

# Significance of Multiple Adverse Social Determinants of Health on the Diagnosis, Control, and Management of Diabetes



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## INTRODUCTION

There is a strong association between poor diabetes control and individual adverse social determinants of health (SDH).<sup>1,2</sup> While individual adverse SDH have been examined in relation to diabetes control, few investigations have simultaneously evaluated associations with multiple adverse SDH or the number of SDH in diabetes diagnosis or control. This is important to elucidate, as the presence of one adverse SDH is frequently associated with the presence of others.<sup>3</sup> As the incidence and prevalence of diabetes increase, there is a need to comprehensively investigate adverse SDH that could contribute to this phenomenon.<sup>4</sup> Using nationally representative data, we examined associations between seven domains of adverse SDH and the control and diagnosis of diabetes. We also examined the association between adverse SDH (type of SDH and number of SDH) and receiving diabetic standard process of care measures.

## METHODS

We used the National Health and Nutrition Examination Survey 2011–2014 data<sup>5</sup> and included all adults ( $\geq 21$  years old) who (1) responded to survey questions on sociodemographic information (race/ethnicity, gender, age) and had diagnosed diabetes (were told by a doctor or health professional that they have the disease), (2) completed physical examination with a body mass index (BMI), and (3) obtained blood hemoglobin a1c (HbA1c) level. Undiagnosed diabetes was defined as having HbA1c  $\geq 6.5\%$  while reporting no history of diabetes. Uncontrolled diabetes was defined as having HbA1c  $> 7.5\%$  for participants  $\geq 70$  years old or HbA1c  $> 7.0\%$  for patients  $< 70$  years old.<sup>6</sup> We examined three standards of care for diabetes: diabetic foot examination, pupil dilation examination, and/or measurement of HbA1c within the past year. We identified seven domains of adverse SDH: low education, low income, lack of health insurance, food insecurity, poor housing, no/limited employment status, and limited English proficiency.<sup>3</sup>

We performed descriptive statistics on sociodemographic characteristics and chi-square tests of similarity. We ran multivariate logistic regression models to identify characteristics associated with each of the diabetic standards of care. First, we estimated a model including all adverse SDH. In the second model, we simply included the number of adverse SDH. All statistical analyses incorporated the multi-stage stratification sampling design, and weights of the survey. The Feinstein Institutes of Medical Research Institutional Review Board granted exempt status.

## RESULTS

Low income, lack of health insurance, food insecurity, and limited English proficiency were each significantly associated with uncontrolled diabetes (Table 1). The presence of food insecurity, poor housing, and limited English proficiency were each individually associated with having undiagnosed diabetes. Adjusting for covariates, low education (OR = 0.56 [0.34–0.93]), low income (OR = 0.36 [0.28–0.57]), and lack of health insurance (OR = 0.35 [0.21–0.59]) were associated with decreased odds of receiving an HbA1c test in the past year (Table 2). Lack of health insurance (OR = 0.59 [0.40–0.86]) and food insecurity (OR = 0.73 [0.54–1.00]) were associated with decreased odds of having a dilated pupil examination in the past year. Next, we examined the number of adverse SDH associated with diabetic standards of care process measures. There was an inverse relationship between number of adverse SDH and process of care measures, specifically having HbA1c checked and dilated pupil examination in the past year. Participants with multiple adverse SDH (3 adverse SDH OR = 0.18 [0.11–0.29] and 5+ adverse SDH OR = 0.16 [0.05–0.51]) had even lower odds of having HbA1c checked compared with those with one adverse SDH (OR = 0.49 [0.27–0.88]). The presence of multiple adverse SDH (having 5+ adverse SDH) decreased the odds of receiving a dilated pupil examination (OR = 0.24 [0.07–0.77]).

## CONCLUSIONS

We found adverse SDH to have varying impacts on the diagnosis of diabetes, disease control, and diabetes care. The presence of certain adverse SDH was associated with lack of a dilated pupil exam and HbA1c level check within the past year. Most importantly, there was a dose response between the

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**Table 1 Characteristics of Participants With and Without a Diagnosis of Diabetes (Weighted %)**

	Diagnosed diabetes (n = 1224)		No diagnosis of diabetes (n = 8385)	
	All	Uncontrolled DM <sup>†</sup> (n = 522)	All	Undiagnosed DM (n = 287)
Race/ethnicity				
Non-Hispanic White	61.7	56.5*	67.8	46.4
Non-Hispanic Black	14.4	14.2*	10.5	19.8
Hispanic	14.9	19.3*	14.2	19.0
Non-Hispanic Asian	5.2	5.5*	5.0	10.4
Other	3.8	4.6*	2.5	4.5
Male	50.2	54.0	48.2	56.3
Age group				
21–34	3.3	3.4*	28.2	7.4*
35–49	16.9	19.7*	29.3	28.4*
50–64	41.9	50.8*	26.5	38.1*
65+	38.0	26.1*	16.1	26.1*
BMI				
Underweight	0.5	0.0	1.4	0.0
Normal	11.7	10.4	29.9	8.7
Overweight	26.2	23.6	34.7	20.3
Obese	61.5	65.8	34.1	71.0
Adverse SDH				
Low education	23.5	21.2	14.6	24.4
Low income	23.4	26.4*	19.1	19.8
No health insurance	12.3	16.5*	19.5	24.0
Food insecurity	26.4	31.6*	21.7	33.4*
Poor housing	2.4	1.7	2.8	6.1*
No/limited employment	26.8	28.9	19.3	19.2
Limited English proficiency	9.3	12.3*	7.6	16.7*

\*The p value < 0.05 when comparing controlled vs. uncontrolled diabetes among participants with diagnosed diabetes or comparing no diabetes vs. undiagnosed diabetes among participants without a diagnosis of diabetes

†Uncontrolled diabetes defined as HbA1c > 7.5% for 70 years or older and HbA1c > 7 for younger than 70 years old

**Table 2 Standards of Care in Diabetes and Adverse SDH (Adjusting for Gender and BMI)**

	Diabetic foot exam		Dilated pupil exam		HbA1c	
	All SDH	No. of SDH	All SDH	No. of SDH	All SDH	No. of SDH
Race/ethnicity (reference, non-Hispanic White)						
Black	1.14 [0.66–1.99]*	1.18 [0.70–2.00]	1.24 [0.87–1.78]	1.14 [0.81–1.62]	0.50 [0.31–0.82]*	0.49 [0.31–0.77]*
Hispanic	1.37 [0.73–2.45]	1.23 [0.69–2.23]	0.83 [0.50–1.38]	0.76 [0.54–1.08]	0.67 [0.37–1.20]	0.54 [0.35–0.84]*
Asian	1.30 [0.77–2.21]	1.29 [0.80–2.08]	1.14 [0.62–2.11]	1.02 [0.62–1.70]	0.95 [0.48–1.90]	0.73 [0.40–1.34]
Age group (reference, 21–35)						
35–49	1.44 [0.47–4.39]	1.49 [0.50–4.43]	2.48 [1.22–5.05]*	2.53 [1.22–5.24]*	0.99 [0.28–3.48]	1.06 [0.31–3.61]
50–64	0.83 [0.27–2.58]	0.88 [0.29–2.72]	3.09 [1.54–6.19]*	3.13 [1.55–6.35]*	1.09 [0.33–3.67]	1.10 [0.33–3.66]
65+	1.19 [0.32–4.37]	1.31 [0.40–4.32]	6.77 [2.88–15.90]*	6.05 [2.73–13.38]*	0.82 [0.22–3.04]	0.69 [0.20–2.37]
Social needs (reference group, no SDH)						
Low education	0.94 [0.60–1.46]		0.65 [0.44–0.97]		0.56 [0.34–0.93]*	
Low income	1.15 [0.78–1.71]		0.77 [0.45–1.32]		0.36 [0.28–0.57]*	
No health insurance	0.67 [0.39–1.17]		0.59 [0.40–0.86]*		0.35 [0.21–0.59]*	
Food insecurity	0.10 [0.63–1.57]		0.73 [0.54–1.00]*		1.18 [0.83–1.69]	
Poor housing	1.43 [0.43–4.82]		1.13 [0.56–2.30]		0.81 [0.42–1.56]	
No/limited employment	0.93 [0.56–1.53]		1.13 [0.77–1.67]		1.05 [0.71–1.57]	
Limited English proficiency	0.90 [0.49–1.65]		1.04 [0.54–1.99]		0.76 [0.41–1.41]	
Number of SDH						
One		1.06 [0.56–2.00]		0.70 [0.44–1.10]		0.49 [0.27–0.88]*
Two		0.78 [0.51–1.20]		0.66 [0.34–1.29]		0.42 [0.25–0.71]*
Three		0.86 [0.48–1.54]		0.49 [0.31–0.77]*		0.18 [0.11–0.29]*
Four		1.08 [0.47–2.53]		0.46 [0.21–1.02]		0.24 [0.13–0.43]*
Five+		1.04 [0.20–5.35]		0.24 [0.07–0.77]*		0.16 [0.05–0.51]*

number of adverse SDH and diabetic process measures. The study is limited by cross-sectional analysis, community survey design, and a lack of patient-reported social needs. Given the significance of adverse SDH in disease process measures in diabetes, such as glycemic control and monitoring of microvascular complications, the success of interventions addressing adverse SDH could be measured through disease specific process measures. Lastly, interventions designed to address adverse SDH have the potential to influence how patients are diagnosed with and manage their medical conditions.

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