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Food Insecurity and Hypoglycemia Among Safety Net Patients with Diabetes

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Introduction

In 2008, 1 in every 7 US households was food insecure, or at risk of going hungry because of an inability to afford food.(1) Food insecurity generally occurs cyclically and episodically, with periods of food adequacy followed by food scarcity; the average food insecure household experiences seven episodes of food scarcity annually.(2) We hypothesized that the cyclic nature of food insecurity, and its associated fluctuations in dietary intake, would predispose patients with diabetes to wide variations in blood glucose levels, including clinically significant hypoglycemia.

Methods

We conducted a cross-sectional survey and chart review of patients with type 2 diabetes receiving care in community health clinics in San Francisco and Chicago. All participants were 18 years of age, fluent in English or Spanish, and had a documented diagnosis of diabetes. We measured food insecurity using the 6-item US Household Food Security Survey Module.(3) We measured our primary outcome of severe hypoglycemia using the same question used in landmark diabetes studies: “In the past year, how many times have you had a severe low blood sugar reaction, such as passing out or needing help to treat the reaction?”(4) Categorical response options included 0, 1-3, 4-6, 7-11, or 12+ times in the previous year. We dichotomized severe hypoglycemia at 4+ times based on response

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Abstract presentations: This work has been presented in abstract form at the following meetings: Clinical and Translational Research and Education Meeting, ACRT/SCTS Joint Annual Meeting, Washington, DC (April 6, 2010); Society of General Internal Medicine Meeting, Minneapolis, MN (May 1, 2010); and Centers for Disease Control and Prevention's (CDC) Diabetes Translation Conference, Kansas City, MI (April 13-15, 2010). It has been submitted for consideration of presentation at the 2011 American Public Health Association meeting.

distribution. To validate self-reported hypoglycemia, we compared self-reported to clinical (ICD-9 251.*) diagnoses of hypoglycemia for a subset of 237 participants from one health system. We found a high correlation ($p=0.002$) and good between-measure agreement ($\kappa=0.7$).

We determined whether food insecurity was an independent risk factor for 4+ episodes of severe hypoglycemia using a multivariate logistic regression model including socio demographic characteristics differing by $p<0.2$ in univariate analysis (age, race/ethnicity, smoking, English proficiency, income, and education) and known or hypothesized risk factors for hypoglycemia (insulin use, renal disease, adherence to medication and blood glucose testing, body mass index, comorbid disease burden, hypoglycemia knowledge, problem alcohol use, and HbA1c). Participants who had experienced a severe hypoglycemic episode were asked whether their blood sugar “had ever gotten too low because you couldn't afford to buy enough food.”

The study was approved by the institutional review boards of the sponsoring institutions and participants provided written informed consent.

Results

Of the 782 eligible patients approached, 711 (91%) completed interviews. Participants were 53% Latino, 30% African-American, and 17% White. Almost half of participants ($n=325$, 46%) were food insecure. Food insecure participants were significantly younger (mean 53 vs 56 years, $p<0.001$), had lower household incomes (81% vs 70% reporting $< \$25,000$ annually, $p<0.001$), and were more likely to smoke (34% vs 17%, $p<0.001$) than food secure participants. Mean hemoglobin A1c (HbA1c) was higher among food insecure than food secure participants (8.54% vs. 8.09%, $p=0.007$).

Almost 28% of participants ($n=197$) reported 1 severe hypoglycemic episode in the previous year, and 9.4% of participants reported 4 episodes. Participants who were food insecure were significantly more likely than those who were food secure to report 4 episodes (12.6% vs. 6.7%, OR 2.00, 95% CI 1.19-3.35). This association remained significant after adjusting for demographic factors and other risk factors for hypoglycemia with an odds ratio of 2.95 (1.48-5.91). Food insecurity, problem alcohol use, comorbid illness burden, and BMI were significantly associated with hypoglycemia in the fully adjusted model (Table). Sensitivity analyses dichotomizing the hypoglycemia variable at 7 episodes or 12 episodes did not alter results.

Among participants reporting hypoglycemic episodes, those who were food insecure were significantly more likely to attribute hypoglycemia to the inability to afford food (43.2% vs. 6.8%, $p<0.001$).

Comment

In our two-city sample, we found that almost half of patients with diabetes seeking care in urban, safety-net community health clinics are at risk of hunger because of the inability to afford food. This food insecurity is a significant risk factor for frequent episodes of severe

hypoglycemia, even after adjusting for other risk factors for hypoglycemia. We observed a higher prevalence of severe hypoglycemia (28%) than that reported in another study of community-dwelling adults (11%).⁽⁶⁾ Food insecurity may partially explain this elevated risk.

Hypoglycemia is one of the most common adverse drug events leading to emergency room visits and hospitalizations,⁽⁵⁾ even though most hypoglycemic episodes are never brought to medical attention. Depending on severity and duration, hypoglycemia may reduce quality of life and cause traumatic accidents, cognitive dysfunction, and death. Insuring that low-income patients on hypoglycemic medications have reliable access to food is therefore an important patient safety issue that clinicians in safety-net settings should consider when patients report frequent hypoglycemia. Clinicians should consider food insecure any patient who agrees that in the last year “we worried whether our food would run out before we had money to buy more” or “the food we bought just didn’t last and we didn’t have money to get more”.⁽⁷⁾

Although other studies have also suggested food insecurity is associated with poorer overall glycemic control as measured by high HbA1c, ours is the first of which we are aware to report on hypoglycemic episodes. The higher HbA1c levels we observed in food insecure compared with food secure participants suggests that tighter glycemic control does not explain the increased hypoglycemia risk associated with food insecurity. Although it may appear contradictory that food insecurity is associated with both hypoglycemia and hyperglycemia, there are several potential explanations. First, lengthy episodes of food adequacy, during which blood glucose levels may run high, are often followed by brief episodes of food scarcity.⁽⁸⁾ Second, clinicians may relax glycemic targets when patients encounter frequent or severe hypoglycemic episodes. Such relaxation of glycemic targets may be appropriate for some patients. However, screening low-income patients who report frequent hypoglycemic episodes for food insecurity and providing assistance in obtaining reliable access to food may help reduce socioeconomic disparities in diabetes care and outcomes.

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Table
Risk Factors for 4+ Episodes of Severe Hypoglycemia Among 711 Patients with Diabetes in Safety Net Settings

	OR*	95% CI
Food insecurity	2.95	1.48-5.91
Age (per decade)	0.92	0.67-1.25
Race:		
White	1.0	--
African-American	0.58	0.22-1.50
Latino	0.65	0.25-1.68
English proficient	0.78	0.32-1.87
Education		
< High school degree/GED (ref)	1.0	--
High school degree/GED	0.79	0.34-1.84
> High school degree/GED	0.59	0.24-1.42
Income		
<\$10,000 (ref)	1.0	--
\$10,000-24,999	0.42	0.21-0.85
\$25,000+	0.96	0.40-2.25
Tobacco use	0.93	0.44-1.97
Body mass index, kg/m ²		
Underweight (<18.5)	12.8	1.04-157.1
Normal (18.5-24.99, ref)	1.0	--
Overweight (25.0-29.00)	0.37	0.14-0.99
Obese (≥30)	0.27	0.11-0.66
Insulin	1.48	0.75-2.91
Renal disease	1.64	0.83-3.27
Optimal adherence to blood glucose monitoring	0.83	0.43-1.57
Morisky medication adherence score		
0 (optimal adherence, ref)	1.0	--
1	1.09	0.51-2.31
2	0.77	0.32-1.82
3	0.77	0.23-2.55
4 (poor adherence)	1.85	0.39-8.76
Problem alcohol use	2.20	1.08-4.46

	OR*	95% CI
Comorbid illness (per illness)	1.47	1.07-2.02
Poor hypoglycemia knowledge		
Ability to identify hypoglycemia symptoms	0.74	0.27-2.04
Ability to identify correct response to hypoglycemia symptoms	1.89	0.53-6.80
HbA1c (per % point)	0.94	0.81-1.09

* All odds ratios are from a single multivariate model including all variables in the table.