Trends in Food Insecurity in the USA for Individuals with Prediabetes, Undiagnosed Diabetes, and Diagnosed Diabetes

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INTRODUCTION

Approximately 12% of the adult population have diabetes, with nearly 1 in 4 being undiagnosed [1]. Additionally, 84.1 million US adults have prediabetes [1]. A healthy diet is important for disease management, both to promote weight loss and to prevent progression or complications [1]. However, social factors influencing diet, such as food security, can impact an individual's ability to manage or delay disease [2]. Food insecurity indicates either a lack of availability or a lack of ability to acquire healthy food [3].

While food insecurity in the overall population has decreased since 2011, in those diagnosed with cardiometabolic diseases, it has continued to climb [2]. In addition, little research on food insecurity has been conducted in populations with undiagnosed diabetes or prediabetes. Therefore, the aim of this paper was to investigate trends in food insecurity for those with diagnosed diabetes, undiagnosed diabetes, and prediabetes using nationally representative data from 2005 to 2014.

METHODS

National Health and Nutrition Examination Survey (NHANES) survey data from 2005 to 2014 was analyzed: 27,218 adults aged 20 and over (representing a US population of 217,916,246) were included [4].

Food insecurity during the prior year was based on response to the Food Security Survey Module [3]. Questions ask whether individuals had enough money to purchase food, skipped meals due to cost, or ate less because of cost [3]. Full and marginal food security were considered food secure, while low and very low food security were considered food insecure.

Diabetes status was based on response to diabetes-related questions and HbA1c. Diagnosed diabetes included those answering "yes" to having been told by a health professional they had diabetes, taking insulin, or taking diabetic pills to lower blood sugar. Undiagnosed diabetes included those who answered "no" to all three questions but had an HbA1c $\geq$ 6.5%. Prediabetes included those who answered "yes" to having been told they had prediabetes or had $5.7\% \leq$ HbA1c $< 6.5\%$.

Analyses accounted for complex survey design including oversampling, nonresponse, and post-stratification using SAS v9.4. Weighted percent reporting food insecurity by diabetes status over survey wave was compared using a Cochran-Armitage trend test. Logistic regression models for food insecurity by diabetes status were adjusted by survey wave and demographic variables.

RESULTS

18.2% of participants reported food insecurity between 2005 and 2014. Food insecurity increased from 9.7% in 2005–2006 to 15.2% in 2013–2014 ($p < 0.001$) (see panel 1 of Fig. 1). The average annual rate change was 1.6% (95%CI 0.5–2.6%), representing significant year-over-year increase. Panel 2 of Figure 1 shows trends by diabetes status, with significant differences in weighted prevalence ($p < 0.001$). Prevalence of food insecurity increased more dramatically for those with undiagnosed diabetes than other groups.

Table 1 shows that after adjusting for demographics, compared to individuals with no diabetes, the odds ratio for food insecurity for prediabetes is 1.39 (95%CI 1.21–1.59), for undiagnosed diabetes is 1.81 (95%CI 1.37–2.38), and for diagnosed diabetes is 1.58 (95%CI 1.29–1.93).

DISCUSSION

Between 2005 and 2014, compared to individuals without diabetes, those with prediabetes were 39% more likely to be food insecure, those with diagnosed diabetes were 58% more likely to be food insecure, and those with undiagnosed diabetes were 81% more likely to be food insecure.

Given the confluence of factors that impact low-income individuals [5], the increase in overall prevalence by diabetes
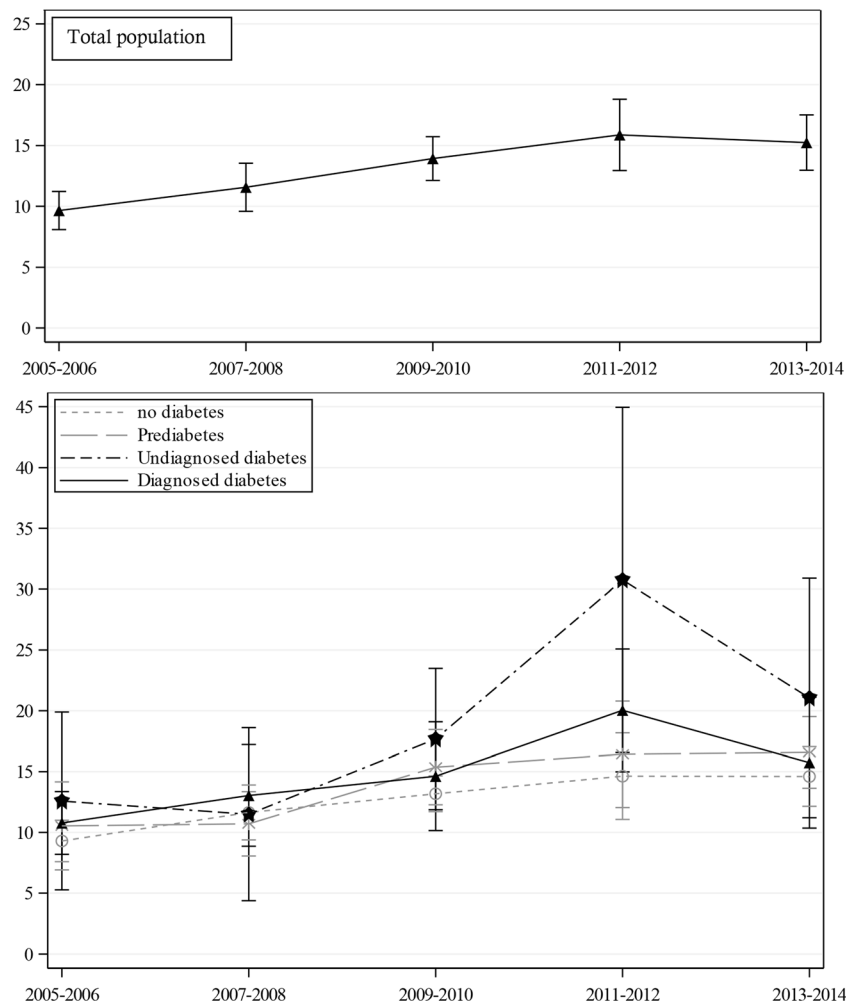
Figure 1 Trends in food insecurity 2005–2014, % reporting food insecurity overall and by diabetes status.

status and increased odds for prediabetes or undiagnosed diabetes has important implications for primary care. As individuals with lower socioeconomic status have limited access to the healthcare system [5], increasing diabetes screening in food insecure populations is needed. Offering community screening events or developing methods for engaging food insecure populations in primary care may help improve diagnosis and overall health. In addition, because adherence to a healthy diet can help prevent transition from prediabetes to diabetes, the increased

existence of food insecurity in those with prediabetes is worth noting. Screening individuals with prediabetes for food insecurity may help inform medical recommendations to help reverse or slow progression to diabetes. Barriers to a healthy diet noted by low-income individuals with diabetes include the need focus on understanding of concepts and definitions, such as nutritional terms or nutrition labels [6]. These factors should be taken into account in the clinical encounter to better align recommendations with socioeconomic realities.

Table 1 Multivariable Logistic Regression Estimates for Food Insecurity by Diabetes Status

	Crude odds ratio OR (95%CI)	p value	Adjusted odds ratio* OR (95%CI)	p value
Diabetes status		0.0003		<0.0001
No diabetes	Reference		Reference	
Prediabetes	1.15 (1.01–1.31)		1.39 (1.21–1.59)	
Undiagnosed diabetes	1.61 (1.26–2.07)		1.81 (1.37–2.38)	
Diagnosed diabetes	1.23 (1.04–1.46)		1.58 (1.29–1.93)	
Survey year		<0.0001		0.0006
2005–2006	Reference		Reference	
2007–2008	1.22 (0.96–1.57)		1.09 (0.87–1.38)	
2009–2010	1.52 (1.22–1.89)		1.38 (1.12–1.70)	
2011–2012	1.77 (1.35–2.31)		1.51 (1.20–1.90)	
2013–2014	1.68 (1.33–2.13)		1.55 (1.23–1.96)	

*Adjusted models include gender, age, race, education level, marital status, ratio of family income to poverty level, and survey year

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