

## BRIEF REPORT

## Relationship Between Social Risks and Diabetes Metrics in a US Health System

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**Objective:** The primary aim of this cross-sectional analysis was to evaluate the association of multiple social risk domains on the attainment of a composite quality metric in patients with diabetes in a large US regional practice.

**Research Design and Methods:** The study population included adult patients with type 2 diabetes empaneled to a family medicine clinician in Mayo Clinic Rochester or Mayo Clinic Health System. Patients met the diabetes metric (D5) if: HgbA1c < 8, Blood pressure < 140/90, statin use unless contraindicated, avoidance of tobacco use, and aspirin use if coexisting vascular disease. The D5 metric, demographic, and social risks year end 2022 data were collected from the electronic health record (EHR). A multiple logistic regression model was calculated for each social risk domain, controlling for demographic factors.

**Results:** Among 44,010 patients with type 2 diabetes, the D5 metric was less likely to be met in those who were younger, nonwhite, rural, lower visit utilizers, or who had commercial or unknown insurance. Patients who gave high-risk answers to social risk domains of housing risk, financial risk, food insecurity, and transportation needs were significantly less likely to meet the D5 metric.

**Conclusions:** This data reinforces the important clinical impact social risk factors have for primary care patients and highlights the need for more interventional studies. (J Am Board Fam Med 2024;37:939–947.)

**Keywords:** Cross-Sectional Studies, Diabetes Mellitus, Electronic Health Records, Family Medicine, Health Disparities, Logistic Regression, Primary Health Care, Social Determinants of Health, Social Risk Factors

## Introduction

Type 2 diabetes mellitus impacts 37.3 million people in the United States, approximately 11.3% of the US population.<sup>1</sup> Diabetes prevalence and its associated complications disproportionately affect racial and ethnic minorities and low-income

adults.<sup>2,3</sup> Social determinants of health (SDOH) are the nonmedical factors that influence health outcomes, and are considered primary contributors to health disparities, especially in chronic diseases such as diabetes.<sup>4–6</sup> Despite increased awareness of SDOH influence on diabetes outcomes, there has been a lack of population change in diabetes outcomes.<sup>7,8</sup>

As US health care shifts to greater emphasis on value-based care and population health outcomes, SDOH screening and interventions have increased in research and practice.<sup>3,9</sup> Primary care settings may be appropriate environments to measure and

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intervene on social risk, defined as “specific adverse conditions at the individual or family level that are associated with poor health and can exacerbate health inequities.”<sup>5,8–13</sup> Primary care delivers over half of all ambulatory care in the United States and can integrate individual clinical care with public health, behavioral health, and community services.<sup>10,14</sup> Integration of social risk data in the electronic health record (EHR) creates opportunities for primary care teams to screen for and address patients’ social risk, coordinate referrals to community resources, and identify patients with the highest needs.<sup>10,15</sup> Documenting patients’ social risk factors in the EHR may lead to increased uptake of social services and improved health outcomes.<sup>16</sup> Many health care institutions have adopted universal EHR-based assessments, despite controversies about social risk screening.<sup>17</sup> The majority of research on social risk screening in patients with type 2 diabetes focuses on underserved or disadvantaged populations; less is known about the characteristics of social risk among patients with diabetes in a general primary care population.

We examined the relationship between patient reported social risk factors captured in the EHR and the likelihood that a patient with type 2 diabetes at a large Midwest health system would have successful diabetes control, as defined by a composite diabetes metric.

## Research Design and Methods

### Study Population

The Mayo Clinic Institutional Review Board deemed this study exempt under 45 CFR 46. The study population included all adults with an ICD-10 diagnosis code of type 2 diabetes who received primary care health services through the integrated system of Mayo Clinic Rochester and Mayo Clinic Health System (MCHS), located in southern Minnesota, western Wisconsin, and northeastern Iowa. MCHS is integrated by a common EHR, Epic Systems, from which all data were extracted, social risk questionnaires were added in 2019. Patients were selected for inclusion if they were actively paneled to a Family Medicine primary care clinician (physician or advanced practice provider) during the study period of January 1 – December 31, 2022. Patients were excluded from analysis if they did not give prior authorization for use of EHR data for research purposes.

### Measures and Outcomes

The diabetes quality outcome was defined by a set of 5 measurements aligned with diabetes practice guidelines known as the D5 metric.<sup>7,18,19</sup> These measurements include most recent measured (within prior 12 months) hemoglobin A1c < 8%, blood pressure < 140/90, statin use unless contraindicated, avoidance of tobacco use, and aspirin use if coexisting vascular disease. Patients were considered attaining D5 quality metric only if they met all 5 criteria using year-end 2022 data.

Covariates of interest extracted from EHR data included age, gender, race, rural/urban status (as defined by Rural Urban Commuting Area), Adjusted Clinical Group score (patient medical complexity measure), payer type, total year 2022 family medicine outpatient visits, and practice location.<sup>20,21</sup>

Questionnaires about social risks were administered to adult patients with clinical encounters through the Mayo Clinic patient online portal system, an electronic tablet on arrival for care, or by clinical staff during a visit. Survey data collected before end of 2022 was used. Social risk domains assessed included housing stability, food insecurity, financial resource strain, intimate partner violence, and transportation needs (Appendix 1).

### Statistical Analysis

Patient characteristics are reported using frequencies and percentages for categorical variables and means and standard deviation for continuous variables. Demographic data among diabetes metric met versus not met cohorts were compared using either Chi-squared test (for categorical data) or a Kruskal-Wallis test (for continuous data). Social risks for the diabetes metric met versus not met groups were analyzed using Chi-squared test. A univariate logistic regression model reporting odds ratio and 95% confidence interval was used for each of the 5 social risk domains to ascertain the likelihood of meeting the D5 metric among patients reporting “at risk” answers versus those reporting “no risk” answers. A multivariable logistic regression model was calculated for each social risk domain controlling for variables including age, gender, race, practice region, rurality, insurance, complexity score and utilization. To demonstrate the relationships between the 5 social risk domains, a Cramer’s V test was used. All analyses were conducted with SAS software (SAS Institute, Cary, NC).

## Results

### Patient Characteristics

A total of 44,010 adult patients with diabetes were included, 44.2% met all components of the D5 metric (Table 1). Study subjects had a mean  $\pm$  standard deviation age of  $66 \pm 14$  years. The majority of subjects were male (55%), resided in rural areas (52.4%), and were government insured (68.9%).

Those who did not meet all 5 of the quality measures for diabetes (D5 Unmet) were more likely to be younger, nonwhite, live in rural areas, have

commercial or unknown insurance, and have had less outpatient visits during the study period than those who met all 5 quality measures (D5 Met). Regional variations across MCHS locations meeting the D5 metric were observed. Medical complexity and gender were not related to the D5 metric.

### D5 Metric and Social Risk Variables

Among patients with diabetes, all high-risk social risk responses were associated with a lower likelihood of meeting the D5 goal (Table 2). Missing

**Table 1. Association Between Patient Characteristics and D5 Metric Among Mayo Clinic and MCHS Patients with Type 2 Diabetes, 2022**

	D5 Unmet (n = 24,557)	D5 Met (n = 19,453)	Total (n = 44,010)	P-value
Age				<0.0001*
Mean (SD)	64.7 (13.60)	67.7 (13.66)	66.0 (13.71)	
ACG Risk score				0.7144*
Mean (SD)	2.8 (3.06)	2.8 (2.91)	2.8 (3.00)	
Gender, n (%)				0.6660†
Woman	11,187 (55.9%)	8,812 (44.1%)	19,999 (45.4%)	
Man	13,369 (55.7%)	10,639 (44.3%)	24,008 (54.6%)	
Nonbinary	1 (50.0%)	1 (50.0%)	2 (0.0%)	
Unknown	0 (0.0%)	1 (100.0%)	1 (0.0%)	
Race, n (%)				<0.0001†
American Indian/Alaskan Native	135 (64.0%)	76 (36.0%)	211 (0.5%)	
Asian	609 (57.0%)	460 (43.0%)	1,069 (2.4%)	
Black	760 (68.3%)	352 (31.7%)	1,112 (2.5%)	
Other	287 (65.5%)	151 (34.5%)	438 (1.0%)	
Pacific Islander	33 (51.6%)	31 (48.4%)	64 (0.1%)	
Unknown	215 (61.8%)	133 (38.2%)	348 (0.8%)	
White	22,518 (55.2%)	18,250 (44.8%)	40,768 (92.6%)	
Insurance type, n (%)				<0.0001†
Commercial	5,972 (58.9%)	4,171 (41.1%)	10,143 (23.0%)	
Government	16,573 (54.7%)	13,732 (45.3%)	30,305 (68.9%)	
Mayo insured	1,715 (54.4%)	1,439 (45.6%)	3,154 (7.2%)	
Unknown	297 (72.8%)	111 (27.2%)	408 (0.9%)	
Outpatient visits 2022				<0.0001*
Mean (SD)	3.4 (4.96)	3.7 (5.50)	3.5 (5.21)	
Practice region, n (%)				0.0166†
A	5,693 (54.6%)	4,731 (45.4%)	10,424 (23.7%)	
B	5,295 (55.5%)	4,251 (44.5%)	9,546 (21.7%)	
C	6,293 (56.9%)	4,769 (43.1%)	11,062 (25.1%)	
D	3,507 (56.0%)	2,760 (44.0%)	6,267 (14.2%)	
E	3,769 (56.2%)	2,942 (43.8%)	6,711 (15.2%)	
Urban/rural, n (%)				0.037†
Urban	11,580 (55.3%)	9,368 (44.7%)	20,948 (47.6%)	
Rural	12,973 (56.3%)	10,084 (43.7%)	23,057 (52.4%)	
Missing	4	1	5	

\*Kruskal-Wallis P-value; †Chi-Square p-value.

Percentages were calculated by row.

Abbreviation: SD, Standard deviation.

**Table 2. Association Between Social Risk Variables and D5 Metric Among Mayo Clinic and MCHS Patients with Type 2 Diabetes, 2022**

	D5 Unmet (n = 24,557)	D5 Met (n = 19,453)	Total (n = 44,010)	P-value
Housing stability risk, n (%)				<0.0001*
At risk	1,675 (12.0%)	891 (7.3%)	2,566 (9.8%)	
Not at risk	12,331 (88.0%)	11,321 (92.7%)	23,652 (90.2%)	
Missing	10,551	7,241	17,792	
Financial strain risk, n (%)				<0.0001*
High risk	955 (6.3%)	446 (3.4%)	1,401 (4.9%)	
Medium risk	2,292 (15.0%)	1,429 (10.8%)	3,721 (13.1%)	
Low risk	11,988 (78.7%)	11,305 (85.8%)	23,293 (82.0%)	
Missing	9,322	6,273	15,595	
Food insecurity, n (%)				<0.0001*
At risk	1,761 (11.9%)	861 (6.7%)	2,622 (9.5%)	
Not at risk	13,036 (88.1%)	12,006 (93.3%)	25,042 (90.5%)	
Missing	9,760	6,586	16,346	
Transportation needs, n (%)				<0.0001*
Unmet needs	848 (5.5%)	400 (3.0%)	1,248 (4.3%)	
No needs	14,588 (94.5%)	12,958 (97.0%)	27,546 (95.7%)	
Missing	9,121	6,095	15,216	
Intimate partner violence, n (%)				0.0003*
At risk	398 (2.7%)	260 (2.1%)	658 (2.4%)	
Not at risk	14,176 (97.3%)	12,422 (97.9%)	26,598 (97.6%)	
Missing	9,983	6,771	16,754	

\*Chi-Square P-value.

data from incomplete surveys varied for each social risk factor, with up to 40% missing for housing risk. Each of the 5 social risk variables was examined separately in an adjusted multivariable analysis (Table 3). Worse D5 measures were associated with housing risk, financial risk, food insecurity, and unmet transportation needs. The D5 metric was not associated with intimate partner violence. Financial risk, housing risk, and food insecurity were highly correlated (Cramer's V test > 0.30) with each other (Table 4).

## Discussion

In this practice-based, primary care population of adults with type 2 diabetes, nearly all measured social risk domains were associated with lower likelihood of attaining the D5 metric. The large regional practice size, multiple social risk comparisons, and use of a composite diabetes metric add to the strength of these conclusions. Economic stability (including housing, financial risk, food insecurity, and transportation) were the social risk domains most strongly

associated with the D5 metric and are also highly correlated with each other.<sup>8,22</sup> These economic factors seem to significantly impact diabetes management outcomes, which aligns with prior research supporting the correlation between self-reported social risks and diabetes control.<sup>2,6,7,23</sup>

As a cross-sectional study, this analysis does not identify the causal nature of the relationship between individual social risk domains and diabetes quality metrics. Further limitations of using self-reported social risk data include misunderstood questions, misrepresentation of answers, and social desirability bias.<sup>24–27</sup> Accuracy of this self-disclosed information cannot be verified but more closely represents data collected in a community-based primary care practice. Some social risk information was not available in the medical record for approximately one-third of subjects, increasing the risk of nonresponse bias. Reasons for missing data include incomplete questionnaires or patient declination to answer survey questions. Patients with missing data were more likely to not meet the D5 metric, potentially underestimating the effects of social risks on attaining the

**Table 3. Logistic Regression Model Association of Patient-Reported Social Risk with Likelihood of Meeting D5 Metric Outcome Among Mayo Clinic and MCHS Patients with Type 2 Diabetes, 2022**

Social Risk Variable*	Univariate Logistic Regression		Multiple Logistic Regression <sup>†</sup>	
	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value
Housing risk				
At Risk vs Not at Risk <sup>††</sup>	0.58 (0.53, 0.63)	<0.001	0.68 (0.62, 0.74)	<0.001
Financial strain risk				
High Risk vs Low Risk <sup>††</sup>	0.50 (0.44, 0.56)	<0.001	0.60 (0.53, 0.68)	<0.001
Medium Risk vs Low Risk <sup>††</sup>	0.66 (0.62, 0.71)	<0.001	0.74 (0.69, 0.79)	<0.001
Food insecurity				
At Risk vs Not at Risk <sup>††</sup>	0.53 (0.49, 0.58)	<0.001	0.64 (0.59, 0.70)	<0.001
Transportation needs				
Unmet Needs vs Met Needs <sup>††</sup>	0.53 (0.47, 0.60)	<0.001	0.62 (0.55, 0.70)	<0.001
Intimate partner violence				
At Risk vs Not at Risk <sup>††</sup>	0.75 (0.64, 0.87)	<0.001	0.88 (0.75, 1.04)	0.123

\*Separate models were run for each social risk variable with an outcome of meeting the D5 metric.

<sup>†</sup>Adjusted for age, gender, race, campus/location, rurality, insurance, ACG complexity score, utilization (total family medicine outpatient visits in last year).

<sup>††</sup> Reference group, Odds Ratio = 1.

Abbreviation: CI, Class interval.

D5 metric. Practice differences in completion of the social risk questionnaire may contribute to variances in reported social risk rates. An individual socioeconomic measure based on residential address (eg, HOUSES index) may be an alternative approach, which does not require patients to complete a questionnaire and may overcome the limitations of missing data.<sup>7,27</sup>

This study is one of the first to demonstrate the use of EHR-integrated social risk questionnaires to evaluate the relationship with a composite diabetes metrics across a large, regional US primary care practice. The elevated prevalence of high-risk social risk reports and the magnitude of the effects on diabetes metrics among this general medical population deserves attention. While the vast majority of this population presumably has adequate health care access through medical insurance, there are

influences beyond insurance coverage that drive poorer diabetes measures.<sup>19,28,29</sup> By objectively measuring the association between self-reported social risk and diabetes metrics, higher social risk populations can be more accurately identified by care teams. With this initial epidemiologic data, health institutions and care teams can design pilot interventions and enhance community partnerships with the goal of improving diabetes care and outcomes. In the ongoing debate of how best to incorporate social risk screening into primary care training and practice, this data reinforces the important clinical impact these factors have for our patients and highlights the need for more interventional studies.<sup>30–32</sup>

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**Table 4. Correlations Between the Social Risk Variables Using Cramer's V Test**

Social Risk Variables	Housing Risk	Financial Risk	Food Insecurity	Transportation Needs	IPV Risk
Housing risk	—	0.388	0.374	0.215	0.115
Financial risk	0.388	—	0.603	0.287	0.155
Food insecurity	0.374	0.603	—	0.302	0.140
Transportation	0.215	0.287	0.302	—	0.122
IPV risk	0.115	0.155	0.140	0.122	—

Cramer's V > 0.3 is considered highly correlated.

Abbreviation: IPV, Intimate Partner Violence.



To see this article online, please go to: <http://jabfm.org/content/37/5/939.full>.

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## Appendix 1

### Social Determinants of Health Questionnaire (Adults – age 18+)

#### Financial Strain Domain

How hard is it for you to pay for the very basics like food, housing, medical care, and heating?

Not hard at all, not very hard, somewhat hard, hard, very hard, decline

#### Financial Strain Scoring

High risk – Answer to financial resource strain question = hard; very hard

Medium risk – Answer to financial resource strain question = somewhat hard

Low risk – Answer to financial resource strain question = not very hard; not hard at all

*Hall M, Bromberger JT, Matthews KA. Socioeconomic status as a correlate of sleep in African-American and white women. In: Adler NE, Marmot M, McEwen BS, Stewart J, editors. Socioeconomic status and health in industrial nations: social, psychological, and biological pathways. New York: Annals of the New York Academy of Sciences; 1999. pp. 427 to 30*

#### Food Insecurity Domain

Within the past 12 months, you worried that your food would run out before you got the money to buy more.

Never true, sometimes true, often true, decline

Within the past 12 months, the food you bought just did not last and you did not have the money to get more.

Never true, sometimes true, often true, decline

#### Food Insecurity Scoring

At risk – if food scarcity or food worry = sometimes true OR often true

Not at risk – if food scarcity AND food worry = never true

*Hager, E. R., Quigg, A. M., Black, M. M., Coleman, S. M., Heeren, T., Rose-Jacobs, R., Frank, D. A. (2010). Development and Validity of a 2-Item Screen to Identify Families at Risk for Food Insecurity. Pediatrics, 126(1), 26 to 32.*

#### Housing Stability Domain

In the past 12 months, was there a time when you were not able to pay the mortgage or rent on time?

Yes, no, decline

In the past 12 months, how many places have you lived?

Enter numeric value

In the past 12 months, was there a time when you did not have a steady place to sleep or slept in a shelter (including now)?

Yes, no, decline

#### Housing Stability Scoring

At risk – Not able to pay the mortgage or rent on time OR did not have a steady place to sleep OR has lived in 3 or more places in the last year

Not at risk – Able to pay the mortgage or rent on time AND had a steady place to sleep AND lived in less than 3 places in the last year

#### Intimate Partner Violence Domain

Within the last year, have you been afraid of or threatened by a partner, ex-partner, family member, friend, or someone who cares for you?

Yes, no, decline

Within the last year, have you been humiliated or emotionally abused in other ways by a partner, ex-partner, family member, friend, or someone who cares for you?

Yes, no, decline

Within the last year, have you been kicked, hit, slapped, or otherwise hurt by a partner, ex-partner, family member, friend, or someone who cares for you?

Yes, no, decline

Within the last year, have you been raped or forced to have any kind of sexual activity by a partner, ex-partner, family member, friend, or someone who cares for you?

Yes, no, decline

#### Intimate Partner Violence Scoring

At risk – Yes to any question

Not at risk – No to all questions



Sohal, H., S. Eldridge, and G. Feder. 2007. *The sensitivity and specificity of 4 questions (HARK) to identify intimate partner violence: A diagnostic accuracy study in general practice.* *BMC Family Practice* 8(1):49 to 58.

## Transportation Needs Domain

In the past 12 months, has lack of transportation kept you from medical appointments or from getting medications?

Yes, no, decline

In the past 12 months, has lack of transportation kept you from meetings, work, or getting things needed for daily living?

Yes, no, decline

## Transportation Needs Scoring

Unmet needs – if medical transport needs unmet OR work/ADL transport needs unmet = yes

No needs – if medical transport needs unmet AND work/ADL transport needs unmet = no

*National Association of Community Health Centers and Partners, National Association of Community Health Centers, Association of Asian Pacific Community Health Organizations, Association OPC, Institute for Alternative Futures. (2017). PRAPARE. <http://www.nachc.org/research-and-data/prapare/>*