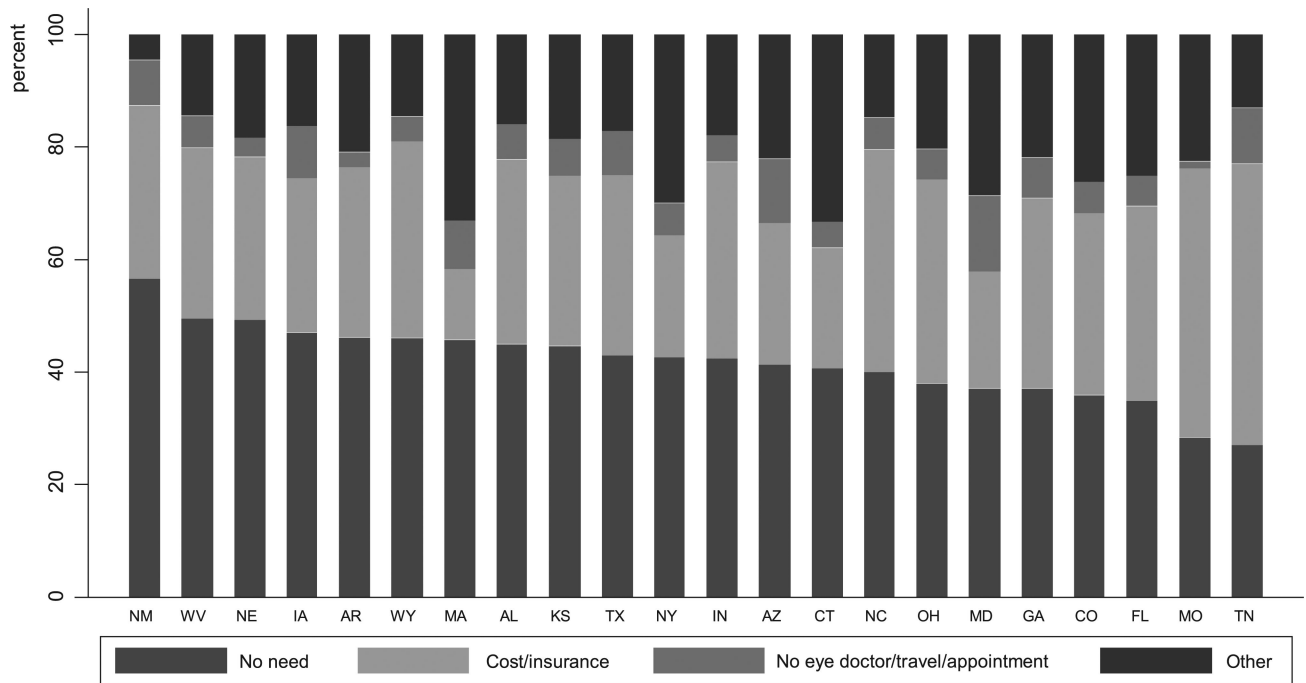


Figure 1. Distribution of main reason for not seeking eye care among people with diagnosed diabetes, by state. “No eye doctor/travel/appointment” if respondents answered “do not have/know an eye doctor,” “too far, no transportation,” or “could not get appointments.” “No need” if respondents answered “no reason to go” or “have not thought of it.” Data source, BRFSS 2006–2010.

Table 1Characteristics of persons aged \geq 40 years with diagnosed diabetes, 22 states[†], 2006–2010

	<u>Visited eye provider in the preceding 12 months</u>				<i>P</i> value ^{//}
	<u>Yes 21,059 (5.8)[†]</u>		<u>No 6,640 (1.8)[†]</u>		
	%	SE	%	SE	
Age (years)					<0.001
40–64	54.2	0.7	69.9	1.0	
65+	45.8	0.7	30.1	1.0	
Sex					0.089
Male	51.1	0.7	48.9	1.1	
Female	48.9	0.7	51.1	1.1	
Race/ethnicity					0.129
Non-Hispanic white	71.0	0.7	68.4	1.2	
Non-Hispanic black	15.4	0.5	15.1	0.8	
Hispanic	9.2	0.5	11.3	1.0	
Non-Hispanic other	4.3	0.3	5.2	0.6	
Educational attainment					<0.001
Less than high school	15.4	0.5	20.8	1.0	
High school	33.1	0.6	36.0	1.1	
More than high school	51.5	0.7	43.1	1.1	
Income					<0.001
<\$35,000	49.8	0.7	62.2	1.2	
\$35,000	50.2	0.7	37.8	1.2	
Health insurance coverage					<0.001
Yes	94.0	0.3	81.9	1.0	
No	6.0	0.3	18.1	1.0	
Eye insurance coverage					<0.001
Yes	68.6	0.6	45.9	1.1	
No	31.4	0.6	54.1	1.1	
Any known eye disease					<0.001
Yes	55.5	0.7	35.6	1.2	
No	44.5	0.7	64.4	1.2	
Time since diagnosis of diabetes (years)					<0.001
<5	32.7	0.7	42.4	1.3	
5–14	39.7	0.7	38.5	1.2	
15	27.7	0.6	19.0	0.9	
Diabetes education					<0.001

Visited eye provider in the preceding 12 months

	Yes 21,059 (5.8) [†]		No 6,640 (1.8) [†]		<i>P</i> value ^{//}
	%	SE	%	SE	
Yes	57.3	0.7	44.5	1.2	
No	42.7	0.7	55.5	1.2	
Diabetes medication					<0.001
Yes	58.1	0.7	49.2	1.2	
No	41.9	0.7	50.8	1.2	
Vision impairment					<0.001
Yes	25.0	0.6	33.0	1.0	
No	75.0	0.6	67.0	1.0	

Data source, BRFSS 2006–2010. Among persons aged ≥40 years with diabetes, the prevalence of not seeking eye care in the preceding 12 months was 23.5% (95% CI 22.6–24.4).

[†]The 22 states using the BRFSS vision module at least once in the years 2006–2010 included Alabama, Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Indiana, Iowa, Kansas, Maryland, Massachusetts, Missouri, Nebraska, New Mexico, New York, North Carolina, Ohio, Tennessee, Texas, West Virginia, and Wyoming.

[†]Number (population size, million).

^{//}*P* value is from χ^2 Wald test of the null hypothesis that the level of the covariate is independent of seeking eye care in the preceding 12 months.

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Table 2

Distribution of the main reason for not seeking eye care among adults aged 40 years with diagnosed diabetes, stratified by selected sociodemographic and clinical characteristics

	<u>No need[§]</u>		<u>Cost/insurance</u>		<u>No eye doctor/travel/appointment[‡]</u>		<u>Other</u>		<i>P</i> value [¶]
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Total	39.7	37.6–41.9	32.3	30.2–34.5	6.4	5.3–7.8	21.5	19.7–23.4	
Age (years)									<0.001
40–64	34.8	32.2–37.5	38.5	35.8–41.3	6.1	4.7–7.9	20.6	18.3–23.0	
65+	51.3	47.9–54.8	17.8	15.3–20.6	7.2	5.7–9.0	23.7	20.9–26.7	
Sex									<0.001
Male	49.6	46.2–53.0	24.0	21.3–26.9	4.3	3.2–5.7	22.1	19.3–25.3	
Female	30.6	28.1–33.2	40.1	37.1–43.1	8.4	6.6–10.7	20.9	18.8–23.1	
Race/ethnicity									0.079
Non-Hispanic white	42.2	39.8–44.6	30.7	28.5–32.9	5.3	4.4–6.4	21.8	19.8–23.9	
Non-Hispanic black	38.8	33.0–44.9	33.2	28.2–38.7	7.8	5.5–11.1	20.2	16.0–25.0	
Hispanic	28.5	21.3–37.1	38.4	29.2–48.5	10.5	5.4–19.4	22.6	15.3–32.0	
Non-Hispanic other	38.5	28.6–49.5	37.0	26.9–48.4	8.1	2.4–24.1	16.4	10.7–24.4	
Educational attainment									0.001
Less than high school	34.0	29.3–39.0	40.3	35.2–45.7	8.4	5.3–12.9	17.3	14.0–21.2	
High school	42.5	39.2–46.0	31.8	28.6–35.2	4.7	3.7–6.1	20.9	18.1–23.9	
More than high school	40.3	36.9–43.7	28.8	25.8–32.1	6.9	5.2–9.1	24.0	21.1–27.1	
Income									<0.001
<\$35,000	33.5	30.7–36.5	42.1	39.1–45.3	6.4	4.8–8.5	17.9	15.6–20.4	
\$35,000	51.6	47.7–55.5	16.7	13.9–19.9	6.0	4.4–8.1	25.7	22.5–29.2	
Health insurance coverage									<0.001
Yes	44.0	41.7–46.4	24.2	22.3–26.1	7.2	6.0–8.6	24.6	22.5–26.8	
No	21.8	16.9–27.5	67.5	61.3–73.2	2.9	1.0–8.1	7.8	5.5–10.9	
Eye insurance coverage									.0001
Yes	47.6	44.5–50.9	15.5	13.5–17.6	8.1	6.7–9.8	28.8	25.9–31.8	
No	32.8	30.0–35.8	47.3	44.1–50.6	5.0	3.4–7.3	14.8	12.8–17.1	
Any known eye disease									0.081
Yes	38.1	34.4–42.0	31.3	27.9–35.0	8.6	6.2–11.7	22	19.1–25.1	
No	41.2	38.2–44.3	33.9	30.9–37.1	5.3	4.0–7.0	19.5	17.0–22.2	
Time since diagnosis of diabetes (years)									0.005
<5	41.3	37.5–45.3	35	31.2–39.1	5.1	3.1–8.3	18.6	15.7–21.8	
5–14	39.2	35.5–42.9	34.3	30.8–38.1	5.4	4.1–7.1	21.0	17.9–24.6	

	<u>No need[§]</u>		<u>Cost/insurance</u>		<u>No eye doctor/travel/appointment[‡]</u>		<u>Other^{//}</u>		<i>P</i> value [¶]
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	
15	35.5	30.6–40.7	29.3	25.2–33.8	11.7	8.8–15.4	23.5	19.4–28.1	
Diabetes education									0.339
Yes	38.0	34.6–41.4	33.4	30.0–37.0	6.1	4.6–8.1	22.5	19.6–25.7	
No	40.9	37.8–44.1	33.3	30.4–36.5	6.7	5.0–8.9	19.1	16.7–21.8	
Diabetes medication									0.004
Yes	32.0	28.5–35.3	37.0	33.7–40.7	7.8	5.8–10.5	23.0	20.3–26.6	
No	35.0	32.0–38.1	42.0	38.9–45.1	5.1	4.0–6.4	18.0	15.8–20.4	
Vision impairment									<0.001
Yes	24.5	21.5–27.8	45.3	41.6–49.0	8.2	6.5–10.5	22.0	19.1–25.3	
No	47.3	44.5–50.1	25.9	23.5–28.5	5.6	4.2–7.3	21.2	19.0–23.6	

Data source, BRFSS 2006–2010.

[§]“No need” if respondents answered “no reason to go” or “have not thought of it.”

[‡]“No eye doctor/travel/appointment” if respondents answered “do not have/know an eye doctor,” “too far, no transportation,” or “could not get appointments.”

^{//}“Other” if respondents’ answers did not fit into the preceding categories.

[¶]*P* value is from χ^2 Wald test of the null hypothesis that the level of the covariate is independent of the main reason chosen.

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Table 3

Multinomial logistic estimation[†] of RRR and 95% CI for reasons for not seeking eye care among adults aged 40 years with diagnosed diabetes

	<u>Cost/insurance</u>		<u>No eye doctor/travel/appointment[§]</u>		<u>Other</u>	
	RRR	95% CI	RRR	95% CI	RRR	95% CI
Age (years)						
40–64	3.13	2.19–4.47	1.54	0.91–2.61	1.25	0.90–1.73
65+ (reference)	1.00		1.00		1.00	
Sex						
Male (reference)	1.00		1.00		1.00	
Female	3.12	2.32–4.20	3.60	2.11–6.16	1.66	1.23–2.24
Race/ethnicity						
Non-Hispanic white (reference)	1.00		1.00		1.00	
Non-Hispanic black	0.73	0.48–1.10	0.92	0.48–1.77	0.72	0.46–1.13
Hispanic	1.01	0.53–1.89	3.52	1.50–8.25	1.88	0.91–3.89
Non-Hispanic other	1.22	0.53–2.79	3.2	0.95–10.86	1.32	0.69–2.53
Educational attainment						
Less than high school	0.8	0.51–1.25	0.89	0.47–1.68	0.65	0.42–1.01
High school	0.70	0.51–0.98	0.50	0.29–0.86	0.78	0.56–1.09
More than high school (reference)	1.00		1.00		1.00	
Income						
<\$35,000	2.88	2.03–4.09	1.42	0.85–2.37	1.02	0.72–1.45
\$35,000 (reference)	1.00		1.00		1.00	
Health insurance coverage						
Yes	0.36	0.23–0.56	1.19	0.35–4.06	1.53	0.83–2.82
No (reference)	1.00		1.00		1.00	
Eye insurance coverage						
Yes	0.28	0.21–0.38	1.20	0.74–1.95	1.36	0.99–1.88
No (reference)	1.00		1.00		1.00	
Any known eye disease						
Yes	1.02	0.73–1.41	1.3	0.76–2.23	1.19	0.87–1.64
No (reference)	1.00		1.00		1.00	
Time since diagnosis of diabetes (years)						
<5 (reference)	1.00		1.00		1.00	
5–14	1.22	0.86–1.73	1.14	0.61–2.13	1.1	0.78–1.54
15	0.95	0.63–1.45	2.11	1.08–4.11	1.3	0.86–1.97
Diabetes education						

	<u>Cost/insurance</u>		<u>No eye doctor/travel/appointment[§]</u>		<u>Other^{//}</u>	
	RRR	95% CI	RRR	95% CI	RRR	95% CI
Yes	1.11	0.82–1.49	0.84	0.48–1.45	1.15	0.84–1.57
No (reference)	1.00		1.00		1.00	
<hr/>						
Diabetes medication						
Yes	1.36	0.94–1.97	1.88	1.06–3.32	1.39	0.96–2.02
No (reference)	1.00		1.00		1.00	
<hr/>						
Vision impairment						
Yes	3.14	2.35–4.22	2.19	1.34–3.58	1.65	1.18–2.31
No (reference)	1.00		1.00		1.00	

Data source, BRFSS 2006–2010. The 22 states using the BRFSS vision module at least once in the years 2006–2010 include Alabama, Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Indiana, Iowa, Kansas, Maryland, Massachusetts, Missouri, Nebraska, New Mexico, New York, North Carolina, Ohio, Tennessee, Texas, West Virginia, and Wyoming. This multinomial logistic regression also controls for year and state.

[†]Multinomial logistic regression: the baseline comparison group is “no need,” which was defined when respondents answered “no reason to go” or “have not thought of it.”

[§]“No eye doctor/travel/appointment” if respondents answered “do not have/know an eye doctor,” “too far, no transportation,” or “could not get appointments.”

^{//}“Other” if respondents’ answers did not fit into the preceding categories.