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Self-rated health and glycemic control in type 2 diabetes: Race by gender differences

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Abstract

Background—Although some studies have shown a link between self-rated health (SRH) and glycemic control in type 2 diabetes (DM), other studies have failed to support this association. The purpose of this study was to determine whether these equivocal findings can be explained by specific interactions between gender, race, and SRH, as suggested by the *intersectionality* literature.

Methods—This cross-sectional study included 287 patients with DM (85 Black men, 78 Black women, 64 White men, and 60 White women). After adjusting for demographic and medical factors, we regressed HbA1c on SRH with and without interactions between gender, race, and SRH. We conducted additional subgroup analyses to further characterize gender by race group differences.

Results—Although there was no main effect of SRH upon HbA1c ($b=.16$, 95% CI: .08 – .39), we found a significant interaction between gender and SRH on HbA1c ($b=-.50$, 95% CI: -.97 – -.03).

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Conflict of Interest: Shervin Assari, Maryam Moghani Lankarani, John D. Piette, and James E. Aikens declare that they have no conflict of interest.

Ethics:

Consent and IRB Approval: All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. University of Michigan IRB approved the study. All participants provided written informed consent.

In race by gender stratified models, SRH ($b=.53$, 95% CI:.00–1.07) was associated with HbA1c in Black men. SRH was not associated with HbA1c in White men, White women, or Black women.

Conclusion—Combined race and gender differences may exist in the link between SRH and glycemic control in DM. Specifically, Black men with DM may be more attuned to the relationship between their overall health and their glycemic control.

Keywords

Population differences; ethnic groups; race; gender; self-rated health; glycemic control; diabetes

Introduction

Across numerous chronic conditions, patients' global self-rated health (SRH) predicts future morbidity and mortality (1–4). For example, DeSalvo's meta-analysis concluded that poor SRH is independently associated with a 2-fold increase in mortality risk as compared with individuals with excellent SRH, even after accounting for functional status, mental health, and chronic disease burden (4). In the general population, poor SRH also predicts DM risk (5), and among DM patients, SRH independently predicts DM complications (6) and mortality (7).

As a result of such findings, SRH has become an accepted clinical endpoint in DM research and practice (8,9). However, findings are quite mixed as to whether poor SRH is correlated with poor glycemic control or not (10–14). While some studies have indicated greater hemoglobin A1c (HbA1c) levels among patients with poor SRH (6), others have reported this association as either weak (10,11) or absent (12–14).

There are many reasons to suspect that the weak relationship between SRH and glycemic control can be due to the heterogeneity of this association across demographic sub-populations. Health appraisal involves a series of complex processes of adaptation and personal identity (15). Evaluation of one's SRH is strongly influenced by factors such as race, gender, culture, and class (16). For Black men, health appraisal may be especially based upon functional status and overall feeling rather than physiologic indicators of health status such as HbA1c or blood pressure (16). Health is appraised by comparisons with other people in one's social network and age group (15,17–18). Because social networks vary in size and quality across race and gender groups, these differences may also shape the interpretation of health in the context of chronic disease (19,20). Finally, there is considerable variation across race and gender in cultural discourses (i.e. effects of culture on communication styles) and individual experiences, which in turn shape individuals' interpretation of their own health status (21–24). Cultural discourses also shape cognitive and mental models (i.e. effects of culture on thinking styles) that are involved in all evaluations including appraisal of one's health (25–27). All these complexities suggest that variation may exist in what SRH reflects across groups (28).

For Black people living with chronic illness, evaluative processes may replace undesirable with desired health perceptions, so they may report good SRH despite social and medical adversities (16). For example, a considerable proportion of Black elders may appraise their

health using inclusive, holistic rationales, which may lead to an overly optimistic appraisal of their health status relative to *objective* biomedical indicators (16). It is generally believed that for many Blacks, appraisal of health is beyond symptoms, biologic measures, and functional abilities and may be shaped by resilience, gratitude, and spirituality (16,29). Gender also plays a role, with some data suggesting that women underestimate their health status relative to objective indicators (30,31). Additionally, according to the *Sponge Hypothesis*, women's SRH is more likely to be influenced by their affect than men's (30,31).

Consistent with these theories, a growing literature on chronic conditions demonstrates that the predictive validity of SRH with respect to objective health outcomes depends on race (32–36), gender (37–40) and their intersection. Among patients with DM, however, very little is known about potential variation in the relationship between SHR and glycemic control, the primary indicator of their risk for microvascular complications and the main metric used to measure diabetes severity (40,41). In this study, we investigated race by gender variation in the association between SRH and glycemic control among patients with DM type 2.

Methods

Design and setting

The data for this cross-sectional analysis were taken from the baseline of a longitudinal epidemiological study that was aimed at elucidating the contribution of psychosocial factors to racial disparities in DM outcomes. Briefly, the parent study recruited 287 patients with type 2 diabetes. This sample was stratified such that approximately half of the participants self-identified as non-Hispanic Caucasian/White and the other half self-identified as African-American/Black (42,43). Participants' glycemia and depressive symptoms were assessed at baseline as well as 6 and 12 months later.

Participants and sampling

The parent study identified eligible patients from the administrative and clinical databases of an urban health care system located in a large Midwestern US city and composed of tertiary health care settings and sub-specialty clinics. Due to the structure of the health care system involved, 100% of the participants were covered by the same private health insurer.

In order to participate, patients needed to: 1) be between 18 and 80 years of age, 2) be able to complete self-report instruments, 3) have a recorded diagnosis of type 2 DM, and 4) self-identify as either non-Hispanic Caucasian/White or African-American/Black. Diagnosis of DM was based on at least one of the following criteria: 1) positive history of hospitalization with a DM-related ICD-9 code (250.x, 357.2, 362.0, or 366.41), 2) two or more outpatient visits with a DM-related ICD-9 code, or 3) prescription for a glucose control medication or monitoring supplies. The study excluded individuals with type 1 DM through chart review and telephone screening conducted by research staff.

Ethics

The study protocol was approved by the Institutional Review Board at the University of Michigan Medical School. All participants provided written informed consent.

Enrollment

Eligible patients were mailed a study invitation letter followed by a recruitment telephone call from research staff for further screening and enrollment scheduling.

Assessments

Data collection was conducted at baseline on demographic factors, glycemic control, and other variables.

Demographic factors.—The study collected data on self-reported age and gender. Age was treated as a continuous measure, and gender was female versus male [reference category].

Self-identified race and ethnicity.—Participants were asked to classify themselves using U.S. Census racial/ethnic categories, and the study included only those who self-classified as either non-Hispanic White (Caucasian) or non-Hispanic Black (African American). For data analyses, we created indicators for race by gender subgroups of White men, White women, Black men, and Black women.

Socioeconomic status (SES).—SES was measured using the U.S. Census Bureau Index of Socioeconomic Status (44), adjusted for the regional Consumer Price Index (42,43).

Self-rated health.—Respondents were asked to classify their self-rated health as 1) excellent, 2) very good, 3) good, 4) fair, or 5) poor. This single item measure has been widely used (45–47). Treated as a continuous measure, SRH was coded from 1 (excellent) to 5 (poor), with higher scores indicating worse SRH.

Primary outcome.—At the time of the survey, research assistants analyzed capillary blood samples through a monoclonal antibody method to measure glycemic control (HbA1c), using the DCA 2000 (GMI, Ramsey, MN) instrument (42,43).

Statistical analysis

The data were analyzed using both Statistical Package for Social Sciences v.20 (SPSS 20, IBM Corporation NY, US) and Stata 13.0 (Stata Corp., College Station, TX, US). Mean (SD) and frequency (%) were calculated to describe the sample. We evaluated bivariate associations using Pearson's r , and used linear regression models to estimate the association between SRH and HbA1c after adjusting for demographics, SES, and DM duration. Regression models were then fit with HbA1c as the dependent variable. In the first model, HbA1c was regressed on patient race, gender, and SHR (all treated as main effects). In the next *models*, all main effects were included as well as all possible 2-way interactions between race, gender, and SRH. In the next model, we also included a 3-way interaction term (i.e., an indicator for Black women with poor SHR). Finally, we examined the

relationship between SHR and HbA1c within race by gender subgroups. For each parameter of interest, we calculated unstandardized beta and 95% CI. We evaluated the statistical significance of p -values against a criterion of $< .05$.

RESULTS

The sample of 287 patients included 78 Black females, 85 Black males, 60 White females, and 64 White males. Descriptive statistics are presented in Table 1. As this table shows, mean HbA1c was highest for Black men, while SRH was poorest for Black women.

Bivariate associations between all the study variables are presented in Table 2. Age was negatively correlated with HbA1c in the overall sample, as well as White and Black men. HbA1c was not correlated with SES or diabetes duration in the overall sample or any of the race by gender groups. Finally, there were no significant unadjusted associations between SRH and HbA1c in the overall sample or any of the race by gender subsamples.

Regression analysis results are provided in Table 3. In Model 1, which included main effects only, SRH was not significantly associated with HbA1c in the pooled sample ($b = .16$, 95% CI: $.08 - .39$, $p = .184$). In Model 2, which included interaction terms, there was a significant 2-way interaction between poor SRH and male gender as a predictor of HbA1c ($b = -.50$, 95% CI: $-.97 - .03$, $p = .003$). The 3-way interaction was not significant.

The results of the race by gender stratified regression analyses are shown in Table 4. As predicted, SRH was associated with HbA1c among Black men ($b = .53$, 95% CI: $.00 - 1.07$, $p = .050$), but not White men, White women, and Black women. That suggests among Black men, those with poorer SRH had poorer glycemic control.

DISCUSSION

Based on the intersectionality framework and prior literature on chronic conditions outside of DM, we hypothesized that the association between SRH and glycemic control in type 2 DM varies across specific combinations of race and gender. Specifically, we expected that SRH would relate to glycemic control among Whites but not Blacks. Although we did not detect a significant 3-way interaction between SRH, race and gender, we found a significant interaction between SRH and gender, suggesting that the association between SRH and glycemic control is weaker in women than men. In addition, the results of stratified analyses showed race by gender difference in the association between SRH and glycemic control, with a positive association only among Black men.

Our findings are consistent with the intersectionality framework, which advocates for simultaneous consideration of multiple categories of identity, difference, and disadvantage (48). While other social constructs such as class, sexual identity, and location also have roles (49), the intersection of race and gender has been frequently shown alter mechanisms behind health and illness (50–53). This finding may also help explain the documented link between SRH and mortality of patients with DM (7), at least for Black men. Finally, this finding may also help explain why poor SRH predicts a wide range of DM complications (6), again at least for Black men.

In light of the findings, and consistent with assertions from other investigators (8,9), we argue that – especially for Black men – clinicians and researchers who are assessing diabetes outcomes should also consider SRH. As noted above, the literature is quite mixed on whether SRH generally explains glycemic control when DM patients are pooled across race and gender categories (6,10–14). That is, only some (6,10,11) not all (12–14) studies have found a link between poor SRH and high HbA1c levels. Our findings suggest that at least some of these equivocal results may be due to the heterogeneity of what SRH reflects across social and demographic sub-populations.

Our findings bolster the general conclusion that social, ethnic, and cultural factors shape individuals' health self-appraisals (28). As a result, SRH does not have a universal meaning across social, racial, ethnic, and cultural groups (28). In fact, several lines of research suggest that Blacks and Whites may differ in key adaptation and identity processes that are involved in health appraisal. Particularly among Black people, SRH is incongruent with their social and medical adversities (16). Research has also shown that SRH predicts mortality of Whites but not Blacks (35,36,41).

Our finding that Black men's health perceptions better reflect their physiologic indicators was unexpected. The literature suggests that Black individuals' health perception is shaped by within group comparison, which reduces their health expectations. Compared to other racial and ethnic groups, Blacks' health appraisals seem more related to overall feeling and independent functioning rather than the absence of medically defined illnesses (16). Additionally, a tendency towards higher religiosity may lead Blacks to report good SRH despite serious chronic conditions (16,29) due to a sense of gratefulness for their present functional status (51). Self-comparison to members of one's social network may also underlie racial differences in SRH (15,17,18). For example, some research suggests that Blacks' social networks include more individuals with poor health than Whites' social networks do, which could create an optimistic bias in Blacks' health ratings (19,20). Race also affects cultural discourse and mental models (21–23) by shaping values, meanings, and life experiences. Historical life and lived experiences of a racial/ethnic group shape cognitive and emotional processes that are involved in health appraisals (25–27).

Gender also significantly affects how individuals evaluate their overall health (16,30,32,37–39). Compared to men, women are more likely to underestimate their health status, resulting in a weaker overlap between SRH and objective outcomes (40). The Sponge Hypothesis attributes this variation to the stronger influence of affect on health appraisals of women (38). Although gender differences in health appraisal are likely to vary across races (40,41,52), the literature on the combined effects of race and gender on SRH is underdeveloped. In fact, to our knowledge this hypothesis has not been formally evaluated in DM.

There is a need to study whether health literacy, access to care, or health behaviors explain any of the heterogeneities in the association between SRH and glycemic control. One possible hypothesis is that health literacy may moderate the correlation between SRH and glycemic control. Evaluation of SRH as good in the presence of poor glycemic control may have negative consequences. Research should also explore factors that predict incongruence

between subjective and objective health measures, and best modalities to promote health behaviors of individuals who over-estimate their health.

The results should be interpreted with certain limitations in mind. First, we cannot draw causal inferences, given the cross-sectional nature of the research design. Second, the sample sizes were somewhat imbalanced across the race by gender subgroups, which could result in differential statistical power in our stratified analyses. Low sample size may be why our 3-way interaction was not statistically significant. So our results are only suggestive and need replication in a larger number of patients. Third, the sample was recruited within a single healthcare system, thus the results are not generalizable to all patients with DM. Fourth, the analysis did not consider factors such as mental health, physical activity, access to health care, or medication dose. Despite these limitations, current study extends the existing literature on the link between SRH and glycemic control across diverse patients with DM.

To conclude, SRH reflects glycemic control for some but not all demographic groups of patients with DM. To be more specific, poor SRH seems to be associated with glycemic control primarily among Black men with DM. One clinical implication of this finding is that tighter glycemic goals may specifically benefit Black men with DM who report poor SRH. Additional research is needed to replicate these findings.

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Table 1:

Descriptive statistics in the pooled sample and based on the race by gender groups

	Pooled Sample n= 287		White men n=64		White women n=60		Black men n=85		Black women n=78	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (yrs)	55.79	(8.94)	60.23	(9.21)	57.90	(8.14)	53.29	(9.02)	55.80	(6.95)
SES	66.23	(16.66)	66.96	(16.67)	62.68	(17.87)	65.86	(17.17)	63.54	(19.21)
Diabetes duration (yrs)	13.48	(8.84)	13.08	(11.03)	9.44	(6.84)	10.63	(6.74)	9.83	(6.51)
SRH	3.25	(.82)	3.13	(.86)	3.08	(.85)	3.04	(.87)	3.36	(.79)
HbA1c	8.02	(1.87)	7.44	(1.26)	7.24	(1.51)	8.27	(2.10)	7.47	(1.55)

SES; Socioeconomic Status. HbA1c; hemoglobin A1c. SRH; Self-Rated Health

Table 2:

Bivariate (Pearson) correlations in the pooled sample and based on the race by gender groups

	1	2	3	4	5
Pooled Sample					
1 Age	1.00	-.11	.24 **	.01	-.30 **
2 Socioeconomic status		1.00	-.09	-.12 *	-.03
3 Diabetes duration			1.00	.07	.04
4 Self-Rated Health (SRH)				1.00	.10
5 Hemoglobin A1c (HbA1c)					1.00
White Men					
1 Age	1.00	-.33 **	.35 **	-.06	-.31 *
2 Socioeconomic status		1	-.10	.22 #	.03
3 Diabetes duration			1.00	.07	.05
4 Self-Rated Health (SRH)				1.00	.11
5 Hemoglobin A1c (HbA1c)					1.00
White Women					
1 Age	1.00	-.14	.14	.04	-.05
2 Socioeconomic status		1.00	.08	-.20	-.19
3 Diabetes duration			1.00	-.01	.01
4 Self-Rated Health (SRH)				1.00	-.05
5 Hemoglobin A1c (HbA1c)					1.00
Black Men					
1 Age	1.00	-.01	.13	-.01	-.40 **
2 Socioeconomic status		1.00	-.21 #	-.32 **	-.16
3 Diabetes duration			1.00	.18	.07
4 Self-Rated Health (SRH)				1.00	.27 *
5 Hemoglobin A1c (HbA1c)					1.00
Black Women					
1 Age	1.00	-.05	.25 *	.09	-.15
2 Socioeconomic status		1.00	-.18	-.09	.16
3 Diabetes duration			1.00	.04	.01
4 Self-Rated Health (SRH)				1.00	.00
5 Hemoglobin A1c (HbA1c)					1.00

#. p < .1

* p < .05

** p < .01

*** p < .001

Table 3:

Summary of three linear regression models in the pooled sample

	Model 1		Model 2		Model 3	
	<i>b</i>	95% <i>CI</i>	<i>b</i>	95% <i>CI</i>	<i>b</i>	95% <i>CI</i>
Race (Black)	.41 [*]	(.00 – .81)	–0.64	(–2.18 – .91)	–1.09	(–3.09 – .90)
Gender (Female)	–.54 ^{**}	(–.94 – –.15)	1.10	(–.46 – 2.66)	.54	(–1.64 – 2.73)
Age (Yr)	–.07 ^{***}	(–.09 – –.04)	–.06 ^{***}	(–.09 – –.04)	–.06 ^{***}	(–.09 – –.04)
Socioeconomic status	–.01	(–.02 – .00)	–.01	(–.02 – .01)	–.01	(–.02 – .01)
Diabetes duration (Yr)	.01	(–.01 – .04)	.01	(–.01 – .04)	.01	(–.01 – .04)
Medication (Insulin)	.35	(–.08 – .77)	.39 [#]	(–.03 – .82)	.41 [#]	(–.02 – .83)
SRH (Poor)	.16	(–.08 – .39)	.17	(–.22 – .57)	.09	(–.36 – .54)
Race (Black) × Gender (Female)	-	-	–.22	(–1.02 – .58)	.87	(–2.22 – 3.96)
SRH (Poor) × Race (Black)	-	-	.38	(–.08 – .85)	.53 [#]	(–.09 – 1.15)
SRH (Poor) × Gender (Female)	-	-	–.50 [*]	(–.97 – –.03)	–.31	(–1.00 – .37)
SRH × Race (Black) × Gender (Female)	-	-	-	-	–.35	(–1.29 – .60)

Outcome: Hemoglobin A1c (HbA1c)

SRH: Self-Rated Health

b: Unstandardized regression coefficient[#]. *p* < .1^{*}. *p* < .05^{**}. *p* < .01^{***}. *p* < .001

Table 4:

Summary of four linear regression models for race by gender groups

	Model 1		Model 2		Model 3		Model 4	
	White men		White women		Black men		Black women	
	<i>b</i>	95% <i>CI</i>	<i>b</i>	95% <i>CI</i>	<i>b</i>	95% <i>CI</i>	<i>b</i>	95% <i>CI</i>
Age (yrs)	-.07***	(-.11 – -.03)	-.03	(-.07 – .02)	-.10***	(-.15 – -.05)	-.03	(-.09 – .04)
Socioeconomic status	-.01	(-.03 – .01)	-.01	(-.03 – .01)	-.02	(-.04 – .01)	.01	(-.01 – .03)
Diabetes duration (yrs)	.01	(-.02 – .04)	.02	(-.03 – .08)	.03	(-.04 – .10)	.00	(-.06 – .06)
Insulin	.90*	(.21 – 1.59)	-.70	(-1.65 – .25)	.03	(-.92 – .98)	.86*	(.04 – 1.68)
SRH	.03	(-.33 – .40)	-.19	(-.64 – .25)	.53*	(.00 – 1.07)	-.10	(-.63 – .43)

Outcome: Hemoglobin A1c (HbA1c)

SRH; Self-Rated Health

b: Unstandardized regression coefficient# $p < .1$ * $p < .05$ ** $p < .01$ *** $p < .001$