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Racial and Ethnic Disparities in Diabetes Complications in the Northeastern United States: The Role of Socioeconomic Status

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Abstract

The role of socioeconomic status (SES) in explaining racial/ethnic disparities in diabetes remains unclear. We investigated disparities in self-reported diabetes complications, and the role of macro (e.g., income, education) and micro (e.g., 'owning a home' or 'having a checking account') SES indicators in explaining these differences. The sample included individuals with a diagnosis of diabetes (N=795) who were on average 55 years old, and 55.6% non-Hispanic White, 25.0% African American, and 19.4% Hispanic. Approximately 8% reported nephropathy, 35% reported retinopathy, and 16% reported cardiovascular disease. There were significant disparities in the rates of complications among non-Hispanic White, African American and Hispanic participants, with Hispanics having the highest rates of nephropathy, retinopathy, and cardiovascular disease. Macro SES indicators (e.g., income) mediated *racial differences* (i.e., non-Hispanic Whites vs. African Americans) in self-reported retinopathy, a combination of macro and more micro SES indicators (e.g., education, income, and 'owning a home' or 'having a checking account') mediated *racial/ethnic differences* (i.e., non-Hispanic Whites vs. Hispanics) in self-reported cardiovascular disease, and only micro SES indicators (e.g., 'owning a home' or 'having a checking account') mediated differences between *lower income SES racial/ethnic minority groups* (i.e., African Americans vs. Hispanics) in self-reported retinopathy and cardiovascular disease. Findings underscore that indicators of SES must be sensitive to the outcome of interest and the racial/ethnic groups being compared.

Keywords

Minority Health; Disparities; Diabetes Complications; Socioeconomic Status

Research literature dating back to 1960's consistently reports racial and ethnic disparities in the prevalence of diabetes,[1] performance of diabetes-self-management behaviors,[2, 3],access to diabetes care,[4] the quality of diabetes care, [3, 5, 6] risk factors for diabetes-related complications,[7, 8] the presence of diabetes-related complications,[9, 10] and rates of diabetes-specific and all-cause mortality.[9-12] Multiple disciplines continue to search for underlying

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biological, psycho-social, and contextual explanations for racial and ethnic disparities for the purpose of developing interventions to effectively target these mechanisms and, in turn, reduce disparities in diabetes.[13, 14] Recently, it has been suggested that socioeconomic status (SES) is a stronger determinant of diabetes status and outcomes than race/ethnicity,[1, 15-17] and thus may be an underlying mechanism driving racial and ethnic disparities.[1, 17] The extent to which SES explains diabetes disparities is not well understood in part because the contribution of SES may vary by population and endpoint under investigation, and in part because of the suboptimal measurement of SES.

In the United States and many other countries, racial and ethnic minority groups are more likely than majority groups to have low incomes and less education. This poses the important question of whether widely accepted disparities in diabetes are really attributed to race/ethnicity (a non-modifiable factor) or SES (a potentially modifiable factor). The implication being, if SES, a commonly measured factor, were a better marker for other established risk factors in diabetes (e.g., body mass index [BMI],[18] diet,[19] physical activity,[20, 21] and hypertension[18, 22]), it could be easily assessed and used to target interventions. Further, it suggests that upstream efforts to reduce racial and ethnic socioeconomic inequalities may help attenuate racial and ethnic disparities in diabetes.

While the literature on racial and ethnic disparities in diabetes incidence is large, well characterized, and generally consistent, the literature on racial and ethnic disparities in long-term diabetes complications is not. Fewer studies have been conducted regarding complications of diabetes, and they generally suggest that the rates of diabetes complications vary by complication type and by racial and ethnic minority group.[23-25] Notwithstanding this variation, in general, racial and ethnic minorities with diabetes have higher rates of long-term complications relative to non-Hispanic Whites.[26] For example, rates of early and end-stage kidney disease (proteinuria) are 4 times higher among African Americans and 2.5 times higher among Hispanics compared to non-Hispanic Whites.[27, 28] Rates of retinopathy are 3 times higher among Hispanics and twice as high in African Americans compared to non-Hispanic Whites.[23, 29] Rates of diabetes-related blindness are only half as high for non-Hispanic Whites as they are for the rest of the population.[30, 31] Further, while there is no clear evidence for disparities in coronary artery disease (CAD) among individuals with diabetes, there are disparities in the *risk factors* for CAD, with Hispanics and African-Americans being more likely than non-Hispanic Whites to have hypertension[24] and worse glycemic control,[25, 32] and African Americans being more likely than non-Hispanic Whites to have deleterious lipid profiles.[33] Most data in this regard compare African American or Hispanic groups to a non-Hispanic White reference group, but very few compare these groups to each other. As a result, relatively little is known about disparities between African American and Hispanics with diabetes, which limits our ability to prioritize and target intervention efforts to those groups at the greatest risk for diabetes-related complications.

A major limitation of studies exploring SES as a mediator of racial and ethnic disparities in health is the overly simplified operationalization of socioeconomic status.[34] SES is often limited to crude indicators of income and education.[34, 35] Yet, studies of other health conditions suggest that the contribution of SES varies depending on the SES indicator, how the indicator is specified (i.e., variable levels), and by the type of health outcome under investigation.[36] SES is multidimensional and might best be operationalized with multiple indicators, combined according to the research question at hand.[34, 35] This is particularly relevant for research questions that go beyond non-Hispanic White-minority differences to address health disparities *among* minority populations.

Assessment of education, while seemingly straightforward, may be suboptimal as a single indicator of SES. Minority populations may be likely to share overall low levels of

education. Furthermore, equivalent educational attainment between minorities and non-Hispanic Whites in the US may not confer equivalent health benefits. This effect may be more pronounced for immigrant populations educated outside the mainland U.S. such as those of Hispanics heritage.

Assessment of income is also challenging. Minority populations may be more likely to rely on informal sources of financial support that are less regular and more difficult to quantify than work-related income. They may support and be supported by family members outside of the household and therefore have difficulty specifying 'household' size and income. They may also have seasonal patterns of employment that make reporting monthly income inapplicable. Therefore, examining the impact of SES on racial/ethnic health disparities may require the use of more sensitive and easily specified indicators of SES (e.g., measures of assets [e.g., home ownership], engagement with the financial system [e.g., having a checking account], financial stability [e.g., experiencing a sharp drop in income, worsening financial situation], and financial strain [e.g., having difficulty making ends meet, having difficulty paying bills][37]).

This study investigated racial and ethnic differences in self-reported diabetes complications, and the contribution of various indicators of SES in explaining observed differences, after controlling for demographic and diabetes characteristics. We sought to explore the usefulness of a range of SES indicators in explaining disparities between racial and ethnic minorities and non-Hispanic Whites, and between racial and ethnic minorities. We hypothesized that the crude SES indicators (e.g., income and education) may explain differences between non-Hispanic Whites and racial and ethnic minorities, but may not explain differences between minority groups.

Methods

Participants and procedures

Participants included a convenience sample of adults who self-reported a diagnosis of diabetes and were attending the 2002-2005 American Diabetes Association health fairs in the northeastern U.S. Investigators hosted a booth with educational material on diabetes and depression for all fair attendees, and a space for adult passersby with diabetes to participate in an anonymous on-site questionnaire. Trained research assistants administered the questionnaire, provided clarification and answered questions as needed, and compensated participants $5 for their time. A subsample of participants who reported depressive symptoms signed an informed consent form; other participants were not required to, as the remainder of the questionnaire was deemed innocuous by the investigators' institutional review board.

Measures

Race/ethnicity—Self-identified race/ethnicity was reported by respondents from the following options: "non-Hispanic White, European American," "Black, African American," "Latino, Hispanic," "Native American, American Indian," "Asian, Asian American, Pacific Islander," and "Mixed, from more than one group."

Socioeconomic status (SES) indicators—We selected eight SES indicators to measure different aspects of SES, including income, education, assets (home ownership), engagement with the financial system (having a checking account), financial stability (experiencing a sharp drop in income, worsening financial situation), and financial strain (having difficulty making ends meet, and having difficulty paying bills).[37] To measure macro SES indicators, participants were asked to estimate annual income before taxes (0 =

<10K, 1 = 10-20K, 2 = 21-40K, 3 = 41-60K, or 4 = >61K), and to report their highest educational attainment (1 = less than high school, 2 = high school, 3 = some college or vocational school, 4 = college degree, or 5 = graduate or professional school). To measure micro SES indicators, participants were asked: do you own your own dwelling? (0 = no, 1 = yes), do you have a checking account? (0 = no, 1 = yes), how hard is it to make ends meet? (1 = hard, 2 = not hard/not easy, or 3 = easy), have you ever experienced a sharp drop in income? (0 = no, 1 = yes), do you have difficulty paying bills? (0=no, 1 = yes), and how would you describe your financial situation? (0 = getting worse, 1 = staying the same, or 2 = getting better).

Diabetes complications—The survey asked in lay language about physician-diagnosed nephropathy (diabetes-related kidney problems), retinopathy (diabetes-related vision problems), or cardiovascular disease (heart disease), with 0 = no or 1 = yes as response options. These questions were based on the U.S. Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System questions for patient report of physician diagnosis of disorders such as hypercholesterolemia[38] and arthritis.[39]

Covariates—We controlled for demographic characteristics, including age as a continuous variable, and sex and insurance status as dichotomous variables. While insurance status is often associated with race/ethnicity,[4] health outcomes,[40, 41] and SES,[42] traditionally defined by education and income,[1, 34, 35, 43] it does not fully explain racial/ethnic disparities in health.[40, 41, 44] Furthermore, our sample showed overall high levels of insurance status (90.7%). For these reasons, we treated insurance status as a covariate in our analyses.

We also controlled for diabetes characteristics, including years since a diagnosis of diabetes and BMI kg/m^2 as continuous variables, and diabetes type and insulin use as dichotomous variables. Self-reported height and weight were used to calculate BMI kg/m^2. A point-of-care device assessed glycemic control (HbA1c).

Analyses

The numbers of “Native Americans, American Indians,” “Asians, Asian Americans, Pacific Islanders,” and “Mixed, from more than one group” in the sample were too few to analyze as distinct groups, and there is no theoretical justification for combining them into an “Other” category. We therefore restricted the analyses to “non-Hispanic Whites, European Americans,” “Blacks, African Americans,” and “Latinos, Hispanics.” Data were analyzed using means, frequencies, and cross tabulations to calculate descriptive statistics. Chi-square tests for categorical variables and the the Kruskal-Wallis non-parametric test for continuous variables tested race/ethnicity differences by demographic characteristics, SES indicators, and diabetes characteristics. Chi-square tests also tested the bivariate relationship between each SES indicator and self-reported nephropathy, retinopathy, and cardiovascular disease.

At least a dozen methods for testing hypotheses about mediation have been proposed.[45] Of these approaches, bootstrapping[45, 46] is the currently recommended approach [47] because it does not require a significant effect of the predictor on the outcome for mediation to occur; it has more power, maintains reasonable control over the Type 1 error rate; and, for multiple meditator models, it provides the most powerful and reasonable methods of obtaining confidence limits for specific indirect effects (i.e., mediators) – in particular, bias corrected (BC) and accelerated (BCa) bootstrapping.[48] Thus, we conducted a series of indirect effect tests with BCa bootstrap (5000 cases) estimation to examine whether race/ethnicity had an indirect effect on the likelihood of reporting nephropathy, retinopathy, or cardiovascular disease via each SES indicator adjusted for every other SES indicator and all other

covariates. All analyses were performed using SPSS version 19.0. A 2-sided *P* value of less than .05 was considered statistically significant.

Results

Sample

The sample of 795 adults with diabetes was predominately female (64.7%), middle-aged (M = 55.2 years SD ± 13.3), diagnosed with type 2 diabetes (80.9%) for an average M = 10.4 years (SD ± 10.5), insured (90.7%), and not taking insulin (63.2%). The sample included 55.6% " non-Hispanic Whites, European Americans," 25.0% "Blacks, African Americans," and 19.4%"Latinos, Hispanics." Approximately 28% of the sample reported an annual income of <20K and 12% reported less than a high school education, but 65% reported at least some college. The average BMI was M = 31.6 kg/m^2 (SD ± 7.2) and the average HbA1c was M = 7.3 (SD ± 1.7). Approximately 8% of the sample reported physician-diagnosed nephropathy, 35% reported retinopathy, and 16% reported cardiovascular disease. Sample characteristics and racial and ethnic differences by demographic characteristics, SES indicators, and diabetes characteristics can be found in Table 1.

Bivariate relationships

There were significant racial and ethnic differences on six of the eight SES indicators (all tests, p<.001). Overall, Whites reported higher incomes, more education, and were more likely to report 'owning a home', 'having a checking account', and 'having difficulty making ends meet', and were less likely to report 'difficulty paying bills' than both African Americans and Hispanics. African Americans reported higher incomes, more education, were more likely to report 'owning a home' and 'having a checking account', and were less likely to report 'difficulty paying bills' compared to Hispanics. However, African Americans were more likely than Hispanics to report 'having difficulty making ends meet' and 'ever experiencing a sharp drop in income'.

Of the six SES indicators significantly associated with race/ethnicity, four (i.e., education, income, 'owning a home', and 'having a checking account') were also associated with at least one observed diabetes complication. Participants with lower incomes were more likely than participants with higher incomes to report having nephropathy (p<.01), retinopathy (p<.001), and cardiovascular disease (p<.001). Participants with less education were more likely than participants with more education to report having nephropathy (p<.001) and retinopathy (p<.001). Participants who 'did not own a home' were more likely than participants who 'owned a home' to report having nephropathy (p<.01) and retinopathy (p<.001). Participants who 'did not have a checking account' were more likely than participants who 'had a checking account' to report having nephropathy, retinopathy, and cardiovascular disease (all tests, p<.001). 'Ever experiencing a sharp drop in income' or 'having difficulty paying bills' were not associated with any of the observed complications. Only the four SES indicators that were associated with both race/ethnicity and at least one observed diabetes complication were included in our bootstrap analyses.

Tests of mediation

Table 2 presents the indirect effects of each race/ethnicity comparison on each complication via the combined set of four SES indicators (total) and each individual indicator (education, income, 'owning a home', 'having a checking account') adjusted for age, sex, insurance status, BMI, diabetes type, diabetes duration, and insulin use.

Nephropathy—While African Americans were as likely as non-Hispanic Whites to report having nephropathy (total effect = 0.30, p=.63), Hispanics were more likely than African

Americans and non-Hispanic Whites to report having nephropathy (total effect = 1.42, p=.03, and total effect = 1.77, p<.001, respectively). These differences became non-significant when adjusted for the four SES indicators (direct effect of Hispanic vs. African American race/ethnicity = 0.87, p=.29 and direct effect of Hispanic vs. non-Hispanic White race/ethnicity = 0.85, p=.24, respectively). However, the degree of difference between Hispanic and African American participants or Hispanic and non-Hispanic White participants on reporting nephropathy was neither explained by racial/ethnic differences on the combined set of SES indicators (total indirect effect = 0.43, 95% BCa bootstrap CI of -0.86 to 2.17 and total indirect effect = 0.84, 95% BCa bootstrap CI of -0.18 to 2.02) nor by racial/ethnic differences on any one SES indicator (i.e., education, income, 'owning a home' or 'having a checking account').

Retinopathy—Hispanics were significantly more likely than African Americans to report having retinopathy (total effect = 0.90, p=.02), and this difference became non-significant when adjusted for the four SES indicators (direct effect = 0.53, p=.25). The degree of difference between Hispanics and African Americans on having retinopathy was not explained by Hispanic and African American differences on the combined set of SES indicators (total indirect effect = 0.51, 95% BCa bootstrap CI of −0.06 to 1.13), but was explained by Hispanic and African American differences on 'owning a home' (indirect effect = 0.25, 95% BCa bootstrap CI of 0.02 to 0.60) and 'having a checking account' (indirect effect = 0.36, 95% BCa bootstrap CI of 0.00 to 0.83).

Hispanics were also significantly more likely than non-Hispanic Whites to report having retinopathy (total effect =1.52, p<.001), and this difference remained significant when adjusted for the four SES indicators (direct effect = 1.10, p<.01). Furthermore, the degree of difference between Hispanic and non-Hispanic White participants on having retinopathy was neither explained by Hispanic and White differences on the combined set of SES indicators (total indirect effect = 0.46, 95% BCa bootstrap CI of −0.18 to 1.05) nor by any one SES indicator.

African Americans were as likely as non-Hispanic Whites to report having retinopathy at the P <.05 cutoff, but would have been more likely than non-Hispanic Whites to report having retinopathy at the 0.10 cutoff (total effect = 0.59, p=.06), becoming non-significant at the that level when adjusted for the four SES indicators (direct effect = 0.45, p=.18). While the degree of difference between African Americans and non-Hispanic Whites on having retinopathy was not explained by African American and non-Hispanic White differences on the combined set of SES indicators (total indirect effect = 0.14, 95% BCa bootstrap CI of -0.10 to 0.44), it was explained by African American and non-Hispanic White differences on income (indirect effect = 0.16, 95% BCa bootstrap CI of 0.02 to 0.39).

Cardiovascular disease—Hispanics and African Americans did not differ on reporting cardiovascular disease (total effect = −0.37, p=.37). The degree of difference between Hispanics and African Americans on having cardiovascular disease, even if not significant, was not explained by Hispanic and African American differences on the combined set of SES indicators (total indirect effect = 0.30, 95% BCa bootstrap CI of −0.38 to1.13), but was explained by Hispanic and African American differences on 'having a checking account' (indirect effect = 0.69, 95% BCa bootstrap CI of 0.13 to 1.34).

Hispanics were significantly more likely than non-Hispanic Whites to report having cardiovascular disease (total effect = 0.93, p=.02), and this effect became non-significant when adjusted for the four SES indicators (direct effect = −0.34, p=0.58). The degree of difference between Hispanics and non-Hispanic Whites on having cardiovascular disease was explained by Hispanic and non-Hispanic White differences on the combined set of SES

indicators (total indirect effect = 1.08 and a 95% BCa bootstrap CI of 0.12 – 1.88), but not by Hispanic and non-Hispanic White differences on any 1 SES indicator.

African Americans were significantly more likely than non-Hispanic Whites to report having cardiovascular disease (total effect = 1.31, p<.001), and this difference remained significant when adjusted for the four 4 SES indicators (direct effect = 1.10, p<.01). The degree of difference between African Americans and non-Hispanic Whites on having cardiovascular disease was neither explained by African American and non-Hispanic White differences on the combined set of SES indicators (total indirect effect = 0.17 and a 95% BCa bootstrap CI of -0.04 to 0.46) nor by African American and non-Hispanic White differences on any 1 SES indicator.

Discussion

The main findings of this study are that: (1) disparities in self-reported diabetes complications exist among Hispanics, African Americans and non-Hispanic Whites even after controlling for numerous demographic and diabetes characteristics; (2) SES indicators help to explain, and in some cases account for, some disparities in diabetes complications; (3) various indicators of SES differentially mediate the relationships between race/ethnicity and diabetes complications. Specifically, where SES did mediate, macro SES indicators (e.g., income) mediated *racial differences* (i.e., non-Hispanic Whites vs. African Americans) in self-reported retinopathy, a combination of macro and more micro SES indicators (e.g., education, income, and 'owning a home' or 'having a checking account') mediated *racial/ethnic differences* (i.e., non-Hispanic Whites vs. Hispanics) in self-reported cardiovascular disease, and only micro SES indicators (e.g., 'owning a home' or 'having a checking account') mediated differences between *lower SES racial/ethnic minority groups* (i.e., African Americans vs. Hispanics) in self-reported retinopathy and cardiovascular disease.

Hispanics were more likely to report having nephropathy and retinopathy than African Americans or non-Hispanic Whites, and were more likely to report having cardiovascular disease than non-Hispanic Whites. The overall worse profile for Hispanics is consistent with recent evidence[49, 50] that challenges the 'Hispanic paradox', which a decade or so ago posited that Hispanics in the U.S. had comparable or better health outcomes than non-Hispanic Whites, despite what their socioeconomic situations would predict. Contributing to that literature is our finding that Hispanics had higher rates of self-reported complications as well as the lowest incomes, least amount of education, were least likely to own a home or have a checking account, and had the most difficulty paying bills compared to non-Hispanic Whites *and* African Americans. Interestingly, Hispanics were the least likely to report having a hard time 'making ends meet'. Other work has shown that Hispanics may have social networks that can provide resources to buffer the deleterious effects of financial deprivation.[51]

In this study, the Hispanic-non-Hispanic White difference in having cardiovascular disease was mediated by the combined set of SES factors including education, income, 'owning a home' and 'having a checking account'. As predicted, macro SES indicators (i.e., income and education) were useful in explaining Hispanic- non-Hispanic White differences in health. On the other hand, Hispanic-African American differences in having retinopathy were mediated only by 'owning a home' or 'having a checking account, and Hispanic-African American differences in having cardiovascular disease were solely mediated by 'having a checking account'. Education may not be sensitive among lower-SES minority groups, given that attendance at schools in poor neighborhoods may not confer the same educational experiences and benefits as educational attainment at schools in higher SES environments. Similarly, income may not be sensitive among populations with overall low

levels of financial resources. SES indicators that are more sensitive, discrete and easily specified such as ‘owning a home’ or ‘having a checking account’, may be required to detect socioeconomic influences in such populations. In addition, ‘owning a home’ or ‘having a checking account’ may be particularly useful when assessing the SES of Hispanic groups because these factors may be affected by immigration status and acculturation.

‘Having difficulty making ends meet’, ‘having difficulty paying bills’, ‘ever experiencing a sharp drop in income, or ‘perceiving one's financial situation as getting worse, staying the same, or getting better’ were not related to the observed diabetes complications. Temporally distal indicators of SES that do not capture recency and duration of one's SES, and/or indicators of SES that reflect one's attitude toward finances rather than finances per se, may not be the most sensitive measures of SES, particularly when assessing differences between lower-SES, racial/ethnic minority groups.

Taken together, these findings underscore that indicators of SES must be sensitive to the SES milieu of particular respondents. That is, measures must be specific to the outcome of interest, the racial and ethnic groups being compared, and the analytic approach used to untangle observed differences. Until it can be clearly established which indicators of SES are important for specific populations or health outcomes, we recommend a comprehensive approach to SES assessment that goes beyond the standard use of income and education. We also suggest that ‘owning a home’ or ‘having a checking account’ are promising indicators that should be validated in future studies.

Limitations of this study include a relatively smaller number of “Hispanic” participants; the inability to differentiate between Hispanic subgroups or represent other ethnic-minority groups; a recruitment strategy that may have yielded a non-representative sample of adults who attend health fairs, limiting generalizability to the general population; and self-reported measures of SES, diabetes characteristics (e.g., diabetes type, duration, insulin use), and diabetes-related complications. Also, we found similar rates of nephropathy for African Americans and non-Hispanic Whites, a finding that is inconsistent with published data and likely reflects the limits of self-reported medical diagnoses. Finally, we did not account for the variety of system-level, provider-level, and patient-level factors (e.g., access to care, therapeutic inertia, patient education, and medication adherence) that may impact the association between race/ethnicity and diabetes-related complications. The major strengths of this study include a diverse sample of non-Hispanic White, African American, and Hispanic participants who were recruited from the community rather than a clinical setting, the use of multiple measures of SES, and careful control of demographic and diabetes characteristics.

Conclusions

Consistent with recent literature,[1] continuing to focus on racial and ethnic status as the primary determinant of disparities in diabetes-related outcomes diverts effort from socio-medical interventions such as improving social circumstances, access to effective care, and upstream social policies that increase equity. Research to further this agenda must adequately measure socio-economic determinants of health.

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Table 1

Sample Characteristics and Racial and Ethnic Differences by Demographics, Socioeconomic Status, and Diabetes Status.

Variables	Total	White n (%)	Black (n) %	Hispanic (n) %	P-value
N	795	442 (55.6)	199 (25.0)	154 (19.4)	
DEMOGRAPHIC CHARACTERISTICS					
Age, Mean years ± SD	55.2 ± 13.3	55.0 ± 13.6	55.2 ± 12.9	55.8 ± 12.8	0.94
Sex					
Female	514 (64.7)	271 (61.3)	146 (73.7)	97 (63.0)	<0.01
Health Insurance Status					
Insured	711 (90.7)	412 (94.1)	179 (90.9)	120 (80.5)	<0.001
SES INDICATORS					
Education					
Less than high school	97 (12.4)	12 (2.8)	18 (9.2)	67 (44.1)	<0.001
High school	177 (22.6)	97 (22.2)	48 (24.6)	32 (21.1)	
Some college or Votech	259 (33.1)	157 (36.0)	68 (34.9)	34 (22.4)	
College degree	126 (16.1)	83 (19.0)	33 (16.9)	10 (6.6)	
Graduate or professional school	124 (15.8)	87 (20.0)	28 (14.4)	9 (5.9)	
Annual income before taxes					
< 10,000	72 (10.0)	32 (7.9)	28 (16.0)	12 (8.7)	<0.001
10,000-20,000	133 (18.5)	49 (12.1)	24 (13.7)	60 (43.5)	
21,000-40,000	200 (27.9)	107 (26.4)	58 (33.1)	35 (25.4)	
41,000-60,000	159 (22.1)	102 (25.2)	37 (21.1)	20 (14.5)	
> 61,000	154 (21.4)	115 (28.4)	28 (16.0)	11 (8.0)	
Do you own your own dwelling?					
Yes	471 (60.5)	325 (73.9)	109 (56.8)	37 (25.3)	<0.001
Do you have a checking account?					
Yes	455 (83.2)	308 (97.5)	97 (88.2)	50 (41.3)	<0.001
How hard is it to make ends meet?					
Hard	106 (20.0)	81 (26.3)	17 (15.6)	8 (7.0)	<0.001
Not hard or not easy	231 (43.5)	143 (46.4)	48 (44.0)	40 (35.1)	
Easy	194 (36.5)	84 (27.3)	44 (40.4)	66 (57.9)	
Have you ever experienced a sharp drop in income?					

Variables	Total	White n (%)	Black (n) %	Hispanic (n) %	P-value
Yes	274 (51.4)	161 (51.8)	63 (57.8)	50 (44.2)	0.13
Do you have difficulty paying bills?					
Yes	192 (36.4)	85 (27.7)	41 (38.3)	66 (57.9)	<0.001
How would you describe your financial situation?					
Getting worse	100 (22.1)	65 (20.9)	26 (23.4)	9 (29.0)	0.54
Staying the same	225 (49.7)	156 (50.2)	52 (46.8)	17 (54.8)	
Getting better	128 (28.3)	90 (28.9)	33 (29.7)	5 (16.1)	
DIABETES CHARACTERISTICS					
BMI kg/m^2, Mean ± SD	31.6 ± 7.2	31.8 ± 7.7	31.8 ± 7.3	30.7 ± 5.6	0.61
Diabetes Type					
Type 2	641 (80.9)	329 (74.4)	172 (86.9)	140 (92.1)	<0.001
How long have you had diabetes? Mean years ± SD	10.4 ± 10.5	10.9 ± 11.0	9.9 ± 10.5	9.2 ± 8.9	0.19
Insulin Use					
Yes	292 (36.8)	187 (42.3)	61 (30.7)	44 (28.8)	<0.001
HbA1c, Mean ± SD	7.3 ± 1.7	6.5 ± 1.0	7.7 ± 1.8	6.7 ± 0.8	< 0.01

Note. SD = standard deviation, SES = socioeconomic status, BMI = body mass index. Chi-square tests for categorical variables and the Kruskal-Wallis non-parametric test for continuous variables.

Table 2

Indirect Effects of Race/Ethnicity on Diabetes Complications via Socioeconomic Status Indicators.

	Diabetes Complications		
	Nephropathy	**Retinopathy**	**Cardiovascular disease**
	Point Estimate (95% BCa bootstrap CI)		
RACE/ETHNICITY			
Hispanic vs. African American			
SES INDICATORS			
Total	0.43 (−0.86, 2.17)	0.51 (−0.06, 1.14)	0.30 (−0.38, 1.13)
Education	−0.45 (−1.37, 0.84)	−0.24 (−0.81, 0.28)	−0.43 (−1.14, 0.41)
Annual income before taxes	0.24 (−0.30, 0.84)	0.14 (−0.05, 0.49)	0.03 (−0.27, 0.35)
Do you own your own dwelling?	0.21 (−0.29, 2.95)	0.25 (0.02, 0.60)‡	0.02 (−0.29, 0.30)
Do you have a checking account?	0.43 (−0.63, 1.27)	0.36 (0.00, 0.83)‡	0.69 (0.13, 1.34)‡
RACE/ETHNICITY			
Hispanic vs. non-Hispanic White			
SES INDICATORS			
Total	0.84 (−0.18, 2.02)	0.46 (−0.18, 1.05)	1.08 (0.12, 1.88)‡
Education	−0.27 (−0.99, 0.61)	−0.21 (−0.68, 0.22)	−0.08 (−0.66, 0.51)
Income	−0.07 (−0.60, 0.39)	0.14 (−0.13, 0.45)	0.08 (−0.37, 0.47)
‘Owning a home’	0.43 (−0.16, 1.10)	0.27 (−0.06, 0.61)	0.45 (−0.09, 0.91)
‘Having a checking account’	0.74 (−0.07, 1.54)	0.26 (−0.25, 0.77)	0.63 (−0.05, 1.32)
RACE/ETHNICITY			
non-Hispanic White vs. African American			
SES INDICATORS			
Total	0.01 (−1.47, 1.98)	0.14 (−0.10, 0.44)	0.17 (−0.04, 0.46)
Education	−0.11 (−0.49, 0.03)	−0.06 (−0.24, 0.01)	−0.01 (−0.17, 0.04)
Income	0.05 (−0.15, 0.40)	0.16 (0.02, 0.39)‡	0.05 (−0.06, 0.25)
‘Owning a home’	0.01 (−0.25, 0.31)	−0.09 (−0.27, 0.01)	0.01 (−0.15, 0.19)
‘Having a checking account’	0.06 (−1.72, 1.80)	0.12 (−0.02, 0.36)	0.12 (−0.03, 0.40)

Note. SES = socioeconomic status, Total = all SES indicators combined, BCa = bias corrected and accelerated, CI = confidence interval; 5,000 bootstrap samples. All point estimates are adjusted for age, sex, insurance status, BMI, diabetes type, diabetes duration, and insulin use.

‡statistically significant.