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Cross-Sectional Associations: Social Risks and Diabetes Care Quality, Outcomes

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Abstract

Introduction: Social risks (e.g., food/transportation insecurity) can hamper type 2 diabetes mellitus self-management, leading to poor outcomes. To determine the extent to which high-quality care can overcome social risks' health impacts, this study assessed the associations

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CREDIT AUTHOR STATEMENT

Rachel Gold: Writing − original draft. Jorge Kaufmann: Writing − original draft, Methodology, Formal analysis. Laura M. Gottlieb: Methodology, Writing − review & editing, Conceptualization. Saul J. Weiner: Formal analysis, Writing − review & editing. Megan Hoopes: Methodology. Jordan C. Gemelas: Conceptualization, Writing − original draft. Cristina Huebner Torres: Writing − review & editing. Erika K. Cottrell: Conceptualization, Methodology, Writing − review & editing. Danielle Hessler: Methodology, Writing − review & editing. Miguel Marino: Formal analysis, Methodology, Writing − original draft. Christina R. Sheppler: Writing − review & editing. Seth A. Berkowitz: Conceptualization, Writing − review & editing.

SUPPLEMENTAL MATERIAL

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between reported social risks, receipt of guideline-based type 2 diabetes mellitus care, and type 2 diabetes mellitus outcomes when care is up to date among community health center patients.

Methods: A cross-sectional study of adults aged ≥18 years (N=73,484) seen at 186 community health centers, with type 2 diabetes mellitus and ≥1 year of observation between July 2016 and February 2020. Measures of type 2 diabetes mellitus care included up-to-date HbA1c, microalbuminuria, low-density lipoprotein screening, and foot examination, and active statin prescription when indicated. Measures of type 2 diabetes mellitus outcomes among patients with up-to-date care included blood pressure, HbA1c, and low-density lipoprotein control on or within 6−12 months of an index encounter. Analyses were conducted in 2021.

Results: Individuals reporting transportation or housing insecurity were less likely to have up-to-date low-density lipoprotein screening; no other associations were seen between social risks and clinical care quality. Among individuals with up-to-date care, food insecurity was associated with lower adjusted rates of controlled HbA1c (79% vs 75%, p<0.001), and transportation insecurity was associated with lower rates of controlled HbA1c (79% vs 74%, p=0.005), blood pressure (74% vs 72%, p=0.025), and low-density lipoprotein (61% vs 57%, p=0.009) than among those with no reported need.

Conclusions: Community health center patients received similar care regardless of the presence of social risks. However, even among those up to date on care, social risks were associated with worse type 2 diabetes mellitus control. Future research should identify strategies for improving HbA1c control for individuals with social risks.

Trial Registration: This study is registered at www.clinicaltrials.gov NCT03607617.

INTRODUCTION

Avoiding type 2 diabetes mellitus (T2DM) complications involves appropriate clinical care, self-management, and social conditions that support health. Community health centers (CHCs) serve low-income individuals regardless of their ability to pay, removing one barrier to receipt of ongoing primary care. However, owing to the interplay between clinical care, self-management, and social circumstances, such access may not result in controlled T2DM risk factors.

Social determinants of health influence exposure to social risks such as food, housing, transportation, and financial insecurity. Social risks can then hamper activities associated with controlled T2DM (e.g., food security impacts the ability to maintain a healthy diet; transportation availability impacts visit adherence; and multiple social risks influence medication adherence).[1–8] The benefits of access to guideline-concordant T2DM clinical care may then be limited because social risks can affect both the ability to receive care and the effectiveness of that care. Therefore, when associations between social risks and poor health outcomes are observed, it can be difficult to determine the extent to which these outcomes result from limited access to care, nonreceipt of appropriate care elements even when care is accessed, or social risk factors that primary care teams have little power to influence. These distinctions have important implications for the health of persons experiencing social risks; understanding them could inform the strategies needed to improve T2DM outcomes in low-income populations.

To address this knowledge gap, associations were analyzed between patient-reported presence of prevalent social risk factors, receipt of guideline-based T2DM care, and T2DM outcomes. These analyses included individuals with T2DM seen in CHCs to determine whether care receipt varied by social risk and whether T2DM control varied by social risk factors among those with up-to-date clinical care. This assessed how social risks are associated both with elements of T2DM care that are under a clinic's control (e.g., provision of diabetic foot examination) and with T2DM outcomes influenced by forces outside of the clinic.

METHODS

Study Population

The study period was July 2016−February 2020. Study data came from CHCs sharing an Epic electronic health record (EHR) through membership in OCHIN, Inc., a nonprofit health information technology provider. Analysis data were extracted from this shared EHR in August 2020. These data are part of the Accelerating Data Value Across a National CHC Network Clinical Research Network, a PCORnet member.

Standardized documentation of patient-reported social risks became feasible in OCHIN's EHR in June 2016. Analyses included the 186 OCHIN member CHC clinics (53% of OCHIN clinics at the time, located throughout the U.S.) that used this EHR functionality to document any patient responses to food, housing, or transportation insecurity screening during the study period.

Analyses were limited to patients aged ≥18 years with documented T2DM on or before their index visit and for whom ≥1 year of observation was feasible. Each patient's observation period ended at their last primary care encounter before March 1, 2020 and began at their first primary care encounter at least 1 year before their end date (giving each ≥1 and ≤3.7 observation years). The first encounter for a person in that period was the index visit, the reference point for all analysis elements. Primary care visits were identified using current procedural terminology codes (Appendix Text 1, available online) and provider type (doctor of medicine, physician assistant, nurse practitioner, doctor of osteopathic medicine).

The study was approved by the Kaiser Permanente Northwest IRB. Ths IRB waived the need to obtain informed consent.

Measures

Patient-level outcomes were measures of T2DM clinical care (i.e., factors more under CHCs' control): up-to-date HbA1c screening (within 183 days after or 7 days before index encounter), up-to-date urine microalbuminuria screening, low-density lipoprotein (LDL) screening, diabetic foot examination (each within 365 days after or 7 days before the index visit), and documentation of active statin prescription among patients for whom a statin medication was indicated per clinical guidelines. Patients for whom a statin was indicated included those who were not pregnant or breastfeeding; had not been diagnosed with rhabdomyolysis, end-stage renal disease, or renal failure; and were either (1) aged 40−75 years or (2) aged >21 years with atherosclerotic cardiovascular disease or LDL ≥160

mg/dL. These were all binary variables. A total of 3 additional binary measures assessed T2DM control outcomes, those potentially less under CHCs' control: HbA1c (<9%), blood pressure (BP) (<140/90 mmHg), and LDL (<100 mg/dL; although specific LDL targets are no longer emphasized in care guidelines, this was included because high LDL indicates poor T2DM control). Control status was assessed as the first result on or within 6−12 months after an index encounter. Analyses of HbA1c and LDL control were limited to individuals with up-to-date HbA1c or LDL screening, respectively, ensuring that control status was not impacted by care status. The number of in-person primary care clinic visits in the year after the index encounter was also assessed.

The independent variable was the presence of social risks. This was categorical and denoted if, during the study period, an individual (1) had been screened for a specific social risk (food, transportation, or housing) and reported having that risk or (2) had been screened for the specific risk and reported no risk. Analyses also considered individuals with no documentation of having been screened for that risk (screening not conducted or no response documented) to enable comparing those who were with those who were not screened. The strategies used to assess patient-reported social risks varied across study CHCs because the EHR enabled documentation with one of several commonly used screening tools or selected individual social risks. Clinics could also choose to screen different individuals for different risks. Therefore, *any positive screening result for a given social risk* is defined as the patient reporting need in that domain regardless of which screening tool was used. Of note, the analyses' primary goal was to assess the associations with reported presence or absence of social risks among individuals who were screened. However, because social risk screening is not universal, these analyses include individuals who were not screened, for comparison across all CHC patients.

A positive social risk screening was included if documented at any point during the observation period. Dependent variables measuring care quality were those occurring 183 or 365 days after or 7 days before the index visit; those measuring diabetes control were from the first screening for HbA1c taken 183 days after or 7 days before the index visit, the first screening for LDL taken 365 days after or 7 days before the index visit, and the first date on or after the index visit for BP. Rather than to establish causal relationships, these observation periods were selected to establish baseline patient characteristics for assessing the associations between social risk, T2DM care quality, and T2DM outcomes.

The following variables were considered in these analyses: sex, race/ethnicity, preferred language, age and insurance status at index encounter, federal poverty level on or after the index encounter, and the number of primary care visits per year during the individual's observation period.

Statistical Analysis

Analyses were conducted in 2021. Characteristics of the study sample were reviewed. Individuals were then compared by social risk group (screened + documented need present, screened + documented need not present, or no screening documented) in terms of their demographic characteristics for each social risk (food, transportation, and housing insecurity). Next, generalized estimating equations (GEE) models were utilized to assess

the association between social risk categories and outcome measures of T2DM control status and provision of guideline-concordant care. The GEE models were stratified by specific social risk. GEE logistic regression analyses were conducted for all binary outcome measures, and GEE negative binomial regression was conducted for the count outcome of post-index utilization. All analyses adjusted for the demographic covariates mentioned earlier and utilized robust sandwich variance estimators with exchangeable correlation structure to account for clustering on patient's primary clinic.

Predicted probabilities and rates, along with contrasts to the ref group and 95% CIs, were calculated. All estimates were conducted using Stata 15, and all statistical testing was 2 sided, with a type I error set to 5%.

RESULTS

Table 1 shows the characteristics of individuals in these analyses (N=73,484). Over half (56%) were female; 36% were Hispanic, 20% were non-Hispanic Black, and 32% were non-Hispanic white; 40% preferred a language other than English; 91% were aged ≥40 years (median=58 years, range=18−103); 79% had household incomes below 200% of the federal poverty level; and approximately 75% were publicly insured, and 11% were uninsured at the index visit. Most (84%) had ≥3 yearly encounters within the CHC network.

Most (96%) had between a 1- and 2-year observation period as defined earlier (Table 1). Almost all (98%) social risk observations (social risk screenings) occurred within 2 years after the index visit (not shown); specifically, 72%−75% occurred <1 year from the index visit, 23%−27% occurred ≥1 and <2 years from the index visit, and <2% occurred ≥2 years after index encounter. Demographic differences between persons who had and those who had not been screened for each social risk were generally statistically significant (Table 1 footnote). Differences between those who were and those who were not screened are presented in Appendix Table 1 (available online).

Tables 2–4 show the associations between specific documented social risks (food, housing, and transportation insecurity, respectively) and the likelihood of T2DM clinical care received and diabetes outcomes.

Among individuals screened for food insecurity, those who reported its presence did not differ significantly from those who did not in any measures of diabetes clinical care received (Table 2). Those reporting having food insecurity had significantly more clinic visits in the assessment year than those reporting not having it (average of 5.4 vs 4.9, $p<0.001$).

Those not screened for food insecurity were significantly less likely to be up to date on urine microalbumin (41.8% vs 45.3%, $p=0.034$) and LDL screening (59.6% vs 62.6%, $p=0.005$) and to have an appropriate statin prescription (71.0% vs 73.9%, $p=0.002$) than those with reported food insecurity. Those not screened for food insecurity also had significantly fewer visits in the assessment year than those who reported this need (4.4 vs 5.4, $p<0.001$).

Among those screened for housing insecurity, those reporting this social risk were significantly less likely than those reporting no such risk to have up-to-date LDL screening

(60.5% vs 64.8%, $p<0.001$) (Table 3). However, those who did report housing insecurity were significantly more likely to have up-to-date foot screening than those reporting not having this risk (13.5% vs 12.3%, $p=0.045$). Those reporting housing insecurity had more visits in the assessment year than those reporting not having this need (5.4 vs 5.0, $p=0.002$) and those whose status was not documented (5.4 vs 4.4, $p<0.001$).

Similar patterns were seen for transportation insecurity as for housing security. See (Table 4).

All measures of T2DM outcomes are among individuals whose care was up to date.

Individuals reporting food insecurity had significantly lower rates of controlled HbA1c than those reporting no food insecurity (74.7% vs 78.5%, $p<0.001$). Those whose food insecurity status was not documented had significantly higher rates of controlled HbA1c than those with documented food insecurity (78.7% vs 74.7%, $p<0.001$) (Table 2).

Those whose housing insecurity status was not documented had significantly higher rates of controlled LDL than those with documented need (60.4% vs 56.3%, $p=0.016$). No significant differences in diabetes outcomes were observed among those reporting no housing need compared to those reporting insecurity (Table 3).

Individuals who reported transportation insecurity were associated with significantly lower rates of controlled HbA1c (73.7% vs 78.5%, $p=0.005$), BP (71.8% vs 74.1%, $p=0.025$), and LDL (56.7% vs 60.8%, $p=0.009$) than individuals reporting no transportation insecurity. Those whose transportation insecurity status was not documented had significantly higher rates of controlled HbA1c (78.6% vs 73.7%, $p<0.001$) and LDL (60.3% vs 56.7%, $p=0.040$) than those with documented need (Table 4).

DISCUSSION

Receipt of guideline-recommended clinical care varied little between CHC patients with T2DM who did versus did not report common social risks. However, among patients with up-to-date clinical care, food insecurity was associated with worse HbA1c control, and transportation insecurity was associated with worse control of all measured diabetes control outcomes; in this study, the delivery of recommended care did not translate to better disease control. This shows that CHCs provide high-quality care to disadvantaged populations. It also shows that guideline-based care may be insufficient to achieve desired T2DM outcomes when patients experience social risks; in those cases, even when patients received guideline-concordant clinical care, social risks were still associated with worse control of T2DM risks.

Previous research makes clear that social risks impact health both through pathways that clinics can address and by undermining patients' ability to adhere to care plans and engage in self-management activities.[1–8] As one example of how this might manifest, even when CHCs provide transportation to the clinic to minimize missed appointments, patients' lack of transportation to pick up prescription refills may impact T2DM control. Understanding the relationships between how social risks impact patient access to care and their ability to self-manage T2DM would be informative to primary care stakeholders (e.g., by showing

policymakers what can be expected of healthcare providers and informing clinical staff about barriers to successful disease management). These analyses contribute knowledge by assessing these relationships in a national network of CHCs, which provide care regardless of patients' ability to pay (removing one barrier to care). The results underscore the clinics' current ability to mitigate some but not all of the health impacts of social adversity.

These findings build on the team's earlier research showing positive associations between neighborhood social deprivation and poor diabetes control in CHC populations. That study showed that if patients' census tract–level social deprivation indices were at the national median of 50 rather than 80 as in these CHCs, diabetes quality metrics would improve for >75% of CHC providers.[9] This study builds on these findings using patient-reported rather than aggregate area-level data to assess the presence of social risks and their associations with T2DM clinical care and outcomes in CHCs. Combined, these findings are concerning because many CHCs' payments pend on clinical outcome metrics, so their overall ability to be successful may be undermined if patients' social risks are not considered in such measurements.

This work underscores the importance of identifying effective mechanisms for primary care providers to help patients address social risks. Although the evidence base on such interventions' effectiveness is growing,[5,10–17] there remains a need to better understand, refine, disseminate, and pay for successful approaches.[3] Addressing these risks need not be tied to clinical care; policy interventions could and should lower the prevalence of these risks, in parallel with improving clinics' capacity to address them.

Demographic differences between patients with reported social risks and those who were not screened warrant consideration. Analyses adjusted for these factors. These align with previous findings from this team and others: social risk screening varies between clinics and by patient characteristics.[18–22] Of note, patients not screened for social risks were less often up to date on clinical care but more likely to have controlled diabetes risk (among those with up-to-date care). The finding regarding clinical care may be related to individuals with reported social risks having higher rates of clinic visits than those not screened because less frequent visits could explain why those not screened were less likely to have guideline-concordant care. The finding regarding measures of T2DM control may reflect care teams being more likely to screen for social risks if uncontrolled diabetes acted as a red flag indicating a need for screening.[23,24] Together, these results show the need for systematic social risk screening to avoid care and outcome inequities resulting from differences in social risk screening.

Limitations

The results of this cross-sectional analysis should be interpreted with consideration of key limitations. Anecdotal evidence suggests that when CHC staff screen patients for social risks, they may document only positive screening results. Thus, some individuals considered not screened may have had negative screening results, so results in this category should not be interpreted to reflect their social risk status.

Screening was documented only for a minority of this study population, so results related to the presence of social risks should only be interpreted as applying to those patients. Generalizability is further limited because these results only apply to CHC patients at clinics where any social risk screening is conducted (in this study, about 53% of OCHIN member CHCs). Related potential bias was addressed by including all eligible patients and adjusting analyses for demographic variables.

The impacts of social risks may differ within this heterogeneous population. Assessing this possibility was beyond these analyses' scope, as was assessing how these CHCs support patients with social risks (e.g., through social service referrals). Both will be explored in future analyses. Different clinics' screening patterns (for example, which social risks they screen for, which patients) should be considered; these patterns may also correlate with the clinic characteristics associated with the quality of provided care. It is possible that clinic characteristics confounding the differences between those who were and those who were not screened were not controlled for; however, this would not explain the differences in T2DM outcomes seen between those who reported the presence and those who reported the absence of social risks, per these analyses' main focus. It was also beyond the scope of this study to assess potential effect modification influences on these outcomes; this should be assessed in future analyses.

Finally, these cross-sectional analyses considered screening results documented at any point in the observation period. In almost the entire study population, relevant screenings occurred <2 years after index encounter, but it is possible that after some time, social risk status should not be considered associated with future outcomes. Although it is unlikely that social risk status changed for much of the study population in this period, research is needed to determine how social risk status changes over time in CHC populations.[25]

CONCLUSIONS

CHCs provide high-quality T2DM care regardless of whether patients face social risks. However, the results of this study suggest that even with this care, individuals who experience social risks still face worse control of key T2DM outcomes. Future research should assess how CHCs can most effectively help individuals experiencing social risks avoid complications of T2DM. Furthermore, these improvements in clinical settings' ability to mitigate social risks' impact should occur in combination with social policy to improve health outcomes that are driven by factors beyond clinical care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Adults With T2DM in CHCs That Screen for Social Risks (July 2016−February 2020)

Characteristics	All, column %	SDH risk screening documentation group, row %								
		Food insecurity			Housing insecurity			Transportation insecurity		
		Documented			Documented			Documented		
		Need	No need	Not documented	Need	No need	Not documented	Need	No need	Not documented
Patients, *n*	73,484	3,283	6,620	63,581	1,554	7,876	64,054	1,625	6,341	65,518
Female, %	56.3	4.7	8.9	86.4	2.1	11.1	86.8	2.3	8.9	88.8
Race and ethnicity, %										
Hispanic	36.3	3.1	5.5	91.3	1.1	5.7	93.2	1.2	4.9	93.8
Non-Hispanic Black	20.4	6.6	12.3	81.1	3.7	19.5	76.9	3.4	14.0	82.6
Non-Hispanic White	31.6	4.9	9.2	85.9	2.4	8.8	88.8	2.6	7.6	89.8
Non-Hispanic other	7.2	3.7	12.8	83.4	1.6	15.4	83.0	2.4	13.1	84.5
No data	4.4	4.0	14.7	81.3	2.4	17.6	80.0	1.9	14.1	84.0
Preferred language, %										
English	60.1	5.4	9.5	85.0	2.7	11.2	86.1	2.8	9.3	87.9
Non-English	39.9	3.0	8.2	88.8	1.2	10.0	88.8	1.3	7.7	91.0
Age at index encounter										
Median (range)	58 (18, 103)	57 (18, 92)	60 (18, 99)	58 (18,103)	57 (18, 98)	61 (18, 99)	58 (18, 103)	57 (18, 92)	60 (18, 98)	58 (18, 103)
Group, years, %										
18–39	9.0	4.3	7.2	88.6	2.0	8.2	89.8	1.9	6.6	91.5
40–64	61.7	5.0	8.1	86.9	2.4	9.6	88.0	2.5	7.9	89.6
≥65	29.3	3.5	11.4	85.1	1.6	13.8	84.6	1.7	10.8	87.6
Payer at index encounter, %										
Medicaid	36.5	5.3	7.6	87.1	2.6	9.7	87.6	2.9	7.8	89.3
Medicare	32.7	4.6	10.0	85.4	2.1	12.1	85.9	2.2	9.8	87.9
Other public	6.1	1.4	4.1	94.5	0.5	5.5	94.0	0.7	4.1	95.2
Private	14.1	3.4	14.5	82.1	1.7	17.3	81.0	1.4	13.6	85.0
Uninsured	10.6	4.3	6.3	89.4	1.9	4.2	93.9	1.9	3.9	94.3
Federal poverty level, %										
>200%	8.3	3.0	12.9	84.1	1.5	10.6	87.9	1.3	9.0	89.7

Characteristics	All, column %	SDH risk screening documentation group, row %								
		Food insecurity			Housing insecurity			Transportation insecurity		
		Documented			Documented			Documented		
		Need	No need	Not documented	Need	No need	Not documented	Need	No need	Not documented
≤200%	78.9	4.7	7.9	87.4	2.2	9.8	88.0	2.4	7.6	90.0
No data	12.8	4.1	13.2	82.7	1.9	16.3	81.8	1.8	14.6	83.6
Visits per year, %										
1–2	16.0	3.0	7.6	89.3	1.4	8.0	90.7	1.3	6.1	92.6
3–4	30.1	3.6	8.7	87.7	1.7	9.7	88.6	1.8	7.9	90.4
5–6	30.0	4.7	9.5	85.8	2.3	11.7	86.0	2.3	9.6	88.1
≥7	23.9	6.2	9.8	84.0	2.9	12.6	84.4	3.2	10.1	86.7
Years of observation,[a] %										
(1.2)	95.3	4.5	9.1	86.5	2.1	10.8	87.1	2.2	8.7	89.0
(2,3.7)	4.7	4.2	7.8	88.0	2.2	8.7	89.2	2.2	6.5	91.4
Statin medication indicated[b]	73.5	4.7	8.9	86.4	2.2	10.6	87.2	2.3	8.6	89.1

Note: These data were representative of 178 clinics spanning 13 U.S. states categorized by regions Midwest (Indiana, Minnesota, Ohio, and Wisconsin), Northeast (Massachusetts), South (Georgia, North Carolina, and Texas), and West (Alaska, California, Montana, Oregon, and Washington). SDH risk group was determined during the observation period. Pearson's chi-square tests were performed comparing characteristics by whether or not the patient had been screened for the specific SDHs need; all tests were statistically significant at the 0.05 *p*-value level, except as described below: for food insecurity, sex was not significant, for housing insecurity and transportation insecurity, the statin medication indicated was not significant.

[a] *Study duration* was determined at the patient level and defined by their last primary care encounter date and their first primary care encounter date that occurred at least 1 year before their last primary care encounter. Primary care encounters were identified using the combination of the level of service CPT codes and practitioner type (MD, PA, NP, and DO).

[b] Statin indication criteria for patients with T2DM who are not pregnant/breastfeeding and who have not been diagnosed with rhabdomyolysis, end-stage renal disease, or renal failure and who are either (1) aged 40−75 years or (2) aged >21 years with atherosclerotic cardiovascular disease or low-density lipoprotein ≥160 mg/dL.

CHC, community health center; CPT, current procedural terminology; DO, doctor of osteopathic medicine; MD, doctor of medicine; NP, nurse practitioner; PA, physician assistant; SDH, social determinant of health; T2DM, type 2 diabetes mellitus.

Table 2.

Diabetes Care and Food Insecurity in Adult CHC Patients With T2DM in 2016–2020

Variables	Predicted probability of diabetes outcomes		
	Estimated % (95% CI)	Difference (95% CI)	*p*-value
Diabetes clinical care outcomes			
Up-to-date HbA1c screening			
Documented: food insecurity	72.5 (69.3, 75.7)	–	
Documented: no food insecurity	73.2 (70.2, 76.2)	0.7 (−1.4, 2.7)	0.525
Food insecurity not assessed	71.9 (69.7, 74.0)	−0.7 (3.3, 2.0)	0.618
Up-to-date urine creatinine screening			
Documented: food insecurity	45.3 (40.5, 50.2)	–	
Documented: no food insecurity	47.0 (42.3, 51.6)	1.6 (−0.4, 3.6)	0.110
Food insecurity not assessed	41.8 (38.0, 45.5)	−3.6 (−6.8, −0.3)	**0.034**
Up-to-date foot screening			
Documented: food insecurity	12.2 (9.3,15.1)	–	
Documented: no food insecurity	13.4 (10.3, 16.5)	1.2 (−0.3, 2.6)	0.106
Food insecurity not assessed	12.4 (9.7,15.2)	0.2 (−0.9, 1.3)	0.695
Up-to-date LDLscreening			
Documented: food insecurity	62.6 (59.8, 65.4)	–	
Documented: no food insecurity	64.4 (62.0, 66.8)	1.8 (−0.1, 3.7)	0.060
Food insecurity not assessed	59.6 (57.6, 61.5)	−3.0 (−5.1, −0.9)	**0.005**
Active statin prescription[a]			
Documented: food insecurity	73.9 (71.7, 76.1)	–	
Documented: no food insecurity	73.9 (72.0, 75.8)	0.0 (−1.8,1.8)	0.966
Food insecurity not assessed	71.0 (69.5, 72.5)	−2.9 (−4.7, −1.1)	**0.002**
Diabetes control outcomes			
Controlled[b] HbA1c (<9%)			
Documented: food insecurity	74.7 (72.8, 76.5)	–	
Documented: no food insecurity	78.5 (76.8, 80.1)	3.8 (1.7, 6.0)	<**0.001**
Food insecurity not assessed	78.7 (78.0, 79.4)	4.0 (2.1, 5.9)	<**0.001**
Controlled blood pressure (<140/90 mmHg)			

Variables	Predicted probability of diabetes outcomes		
	Estimated % (95% CI)	Difference (95% CI)	*p*-value
Documented: food insecurity	72.6 (70.5, 74.6)	–	
Documented: no food insecurity	74.1 (72.6, 75.6)	1.5 (−0.4, 3.5)	0.121
Food insecurity not assessed	73.1 (72.0, 74.2)	0.6 (−1.3, 2.5)	0.563
Controlled[b] LDL (<100 mg/dL)			
Documented: food insecurity	58.1 (55.6, 60.6)	–	
Documented: no food insecurity	60.5 (58.3, 62.7)	2.4 (−0.3, 5.0)	0.082
Food insecurity not assessed	60.3 (59.3, 61.4)	2.2 (−0.1, 4.5)	0.061
Visits in year following index, (rate)			
Documented: food insecurity	5.4 (5.1, 5.7)	–	
Documented: no food insecurity	4.9 (4.7, 5.1)	−0.5 (−0.7, −0.3)	<**0.001**
Food insecurity not assessed	4.4 (4.3, 4.5)	−1.0 (−1.2, −0.8)	<**0.001**

Note: Boldface indicates statistical significance ($p<0.05$).

Estimates were derived using general estimating equations logistic (binary outcomes) or negative binomial (rates outcome) regression and robust sandwich variance estimation for clustering of patients within clinics. For all analyses, regression adjustment was made for sex, race/ethnicity, preferred language, age and insurance status at index visit, first known federal poverty level, and yearly rate of primary care visits (except in estimating the rate outcome). *Index visit* is defined as the first ambulatory visit at least 1 year before their last visit in the electronic health record. Screenings are considered up-to-date if within 183 days after or up to 7 days before the index for HbA1c and 365 days after or up to 7 days before for all others.

[a]Active statin prescription outcome was evaluated in a subset of patients in whom a statin was indicated: patients not pregnant or breastfeeding and who have not been diagnosed with rhabdomyolysis, end-stage renal disease, or renal failure and who are either (1) aged 40−75 years or (2) aged >21 years with atherosclerotic cardiovascular disease or LDL ≥160 mg/dL (n=54,006).

[b]Controlled HbA1c and LDL outcomes were evaluated in the subsets of patients with up-to-date measures as defined earlier (HbA1c: n=53,669; LDL: n=46,204).

CHC, community health center; LDL, low-density lipoprotein; T2DM, type 2 diabetes mellitus.

Table 3.

Diabetes Care and Housing Insecurity in Adult CHC Patients With T2DM in 2016–2020

Variables	Predicted probability of diabetes outcomes		
	Estimated % (95% CI)	Difference (95% CI)	p-value
Diabetes clinical care outcomes			
Up-to-date HbA1c screening			
Documented: housing insecurity	73.6 (69.9, 77.3)	–	
Documented: no housing insecurity	73.1 (69.9, 76.4)	−0.5 (−2.6,1.7)	0.660
Housing insecurity not assessed	71.8 (69.6, 73.9)	−1.9 (−5.1,1.3)	0.255
Up-to-date urine creatinine screening			
Documented: housing insecurity	44.5 (39.4, 49.6)	–	
Documented: no housing insecurity	46.1 (41.1, 51.0)	1.6 (−0.6, 3.7)	0.151
Housing insecurity not assessed	41.7 (38.0, 45.5)	−2.8 (−6.3, 0.8)	0.131
Up-to-date foot screening			
Documented: housing insecurity	13.5 (10.3, 16.6)	–	
Documented: no housing insecurity	12.3 (9.4, 15.1)	−1.2 (−2.3, −0.0)	**0.045**
Housing insecurity not assessed	12.5 (9.7,15.2)	−1.0 (−2.4, 0.4)	0.172
Up-to-date LDL screening			
Documented: housing insecurity	60.5 (57.7, 63.4)	–	
Documented: no housing insecurity	64.8 (62.3, 67.3)	4.3 (2.0, 6.5)	<**0.001**
Housing insecurity not assessed	59.6 (57.7, 61.6)	−0.9 (−3.2,1.4)	0.431
Active statin prescription[a]			
Documented: housing insecurity	72.6 (70.1, 75.0)	–	
Documented: no housing insecurity	74.7 (72.8, 76.6)	2.1 (−0.0, 4.2)	0.051
Housing insecurity not assessed	71.0 (69.5, 72.6)	−1.5 (−3.7, 0.7)	0.169
Diabetes control outcomes			
Controlled[b] HbA1c, (<9%)			
Documented: housing insecurity	76.0 (73.1, 78.8)	–	
Documented: no housing insecurity	78.0 (76.7, 79.4)	2.1 (−0.8, 5.0)	0.158
Housing insecurity not assessed	78.6 (77.9, 79.2)	2.6 (−0.2, 5.4)	0.072
Controlled blood pressure, (<140/90 mmHg)			

Variables	Predicted probability of diabetes outcomes		
	Estimated % (95% CI)	Difference (95% CI)	p-value
Documented: housing insecurity	74.2 (71.4, 76.9)	–	
Documented: no housing insecurity	73.2 (71.4, 74.9)	−1.0 (−3.8,1.7)	0.468
Housing insecurity not assessed	73.1 (72.1, 74.2)	−1.0 (−3.6,1.5)	0.428
Controlled[b] LDL, (<100 mg/dL)			
Documented: housing insecurity	56.3 (52.9, 59.7)	–	
Documented: no housing insecurity	59.8 (57.5, 62.1)	3.5 (−0.3, 7.3)	0.071
Housing insecurity not assessed	60.4 (59.3, 61.5)	4.1 (0.8, 7.5)	**0.016**
Visits in year following index, (rate)			
Documented: housing insecurity	5.4 (5.1, 5.7)	–	
Documented: no housing insecurity	5.0 (4.8, 5.2)	−0.4 (−0.6, −0.1)	**0.002**
Housing insecurity not assessed	4.4 (4.3, 4.6)	−1.0 (−1.2, −0.7)	<**0.001**

Note: Boldface indicates statistical significance ($p<0.05$).

Estimates were derived using general estimating equations logistic (binary outcomes) or negative binomial (rates outcome) regression and robust sandwich variance estimation for clustering of patients within clinics. For all analyses, regression adjustment was made for sex, race/ethnicity, preferred language, age and insurance status at index visit, first known federal poverty level, and yearly rate of primary care visits (except in estimating the rate outcome). *Index visit* is defined as the first ambulatory visit at least 1 year before their last visit in the electronic health record. Screenings are considered up-to-date if within 183 days after or up to 7 days before the index for HbA1c and 365 days after or up to 7 days before for all others.

[a]Active statin prescription outcome was evaluated in a subset of patients in whom a statin was indicated: patients not pregnant or breastfeeding and who have not been diagnosed with rhabdomyolysis, end-stage renal disease, or renal failure and who are either (1) aged 40−75 years or (2) aged >21 years with atherosclerotic cardiovascular disease or LDL ≥160 mg/dL (n=54,006).

[b]Controlled HbA1c and LDL outcomes were evaluated in the subsets of patients with up-to-date measures as defined earlier (HbA1c: n=53,669; LDL: n=46,204).

CHC, community health center; LDL, low-density lipoprotein; T2DM, type 2 diabetes mellitus.

Table 4.

Diabetes Care and Transportation Insecurity in Adult CHC Patients With T2DM in 2016–2020

Variables	Predicted probability of diabetes outcomes		
	Estimated % (95% CI)	Difference (95% CI)	*p*-value
Diabetes clinical care outcomes			
Up-to-date HbA1c screening			
Documented: transportation insecurity	72.9 (68.8, 76.9)	–	
Documented: no transportation insecurity	73.6 (70.3, 76.9)	0.7 (−2.4, 3.8)	0.639
Transportation insecurity not assessed	71.9 (69.8, 74.1)	−0.9 (−4.7, 2.8)	0.635
Up-to-date urine creatinine screening			
Documented: transportation insecurity	44.8 (39.6, 49.9)	–	
Documented: no transportation insecurity	46.3 (41.4, 51.2)	1.5 (−1.0, 4.0)	0.237
Transportation insecurity not assessed	41.7 (38.0, 45.5)	−3.1 (−6.7, 0.6)	0.104
Up-to-date foot screening			
Documented: transportation insecurity	12.3 (9.2,15.5)	–	
Documented: no transportation insecurity	12.6 (9.7, 15.6)	0.3 (−1.6, 2.2)	0.749
Transportation insecurity not assessed	12.5 (9.7,15.2)	0.1 (−1.5, 1.7)	0.883
Up-to-date LDL screening			
Documented: transportation insecurity	60.8 (57.8, 63.7)	–	
Documented: no transportation insecurity	64.8 (62.4, 67.1)	4.0 (2.0, 6.0)	<**0.001**
Transportation insecurity not assessed	59.7 (57.8, 61.6)	−1.0 (−3.5, 1.4)	0.402
Active statin prescription[a]			
Documented: transportation insecurity	72.8 (70.0, 75.6)	–	
Documented: no transportation insecurity	74.0 (72.0, 76.0)	1.2 (−1.7, 4.0)	0.414
Transportation insecurity not assessed	71.2 (69.7, 72.7)	−1.7 (−4.2, 0.8)	0.190
Diabetes control outcomes			
Controlled[b] HbA1c, (<9%)			
Documented: transportation insecurity	73.7 (71.1, 76.4)	–	
Documented: no transportation insecurity	78.5 (76.4, 80.5)	4.7 (1.5, 8.0)	**0.005**
Transportation insecurity not assessed	78.6 (77.9, 79.3)	4.9 (2.2, 7.5)	<**0.001**
Controlled blood pressure, (<140/90 mmHg)			

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Variables	Predicted probability of diabetes outcomes		
	Estimated % (95% CI)	Difference (95% CI)	*p*-value
Documented: transportation insecurity	71.8 (69.5, 74.1)	–	
Documented: no transportation insecurity	74.1 (72.4, 75.9)	2.4 (0.3, 4.4)	**0.025**
Transportation insecurity not assessed	73.1 (72.1, 74.2)	1.3 (−0.9, 3.6)	0.241
Controlled[b] LDL, (<100 mg/dL)			
Documented: transportation insecurity	56.7 (53.0, 60.4)	–	
Documented: no transportation insecurity	60.8 (58.8, 62.8)	4.1 (1.0, 7.2)	**0.009**
Transportation insecurity not assessed	60.3 (59.2, 61.4)	3.6 (0.2, 7.0)	**0.040**
Visits in year following index, (rate)			
Documented: transportation insecurity	5.5 (5.2, 5.8)	–	
Documented: no transportation insecurity	5.0 (4.8, 5.2)	−0.4 (−0.7, −0.2)	<**0.001**
Transportation insecurity not assessed	4.4 (4.3, 4.6)	−1.0 (−1.3, −0.8)	<**0.001**

Note: Boldface indicates statistical significance ($p<0.05$).

Estimates were derived using general estimating equations logistic (binary outcomes) or negative binomial (rates outcome) regression and robust sandwich variance estimation for clustering of patients within clinics. For all analyses, regression adjustment was made for sex, race/ethnicity, preferred language, age, and insurance status at the index visit, first known federal poverty level, and yearly rate of primary care visits (except in estimating the rate outcome). *Index visit* is defined as the first ambulatory visit at least 1 year before their last visit in the electronic health record. Screenings are considered up-to-date if within 183 days after or up to 7 days before the index for HbA1c and 365 days after or up to 7 days before for all others.

[a]Active statin prescription outcome was evaluated in a subset of patients in whom a statin was indicated: patients not pregnant or breastfeeding and who have not been diagnosed with rhabdomyolysis, end-stage renal disease, or renal failure and who are either (1) aged 40–75 years or (2) aged >21 years with atherosclerotic cardiovascular disease or LDL ≥160 mg/dL (n=54,006).

[b]Controlled HbA1c and LDL outcomes were evaluated in the subsets of patients with up-to-date measures as defined earlier (HbA1c: n=53,669; LDL: n=46,204).

CHC, community health center; LDL, low-density lipoprotein; T2DM, type 2 diabetes mellitus.