Food Insecurity, Eye Care Receipt, and Diabetic Retinopathy Among US Adults with Diabetes: Implications for Primary Care

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INTRODUCTION

Diabetic retinopathy (DR) is the most common microvascular complication of diabetes and it is a leading cause of visual impairment and blindness in the USA.[1] However, most vision loss due to diabetic retinopathy is avoidable through early detection and timely treatment and control of glucose and blood pressure levels.[1] Food insecurity, which is limited or uncertain access to food because of inadequate financial resources, is common among individuals with diabetes in the USA and it has been associated with both a lower likelihood of receiving recommended eye care and poor glycemic control.[2, 3] This suggests that food insecurity may be a risk factor for DR-related visual impairment. The objective of this study was to examine whether food insecurity was associated with timely eye examination receipt, having DR and having lost vision due to DR among a national sample of US adults with diabetes. Previous research has not considered the associations between food insecurity and DR-related outcomes and the prior research on eye examination receipt did not use a national sample. The findings of this study have implications for whether primary care-based efforts to facilitate access to eye care for food insecure individuals with diabetes should be expanded.

METHODS

The empirical analyses used publicly available data on adults aged 18 years and older with self-reported diabetes from the 2016 wave of the National Health Interview Survey (NHIS). The NHIS is nationally representative of the US non-institutionalized civilian population. Individuals missing information on the outcome or food security variables were excluded from the analyses ($n = 86$), resulting in a sample of 3433 individuals. The outcomes, all self-reported, were dilated eye examination receipt in the past year (yes/no), ever having received a DR diagnosis from a health professional (yes/no), and having lost vision due to DR (yes/no). Annual dilated eye examinations are recommended for almost all individuals with diabetes.[1] The key explanatory variable was household food security status. The 2016 NHIS included a set of 10 questions related to financial difficulties meeting basic food needs in the past 30 days. Individuals were defined as food secure or food insecure based on the responses to these questions using a standard method.[4] Descriptive statistics were estimated for the diabetes sample and a logistic regression model was estimated for each outcome. Table 2 presents the additional explanatory variables that were included in the regression models. The models of eye examination receipt and DR used the sample of individuals with diabetes; the model of having lost vision due to DR used the subsample of individuals with self-reported DR. All estimates accounted for NHIS design features and the use of a subset of NHIS respondents.

RESULTS

Table 1 presents descriptive statistics for the diabetes sample. After multivariable adjustment, food insecurity was associated with a significantly lower likelihood of having had a dilated eye examination in the past year, a significantly higher likelihood of having lost vision due to DR and was not significantly associated with having self-reported DR (Table 2).

DISCUSSION

This study found that household food insecurity was positively and significantly associated with missing recommended eye examinations among US adults with diabetes and having lost vision due to DR among US adults with self-reported DR. It should be emphasized that the models do not provide causal estimates and a further limitation of the analysis is that the outcomes were self-reported. However, regardless of causality, the findings suggest that knowing an individual is food insecure provides a signal that the individual is likely to need assistance accessing appropriate eye care. Relatedly, there is growing support for the idea that individuals with diabetes in the USA, especially those who seek care in safety-net clinics, should be screened for food insecurity when they visit primary care providers and that information about food security status should be used to inform treatment decisions.[2, 5] In the 2016 NHIS sample, 86.0% of food-insecure adults with diabetes

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Table 1 Characteristics of the 2016 NHIS Sample of US Adults with Diabetes, $n = 3433$

	Full sample of adults with diabetes	Food secure adults with diabetes	Food insecure adults with diabetes
	Weighted percentage (95% CI)	Weighted percentage (95% CI)	Weighted percentage (95% CI)
Self-reported outcome variables			
Had a dilated eye examination in past year	66.0 (63.7–68.3)	68.1 (65.6–70.5)	54.3 (48.2–60.3)
Have diabetic retinopathy	8.5 (7.3–9.8)	7.6 (6.5–8.9)	13.6 (10.3–17.7)
Have lost vision due to diabetic retinopathy	4.0 (3.3–4.9)	3.1 (2.5–3.9)	8.9 (6.2–12.6)
Explanatory variables*			
Food insecure	15.1 (13.4–16.9)	0	100
Family income-to-poverty ratio			
≤ 1	14.3 (12.9–15.9)	9.8 (8.5–11.2)	39.9 (34.5–41.0)
>1 and ≤ 2	21.6 (19.8–23.6)	18.7 (16.8–20.8)	38.1 (32.7–43.7)
>2	57.5 (55.3–59.7)	64.7 (62.4–67.0)	16.9 (12.7–21.9)
Missing	6.5 (5.4–7.8)	6.8 (5.6–8.1)	5.2 (2.5–10.4)
Current diabetes treatments			
Insulin	29.0 (27.2–30.9)	27.7 (25.7–29.8)	36.4 (31.1–42.0)
Oral medication	73.1 (71.2–75.1)	74.2 (72.0–76.2)	67.7 (62.1–72.9)
Comorbidities			
Hypertension	73.4 (71.2–75.1)	72.7 (70.3–75.0)	77.0 (71.2–81.9)
High cholesterol	65.5 (63.2–67.8)	64.8 (62.4–67.2)	69.5 (63.2–75.2)
Cardiovascular disease	32.8 (30.7–34.9)	31.9 (29.6–34.3)	37.8 (32.0–44.0)
Visited a primary care provider in past year	87.6 (85.8–89.2)	87.9 (86.1–89.5)	86.0 (80.4–90.2)

CI, confidence interval; NHIS, National Health Interview Survey
Stata "svy" commands with the "subpop" option were used to estimate descriptive statistics that accounted for the complex design features of the NHIS and for the focus on the subsample of adults with diabetes. Taylor series linearization was used for variance estimation
**This list is a subset of the explanatory variables used in the logistic regression models. Please see the footnotes to Table 2 for a full list of explanatory variables*

Table 2 Multivariable Logistic Regression Models of Dilated Eye Examination Receipt and Diabetic Retinopathy-Related Outcomes

	Had a dilated eye examination in past year	Have diabetic retinopathy	Have lost vision due to diabetic retinopathy
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Food insecure	0.63 (0.47–0.85)	1.47 (0.96–2.26)	2.42 (1.07–5.49)
Current diabetes treatments			
Insulin	1.54 (1.21–1.98)	4.28 (3.07–5.99)	2.22 (1.05–4.70)
Oral medication	1.11 (0.88–1.40)	0.76 (0.54–1.07)	1.04 (0.50–2.16)
Comorbidities			
Hypertension	0.96 (0.74–1.24)	1.05 (0.69–1.58)	0.84 (0.33–2.15)
High cholesterol	1.09 (0.67–1.37)	1.25 (0.84–1.85)	2.29 (1.06–4.94)
Cardiovascular disease	1.00 (0.80–1.26)	1.30 (0.93–1.82)	1.70 (0.86–3.37)

ARMD, age-related macular degeneration; CI, confidence interval; NHIS, National Health Interview Survey
Stata "svy" commands with the "subpop" option were used to estimate logistic regression models that accounted for the complex design features of the NHIS and for the focus on the subsample of adults with diabetes or with diabetic retinopathy. Taylor series linearization was used for variance estimation
The models of dilated eye examination receipt and self-reported diabetic retinopathy used the sample of individuals with diabetes ($n = 3433$); the model of having lost vision due to diabetic retinopathy used the subsample of individuals with self-reported diabetic retinopathy ($n = 301$)
The logistic regression models also included the following explanatory variables: family income-to-poverty ratio (≤ 0.5, > 0.5, and ≤ 1, > 1 and ≤ 1.5, > 1.5 and ≤ 2, > 2 and ≤ 4, > 4, missing), age (18–39 years, 40–64 years, 65–84 years, 85 years, and above), gender, educational attainment (less than high school, high school or General Equivalency Diploma, some college, college, or more), marital status (married, unmarried), family size, race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, other), whether an individual was obese (body mass index ≥ 30, yes/no) or was a current smoker (yes/no), health insurance status (insured (yes/no)), whether an individual reported having a place they usually go for routine or preventive care (yes/no), and region of residence (Northeast, Midwest, South, or West). Additionally, whether a health professional had ever diagnosed an age-related eye disease (diabetic retinopathy (yes/no), ARMD (yes/no), glaucoma (yes/no), cataracts (yes no)), self-reported visual impairment (yes/no), and functional limitations (yes/no) were included as explanatory variables in the dilated eye examination model

reported they had visited a primary care provider in the past year. This suggests that screening for food insecurity in primary care settings and primary care-based strategies to improve vision-related outcomes, such as screening for DR in primary care settings using telemedicine, could identify and reach many of those in need.[6]

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Compliance with Ethical Standards:

Conflict of Interest: *The author declares that she does not have a conflict of interest.*

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