Association between diagnosed diabetes and trouble seeing, National Health Interview Survey, 2011–13*

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Approximately 21 million individuals in the US have diagnosed diabetes.[1] Diabetic retinopathy, a progressive condition that can ultimately lead to blindness, affects approximately 29% of adults aged 40 years and older with diabetes.[2] Diabetes is also associated with an increased likelihood of other conditions that may affect vision, such as cataracts and glaucoma.[3] We assessed the association between diagnosed diabetes and self-reported trouble seeing while controlling for other covariates that may affect vision.

The present study used 2011–13 data from the National Health Interview Survey (NHIS).[4] The NHIS is a nationally representative sample of US households, with one adult member of each family selected to complete a more in-depth survey. Final 2011–13 sample adult response rates ranged from 61% to 66%. Respondents were asked if they had trouble seeing even when wearing usual vision correction. Possible responses included "yes", "no", and "don't know", and were used to create a binary variable equal to one for those who did and zero for those who did not report trouble seeing (responses of "don't know" and refusals [accounting for <0.01% of responses] were considered missing). Those who reported receiving a diabetes diagnosis from a healthcare provider were classified as having diabetes. The sample consisted of adults aged 25 years and older with complete demographic, comorbidity, vision, and diabetes information.[5]

Multivariate logistic regression analysis was used to describe the association between diagnosed diabetes and trouble seeing. We first adjusted for age and sex only, successively

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controlling for select demographic characteristics and diabetes-related comorbidities to investigate the possible reasons for any association. Sampling weights were used to produce nationally representative estimates and standard errors accounted for the complex design of the NHIS.

Before adjusting for covariates, approximately 19% of individuals with diagnosed diabetes had trouble seeing compared with approximately 8% of those without diabetes, a significant difference of over 10 percentage points (Table 1). Those with diagnosed diabetes were older, less educated, and more likely to have a history of comorbid conditions, characteristics that may also be associated with trouble seeing. Table 2 presents results for the multivariate logistic analysis of the correlates of trouble seeing. Model 1 includes an indicator for diagnosed diabetes, age group, and sex. Models 2–4 further control for race/ethnicity (Model 2), for marital status, health insurance status, education level, and census region (Model 3), and a history of comorbid conditions (Model 4). Before controlling for a history of comorbid conditions, having diagnosed diabetes was associated with approximately double the odds of self-reported trouble seeing ($P < 0.01$; Table 2 [Models 1–3]). After controlling for a history of comorbid conditions, the estimated odds ratio (OR) for having diagnosed diabetes decreased to 1.59 ($P < 0.01$; Table 2 [Model 4]).

In addition to the positive correlation between diagnosed diabetes and trouble seeing, we also found that older age, less education, and a history of comorbid conditions were positively associated with self-reported trouble seeing. Conversely, male sex, being married, and having health insurance were negatively associated with trouble seeing. For example, we estimated that having less than a high school degree compared with a bachelors degree or higher was associated with an OR of approximately 2 ($P < 0.01$). A history of high blood pressure, stroke, and any heart disease were associated with ORs of 1.42 ($P < 0.01$), 1.79 ($P < 0.01$), and 1.87 ($P < 0.01$), respectively, compared with no history.

The most recent analytical studies similar to ours using nationally representative US data to examine the association between diabetes and visual impairment used 1999–2004 data.[3,5] Herein, we provide up-to-date estimates of the association of diagnosed diabetes and other covariates with trouble seeing. Compared with the most similar previous study,[5] we found a larger association between diagnosed diabetes and trouble seeing. For example, our Model 1 estimates implied an OR of 2.13, whereas comparable estimates from the previous study suggested an OR of 1.59.[5]

These findings are subject limitations. First, approximately 28% of all diabetes is undiagnosed,[1] suggesting that self-reported diabetes may underestimate true prevalence. To the extent that individuals in the present analysis were incorrectly classified as having or not having diabetes, the actual association between diabetes and trouble seeing is likely to be larger than the estimates we presented. Furthermore, trouble seeing was self-reported and it was not possible to distinguish more severe from milder forms of vision problems. Analysis of the association between diabetes and severe trouble seeing may have yielded different results than those reported here.

Reducing visual impairment due to common eye health problems that are responsive to treatment is a US national health objective.[6] Most visual impairment is correctable or treatable.[7] Establishing the factors associated with trouble seeing may help identify those individuals most at risk of vision loss.

Acknowledgements

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Highlights

- This study used nationally representative 2011–2013 data from the United States to estimate the association between diagnosed diabetes and trouble seeing.

- After controlling for covariates, diagnosed diabetes was associated with approximately double the odds of self-reported trouble seeing.

- Older age, less education, and a history of comorbid conditions were positively correlated, while male sex, being married, and having health insurance were negatively correlated with trouble seeing.

- Establishing the factors associated with trouble seeing may help to identify those individuals most at risk of vision loss.

Table 1

Sample characteristics by diagnosed diabetes, National Health Interview Survey 2011–13[†]

| | Diagnosed diabetes | |
	No	Yes
% Sample (weighted)	89.7	10.3
Outcome		
Trouble seeing when wearing usual vision correction	8.4 (8.1, 8.7)	19.2 *** (18.3, 20.2)
Demographic characteristics		
Age group[†]		
25–44 years	43.0 (42.4, 43.6)	12.0 (11.2, 12.8)
45–64 years	39.1 (38.6, 39.6)	47.6 (46.3, 48.8)
65 years and over	18.0 (17.5, 18.4)	40.4 (39.2, 41.6)
Male	47.7 (47.3, 48.2)	49.7 *** (48.5, 51.0)
Race/ethnicity[†]		
White, non-Hispanic	69.4 (68.7, 70.1)	63.9 (62.5, 65.3)
Black, non-Hispanic	10.9 (10.5, 11.3)	15.4 (14.4, 16.4)
Hispanic	13.6 (13.1, 14.1)	14.9 (13.9, 15.9)
Asian/other	6.1 (5.7, 6.5)	5.8 (5.1, 6.5)
Married	59.7 (59.1, 60.3)	57.4 *** (56.1, 58.7)
Health insurance	84.0 (83.6, 84.5)	90.6 *** (89.9, 91.3)
Education[†]		
Less than a high school diploma	12.9 (12.5, 13.3)	21.9 (20.8, 23.0)
High school diploma or GED	25.4 (24.9, 25.9)	30.3 (29.1, 31.6)
Some college	29.3 (28.8, 29.7)	28.6 (27.4, 29.8)
Bachelors degree or higher	32.5 (31.7, 33.2)	19.2 (18.1, 20.3)
Comorbid conditions		
High blood pressure	28.9 (28.4, 29.3)	72.1 *** (70.9, 73.2)
Stroke	2.3 (2.2, 2.4)	9.5 *** (8.8, 10.3)
Any heart disease	10.5 (10.2, 10.8)	31.5 *** (30.4, 32.7)

All estimates represent weighted percentages with Wald 95% confidence intervals in parentheses. To test for differences between individuals with and without diabetes, t-tests were used for binary variables and Chi-squared tests were used for variables with more than two categories.

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$P < 0.10$,

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$P < 0.05$,

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$P < 0.01$ compared with individuals without diabetes (for binary variables).

[†]Authors' analysis of data from the National Health Interview Survey (NHIS), 2011–2013.[4] The sample includes 10 142 adults with diagnosed diabetes and 80 967 adults without diagnosed diabetes. Individuals who self-reported a diabetes diagnosis from a healthcare provider were classified as having diabetes. Those with prediabetes, borderline diabetes, and women only diagnosed during pregnancy were not classified as having diabetes. The sample was limited to adults aged 25 and older because completed education is more stable after this age.

[‡]Chi-squared tests indicated that the distribution of age group, race/ethnicity, and education level differed significantly at the 5% level for individuals with versus without diabetes.

GED, an individual has passed the general educational development tests, and is considered equivalent to a high school diploma in the US.

Table 2

Multivariate logistic analysis of factors associated with trouble seeing, National Health Interview Survey 2011–13[†]

	Model 1	Model 2	Model 3	Model 4
Diagnosed diabetes	2.13 *** (1.98, 2.28)	2.11 *** (1.96, 2.27)	1.97 *** (1.83, 2.11)	1.59 *** (1.47, 1.71)
Demographic characteristics				
Age group				
25–44 years	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
45–64 years	2.03 *** (1.89, 2.18)	2.04 *** (1.89, 2.19)	2.00 *** (1.86, 2.15)	1.82 *** (1.69, 1.97)
65 years and over	2.24 *** (2.07, 2.43)	2.26 *** (2.08, 2.45)	2.10 *** (1.95, 2.26)	1.54 *** (1.40, 1.69)
Male	0.73 *** (0.69, 0.78)	0.74 *** (0.69, 0.78)	0.76 *** (0.71, 0.81)	0.73 *** (0.69, 0.78)
Race/ethnicity				
White, non-Hispanic		1 [Reference]	1 [Reference]	1 [Reference]
Black, non-Hispanic		1.15 *** (1.06, 1.25)	0.96 (0.89, 1.04)	0.94 (0.86, 1.02)
Hispanic		1.05 (0.97, 1.14)	0.82 *** (0.75, 0.90)	0.88 *** (0.80, 0.96)
Asian/other		0.73 *** (0.64, 0.83)	0.74 *** (0.65, 0.85)	0.77 *** (0.67, 0.88)
Married			0.68 *** (0.65, 0.72)	0.70 *** (0.66, 0.74)
Health insurance			0.85 *** (0.78, 0.92)	0.80 *** (0.74, 0.87)
Education				
Less than a high school degree			2.01 *** (1.83, 2.20)	1.81 *** (1.65, 1.99)
High school degree or GED			1.45 *** (1.33, 1.58)	1.37 *** (1.26, 1.49)
Some college or AA degree			1.36 *** (1.26, 1.47)	1.30 *** (1.20, 1.40)
Bachelors degree or higher			1 [Reference]	1 [Reference]
Comorbid conditions				
High blood pressure				1.42 *** (1.33, 1.51)
Stroke				1.79 *** (1.61, 1.99)
Any heart disease				1.87 *** (1.73, 2.01)

Logistic models were used to estimate the association between covariates and trouble seeing. All estimates represent odds ratios with Wald 95% confidence intervals in parentheses.

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GED, an individual has passed the general educational development tests, and is considered equivalent to a high school diploma in the US; AA, individual has obtained an associate's degree, which is an undergraduate degree that is typically completed in 2 years.