UTILIZATION OF DILATED EYE EXAMS AMONG ADULTS WITH DIABETES

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Abstract

Purpose: The purpose of this study is to determine the utilization rate of dilated eye exams among adults with diabetes, and to examine the differences in receiving dilated eye exams by predisposing, need, and enabling factors.

Methods: National survey data from the 2010 Behavioral Risk Factor Surveillance System. Univariate, weighted bivariate, and logistic regression analyses were performed. Independent variables include demographic information. The dependent variable is the receipt of a dilated eye exam.

Results: Some characteristics of individuals who were more likely to receive a dilated eye exam include adults 65 or older, non-Hispanic Blacks, individuals with a health plan, individuals who had a physical exam within the past year, individuals with some type of formal diabetes education, and individuals earning at least $50,000 annually.

Conclusion: The Andersen Behavior Model that predisposing, need, and enabling factors are positively associated to the receipt of a dilated eye examination was supported. All enabling factors used in our study are strong predictors of receiving a dilated eye examination. Developing effective recommendations and guidelines for dilated eye exam utilization targeting at-risk adults with diabetes may be beneficial for increasing the number of adults with diabetes who receive annual dilated eye exams.

Keywords: Dilated eye exams, diabetes, diabetic retinopathy, diabetic complications

Introduction

Diabetes is one of the fastest growing causes of morbidity and mortality in the United States. In 2012, approximately 7% of the population in the United States had diabetes [1, 2]. According to the American Diabetes Association, in 2007, diabetes was listed as the underlying cause of 71,382 deaths and was listed as a contributing factor in an additional 160,022 deaths. By the year 2020, 44% of the world's population will have diabetes. By 2030, most diabetes cases are projected to develop in the United States, China and India. As diabetes increases, so does the concern for its disabling complications, such as diabetic retinopathy that results in vision loss [3-5]. Preventive measures such as the receipt of a dilated eye exam have been shown effective for preventing vision loss by early detection and timely treatment of diabetic retinopathy.

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Of all microvascular l complications, diabetic retinopathy is the most common. It is a complication from both Type 1 and Type 2 diabetes and accounts for about 10,000 new blindness cases every year in the United States [6, 7]. Diabetes statistics published by the American Diabetes Association indicated that diabetes is the leading cause of new cases of

blindness among adults aged 20-74 years. Between 2005 and 2008, 4.2 million (28.5%) people with diabetes aged 40 years or older had diabetic retinopathy, and of those, almost 4.4% had advanced diabetic retinopathy that could lead to severe vision loss. By the year 2020, the number of individuals who experience diabetic retinopathy is anticipated to be 7.2 million and 1.6 million will experience vision-threatening diabetic retinopathy [5, 8].

Dilated eye examinations have been found to be more effective than non-dilated examinations to determine eye health. A dilated eye exam is a procedure whereby an individual's eyes are dilated so that a clear picture of the inner surface is easily viewable with an ophthalmoscope [9]. Previous research has shown that individuals with diabetes often develop retinopathy within a period of five years of diagnosis. The dilated eye exam can detect retinopathy at an early stage and timely treatment can prevent the occurrence of blindness in 90% of at-risk individuals [10]. Several organizations including the American Diabetes Association (ADA), the American Optometric Association (AOA), and the American Academy of Ophthalmology (AAO) have suggested that adults with diabetes receive a dilated eye exam annually [11].

Previous studies have focused on the prevalence and risk factors of eye diseases and visual impairment among adults 40 years and older with diabetes [12, 13], annual eye care and eye care utilization among adults 40 years and older [14, 15], and vision health disparities [16, 17]. This study differs from others in that it applies the Andersen Behavioral Model theory to help explain the contributing factors of dilated eye exam utilization to enhance the current body of knowledge on using dilated eye exams among adults with diabetes. Specifically, the study is to:

1. Determine the utilization rate of dilated eye exams among adults with diabetes;
2. Examine the differences in receiving dilated eye exams by predisposing, need, and enabling factors.

To answer the research questions set forth, the study used the Andersen Behavior Model as a guide, in which healthcare services utilization is determined by predisposing, need, and enabling factors [18]. Predisposing factors consist of the conditions that increase the likelihood that an individual uses services. In this study the predisposing factors include age, race/ethnicity, gender, and socioeconomic status (SES). Need factors relate to the circumstances that prompt an individual to seek medical attention. In this study the need factors are general health status and specific eye health status. Enabling factors relate to the availability of means and access to healthcare services. In this study the enabling factors are health insurance status, socioeconomic status, use of health care, and diabetes education.

Methods

Data and Sample

The study used the Behavioral Risk Factor Surveillance System (BRFSS) data for the year 2010. The BRFSS is an annual telephone survey of a random sample of non-institutionalized U.S. adults aged 18 years and older. The survey inquires about an individual's general physical, and mental health status, access to preventive health services with respect to chronic diseases, infectious diseases and injuries, and behavioral risk factors such as tobacco use and alcohol consumption. The Centers for Disease Control and Prevention (CDC) developed and administered the survey with the collaboration of the health departments of the 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands [19].

The survey instrument has three components: (1) the core component that contains a standard set of questions used by all states, (2) optional CDC modules that consist of a set of questions related to a specific health condition such as diabetes and (3) state- added questions which are not under the control of the CDC [19]. In 2010, 35states, the District of Columbia,

Puerto Rico, and the Virgin Islands participated in the diabetes module and are included in our study.

Measurements

The following variables based on the Andersen-Aday theoretical framework were included in the study:

Dependent variable: The receipt of a dilated eye exam was the dependent variable in the study. It was measured by a survey question asking if an individual received a dilated eye exam within the past year.

Independent variables:The independent variables consisted of the need factors, enabling factors and predisposing factors. Need factors were measured by two variables including general health status and eye health measured by the presence or absence of diabetic retinopathy. General health status was measured by self-rated health status and categorized as "good" if individuals perceived their health as "excellent", "very good", or "good" and as "not good" for individuals who perceived their health as "fair" or "poor". The presence or absence of diabetic retinopathy was measured by a survey question asking if an individual had ever been told by a medical provider that diabetes had affected his/her eyes or had retinopathy.

Enabling factors included access to health care variables. Many studies have demonstrated that having health insurance and a usual source of care indicated by a routine physical checkup and doctor visit are strong indicators of access to care. Thus, in this study health insurance status, physical checkup, and doctor visit for diabetes are used as indicators of access to care. Health insurance status was measured by whether an individual has any kind of health insurance. Physical checkup was measured by whether an individual visited a doctor for a general physical exam within the past year. Doctor visit for diabetes was measured by whether an individual has ever seen a doctor, nurse or health professional for diabetes reasons during the past 12 months. Diabetes education was also used as an enabling factor in the study. It was measured by whether an individual has ever taken a course or class on diabetes management.

Predisposing factors were measured by demographic variables including age, gender, race, and socioeconomic status including individual educational level, employment status and income. Race was categorized as Non-Hispanic White, Non-Hispanic Black, and "Other" that include Hispanic, Asian, Hawaiian, American Indian, Native Alaskan, multiracial, and other races. Hispanic and all other races are grouped together due to the concern that the small number in each individual race category would not allow reliable and meaningful analysis.

Education was measured by an individual's highest educational level completed and grouped as elementary education if an individual completed up to an elementary education; high school education if an individual had some high school education, a high school graduate or had a GED; and college education if an individual had some college education, college graduate, or post-college education. Employment status was measured by the individual's current employment situation and was categorized as employed including self-employed (full time or part-time); unemployed; retired, and other, including those who are not currently looking for a job, homemakers, students, and those who are unable to work. Income was measured by an annual household income and grouped as less than $25,000, between $25,000 and less than $50,000, and $50,000 or greater. Socioeconomic factors are also considered as enabling factors in the study.

Statistical analyses

The total number of respondents to the 2010 BRFSS survey was 451,075, among which 15 states (AR, CA, CO, KS, ME, MD, MI, MO, NE, NJ, NY, OK, RI, TX, and WA) did not participate in the diabetes module of BRFSS and thus were excluded from the study (n= 163,472). In addition, individuals of the participating states and territories who did not have diabetes (n=250,041) were excluded from the data analysis. As a result, a total of 37,562 individuals who were diagnosed with diabetes constitute the sample and are included in the data analysis.

Using the data provided by the participating states and territories a bivariate analysis was performed to determine the diabetes rate and the utilization of dilated eye exams for each state. Univariate analysis was performed on each variable to provide a description of the sample, followed by weighted bivariate analyses and a series of logistic regression analyses. Chi-square tests were performed to determine the significant difference in receiving a dilated eye exam between each independent variable and dependent variable in the bivariate analysis for categorical data. Finally, a series of weighted logistic regressions were performed to calculate odds ratios (ORs) of receiving a dilated eye exam adjusted for various covariates. Since BRFSS data is comprised of telephone surveys, and telephone coverage varies despite the fact that 95% of US households have telephones, post-stratification weights were used to partially correct for any sampling bias due to non-telephone coverage. The weights adjusted for discrepancies in probability of selection, nonresponse, and non-telephone coverage [19]. In this study, using STATA 11.0 [20], the weight variable was included in the logistic regressions using the final weight of each respondent available in BRFSS 2010 data. A detailed description of BRFSS sample design, data collection and weight calculations can be found elsewhere [19]. All significant tests were two tailed and performed at the 0.05 level of significance.

Results

Diabetes Rate and Utilization of Dilated Eye Exams among Adults with Diabetes by State

The diabetes rate and the rate of receiving a dilated eye exam by state are presented in Table 1. On average, the diabetes rate is 13.06% among participating states and territories, ranging from 20.58% (Puerto Rico) to 6.82% (Alaska). Among adults with diabetes (n=37,562) the average rate of receiving a dilated eye exam is about 70% ranging from 59.49% (Kentucky) to 79.32% (Washington DC). States with a higher diabetes rate tend to have a lower rate of dilated eye exam utilization. For example, states and territories that have a diabetes rate greater than 15%, (Alabama, Kentucky, Mississippi, South Carolina, Tennessee, and Puerto Rico) had a dilated eye exam utilization rate less than 70%.

Table 1. Percentage of Adults with Diabetes and Utilization of Dilated Eye Exams for Participating States, 2010

State	N	% Adults with Diabetes (n)		% of Dilated Eye Exam Use (n)[a]	
Alabama	7,668	16.71%	(1,281)	69.40%	(889)
Alaska	1,964	6.82%	(134)	60.45%	(81)
Arizona	5,756	13.08%	(753)	67.73%	(510)
Connecticut	6,776	10.55%	(715)	74.27%	(531)
Delaware	4,246	12.72%	(540)	74.07%	(400)
District of Columbia	3,976	10.34%	(411)	79.32%	(326)
Florida	35,109	15.01%	(5,270)	71.16%	(3,750)
Georgia	5,788	14.37%	(832)	70.31%	(585)
Hawaii	6,552	10.87%	(712)	73.21%	(522)
Idaho	6,197	11.59%	(812)	67.00%	(544)
Illinois	5,202	12.36%	(643)	68.74%	(442)
Indiana	10,219	13.89%	(1,419)	66.88%	(949)
Iowa	6,102	11.03%	(5,429)	78.45%	(528)
Kentucky	8,061	15.56%	(1,254)	59.49%	(746)
Louisiana	7,032	15.05%	(1,058)	70.23%	(743)
Massachusetts	16,311	11.99%	(1,955)	71.87%	(1,405)
Minnesota	8,968	9.43%	(846)	75.65%	(640)
Mississippi	8,089	17.74%	(1,435)	63.69%	(914)
Montana	7,304	10.02%	(732)	66.80%	(489)
Nevada	3,913	10.58%	(414)	68.36%	(283)
New Hampshire	6,046	10.98%	(664)	76.20%	(506)
New Mexico	6,997	12.45%	(871)	71.64%	(624)
North Carolina	12,139	14.07%	(1,708)	73.01%	(1,247)
North Dakota	4,763	10.18%	(485)	71.75%	(348)
Ohio	9,857	13.95%	(1,375)	69.67%	(958)
Oregon	5,063	11.28%	(571)	67.08%	(383)
Pennsylvania	11,237	13.54%	(1,522)	72.80%	(1,108)
South Carolina	9,433	16.47%	(1,554)	65.25%	(1,014)
South Dakota	6,724	11.73%	(789)	75.67%	(597)
Tennessee	5,767	15.12%	(872)	69.95%	(610)
Utah	10,173	9.46%	(962)	65.38%	(629)
Vermont	6,798	9.43%	(641)	72.07%	(462)
Virginia	5,392	13.07%	(705)	74.33%	(524)
West Virginia	4,401	15.68%	(690)	72.90%	(503)
Wisconsin	4,781	11.80%	(564)	72.52%	(409)
Wyoming	5,839	10.69%	(624)	65.38%	(408)
Guam	784	13.78%	(108)	67.59%	(73)
Puerto Rico	3,542	20.58%	(729)	62.83%	(458)
Virgin Islands	1,822	13.12%	(239)	66.11%	(158)
Total	287,602	12.75%	(37,562)	69.98%	(26,296)

[a]Percentage of dilated eye exam utilization among adults with diabetes

Characteristics of Study Subjects and Utilization of Dilated Eye Exams

The results of univariate analysis in Table 2 show that among the sample of adults with diabetes who indicated whether they received a dilated eye exam within the past year or

not (n=36,731), more than half (52%) were 65 or older, about 60% were women, and more than two-thirds (72%) were non-Hispanic White. Non-Hispanic Blacks and other races including Hispanics constituted about 15% and 13% of the sample, respectively. Approximately 94% of the study subjects obtained at least some high school education, and 48% had a college or post college education. However, nearly half (48%) of individuals in the sample had an annual household income of less than $25,000. Less than one-fourth (24%) of the individuals in the study had an annual income of $50,000 or greater. Approximately 20% of the adults with diabetes indicated that they were told by a medical provider that they had diabetic retinopathy or their eyes were affected.

To answer the research questions, bivariate analysis was used to determine the utilization rate of dilated eye exams and to examine the relationship between dilated eye exam utilization and independent variables. The results from the chi-square tests are shown in Table 2. The overall utilization of a dilated eye exam among adults with diabetes used in the study was 70%. Those who received a dilated eye exam within the past year and those who did not differed significantly by predisposing, need, and enabling factors.

Table 2. Descriptive Characteristics of Individuals Utilizing/Not Utilizing Dilated Eye Exams[a]

Variable		**Dilated Eye Exam**	
	Total[b]	**Yes**	**No**
	N=37,562	**70% (n=26,296)**	**28% (n=10,435)**
Predisposing Factors			
Age***			
18-44	6% (2,317)	5% (1,284)	10% (1,033)
45-64	42% (15,189)	39% (10,086)	49% (5,103)
65 or older	52% (18,930)	56% (14,690)	41% (4,240)
Race***			
Non-Hispanic White	72% (26,026)	72% (18,639)	72% (7,387)
Non-Hispanic Black	15% (5,243)	15% (3,836)	14% (1,407)
Hispanic and other races	13% (4,777)	13% (3,327)	14% (1,450)
Education level***			
Elementary	6% (2,368)	6% (1,657)	8% (801)
High school	46% (16,763)	44% (11,670)	49% (5,093)
College	48% (17,504)	50% (12,991)	43% (4,513)
Income***			
< $25,000	48% (14,784)	45% (9,930)	54% (4,854)
Between $25,000 and <$50,000	28% (8,678)	29% (6,397)	25% (2,281)
$50,000 or greater	24% (7,577)	26% (5,690)	21% (1,887)
Employment status***			
Unemployed	5% (1,865)	4% (1,115)	7% (750)
Employed	26% (9,655)	25% (6,572)	30% (3,083)
Not currently looking for a job	24% (8,774)	22% (5,807)	29% (2,967)
Retired	45% (16,292)	49% (12,701)	35% (3,591)
Gender			
Male	40% (14,548)	40% (10,421)	40% (4,127)
Female	60% (22,183)	60%(15,875)	60% (6,308)
Need Factors			
General health status***			
Good	52% (19,132)	54% (14,217)	47% (4,915)
Not good	48% (17,417)	46% (11,948)	53% (5,469)
Presence of diabetic retinopathy***			
Yes	20% (7,171)	21% (5,497)	16% (1,674)

No	80% (29,095)	79% (20,461)	84% (8, 634)
Enabling Factors			
Having health insurance***			
Yes	92% (33,805)	95% (24,812)	86% (8,993)
No	8% (2,849)	5% (1,424)	14% (1,425)
Doctor visit for general physical exam***			
Yes	88% (32,018)	91% (23,708)	80% (8,310)
No	12% (4,333)	9% (2,319)	20% (2,014)

Variable		**Dilated Eye Exam**	
	Total	**Yes**	**No**
Doctor visit for diabetes***			
Yes	89% (31,361)	90% (22,948)	84% (8,413)
No	12% (4,075)	10% (2,428)	16% (1,647)
Diabetes education***			
Yes	54% (19,783)	57% (15,027)	46% (4,756)
No	46% (16,836)	43% (11,193)	54% (5,643)

*p<0.05, **p<0.01, ***p < 0.001. P values indicate the significance of differences in distribution between those who received a dilated eye exam and those who did not, by χ^2 analysis
[a]Percentage of the total may not add up to 100% due to rounding.
[b]Number of individuals who did not answer to the dilated eye exam (n=831; 2%)

Significant Difference in Dilated Eye Exam Utilization

To answer the research question about the differences in receiving a dilated eye exam by independent variables, a series of logistic regression analysis was conducted to examine the receipt of a dilated eye exam in relation to predisposing, need, and enabling factors while controlling confounding factors. The results of the final logistic regression model are reported in Table 3.

With regard to the predisposing factors, the results indicated that older individuals were more likely than their younger counterparts to receive a dilated eye exam. Compared to individuals aged between 18 and 44 years, the likelihood of receiving a dilated eye exam was 35% greater (OR = 1.35, 95% CI = 1.12-1.62, p < 0.05) for individuals aged between 45 and 64, and more than two times greater for individuals aged 65 and older (OR = 2.07, 95% CI =1.67 - 2.55, p < 0.001).

With respect to race, findings indicated that non-Hispanic Blacks were slightly more likely than non-Hispanic Whites to receive a dilated eye exam (OR = 1.22, 95% CI =1.05-1.41, p <0.01). There was no statistically significant difference in the likelihood of receiving dilated eye exams between non-Hispanic Whites and other races including Hispanics.

The results of the logistic regression reveal that need factors were significantly associated with receiving a dilated eye exam. With respect to general health status the results indicated that healthier individuals, those who reported health status as being "good", were 15% more likely to receive a dilated eye exam than individuals reporting health status as not being good (OR = 1.15, 95% CI =1.03-1.28, p < 0.05). Compared to individuals with no diabetic retinopathy, those with diabetic retinopathy were 34 % more likely to receive a dilated eye exam (OR = 1.34, 95% CI = 1.17-1.54, p< 0.001).

As expected, the enabling factors used in the study were positively associated with receiving a dilated eye exam. Compared to individuals without a health plan, those with a health plan were 77% more likely to receive a dilated eye exam (OR = 1.77, 95% CI =1.46 - 2.15, p < 0.001). In addition, having a physical exam within the past year indicated a more than two times likelihood in receiving a dilated eye exam (OR = 2.16, 95% CI =1.85-2.53, p < 0.001). Furthermore, those who reported a visit to a healthcare provider for diabetes

reasons were 44% more likely to receive a dilated eye exam (OR = 1.44, 95% CI = 1.24-1.68, p < 0.001). The odds of receiving a dilated eye exam for individuals who had some type of formal diabetes education were 55% greater than the odds of those who did not have some type of formal diabetes education (OR =1.55, 95% CI =1.40-1.72, p < 0.001).

The odds of receiving a dilated eye exam were positively associated with annual income, which is also an enabling factor in the study. Individuals earning at least $50,000 annually had 38% greater odds of receiving a dilated eye exam (OR = 1.38, CI =1.18-1.63, p < 0.001) compared to individuals earning less than $25,000 annually.

Table 3. Factors Associated with the Odds of Receiving a Dilated Eye Exam among Adults with Diabetes

Independent Variable (Reference Category)	Adjusted Odds Ratio	(95% CI)[a]
Predisposing Factors		
Age (18-44)		
45-64	1.35	(1.12 - 1.62)**
65 or older	2.07	(1.67 - 2.55)***
Race (Non-Hispanic White)		
Non-Hispanic Black	1.22	(1.05 - 1.41)**
Hispanic and other races	0.96	(0.80 - 1.15)
Education level (Elementary)		
High school	1.14	(0.87 -1.50)
College	1.25	(0.94 - 1.66)
Income (< $25,000)		
$25,000 and < $50,000	1.10	(0.97 - 1.26)
$50,000 or greater	1.38	(1.18 - 1.63)***
Employment (Unemployed)		
Employed or self-employed	0.97	(0.75 - 1.25)
Not looking for a job	1.05	(0.81 - 1.35)
Retired	1.25	(0.97 - 1.61)
Need Factors		
General health status (Not good)		
Good	1.15	(1.03 - 1.28)*
Diabetic Retinopathy (No)		
Yes	1.34	(1.17 - 1.54)***
Enabling Factors		
Health Plan (No)		
Yes	1.77	(1.46 - 2.15)***
Physical exam (No)		
Yes	2.16	(1.85 - 2.53)***
Diabetes doctor (No)		
Yes	1.44	(1.24 - 1.68)***
Diabetes education (No)		
Yes	1.55	(1.40 - 1.72)***

[a]CI =Confidence Interval * p < 0.05 ** p < 0.01 ***p < .001
Variable gender is dropped in logistic regression for insignificance in bivariate analysis.

Discussion

The purpose of this study is to determine the proportion of adults with diabetes who received a dilated eye exam within the past year and to examine how the predisposing factors, need factors, and enabling factors are associated with receiving a dilated eye exam. Our study shows that the percentage of adults who received a dilated eye exam within the past year is 70% which is a significant increase from 54.3% in 2008 [21]. In addition, all states included in the study have met the target value of 58.7% of Healthy People 2020 (HP2020).

The study supported the Andersen Behavior Model that predisposing, need, and enabling factors are positively associated with the receipt of a dilated eye examination. For example, all enabling factors used in the study are strong predictors of receiving a dilated eye examination. The literature also suggested that other factors indicative of individuals

receiving needed services are continuity of care, affordability, and advice from a physician [17]. Due to the limitation of BRFSS data, the study was unable to examine the relationship between these factors and the receipt of a dilated eye examination.

Contrary to a previous study that showed Blacks suffering from diabetes were less likely to receive an annual dilated exam than Whites [22], this study found that the proportion of non-Hispanic Blacks who received a dilated eye exam within the past year is slightly higher than that of non-Hispanic Whites (73% vs. 72%). The study also indicates that there is no significant difference in receiving an annual dilated eye examination between non-Hispanic Whites and other races including Hispanics. The fact that Hispanics and other minority races were lumped together as one group may have caused the detailed differences between races to be lost. Due to the small numbers of each minority group in the data, a meaningful statistical analysis for each individual race could not be performed.

The study findings suggested that younger adults aged 18-64 years, individuals with less education, less income, who had no health insurance or no regular source of care indicated by having an annual physical examination, who visited a doctor for diabetes reasons, and who did not have any formal diabetes management education, are less likely to receive a dilated eye exam. These findings are consistent with previous studies [17, 23].

This study has several limitations. First, the estimated proportion of receiving a dilated eye examination may not be comparable with the statistics reported in HP 2020 due to the use of a different data set. In addition, even though the definition of receiving a dilated eye exam is the same across different data sets, the results could be different using different data. For example, data from the 2000 Medical Expenditure Panel Survey (MEPS) shows that more than 90% of adults with diabetes reported receiving a dilated eye exam within the past year [24]. Based on the National Health and Nutrition Examination Survey (NHANES) III study the same rate is between 60%-70% for adults with Type 2 diabetes [24]. The differences in the proportion of adults receiving an annual dilated eye exam from different studies may stem from the different population included in the study and using different years of standard population for age-adjusted data or without an age-adjustment. For example, in this study, fifteen states are excluded due to nonparticipation in the diabetes module in the year 2010. Thus, caution should be exercised when generalizing study findings to populations beyond study states and territories.

A second limitation of the study concerns the validity and reliability of self-reported measures. Even though BRFSS data has been previously evaluated for validity and reliability, there is a limitation in self-reported data [15]. If respondents of different socioeconomic status assess their need factors and reported their receipt of a dilated eye examination systematically differently due to perception bias or recall bias, the odds of receiving a dilated eye exam by independent factors would be inappropriately estimated. Nonetheless, the validity and reliability of self-rated health related measures in BRFSS has been well documented [25].

Another limitation is related to the way adults with diabetes were categorized into each race/ethnicity group. Due to the insufficient number of adults with diabetes in more refined race/ethnicity groups, racially or ethnically heterogeneous individuals were grouped together in one group labeled as “other.” The dilated eye exam estimate for this group thus has limited practical meaning.

Conclusion

The study found that adults with diabetes who are older, in poor health, have low income, have no health insurance, and who are without formal diabetes education, are less likely to receive a dilated eye exam compared to their counterparts. Unfortunately, our study indicated that these adults with diabetes who are at the greatest risk of developing diabetic

retinopathy, who need the annual dilated eye exam the most, are those who are least likely to have one. This study suggests that more effective policies and programs to promote and aid the utilization of a dilated eye exam among this at-risk and vulnerable subset population with diabetes are needed. Developing effective recommendations and guidelines for dilated eye exam utilization targeting at-risk adults with diabetes may be beneficial for increasing the number of adults with diabetes to receive annual dilated eye exams.

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