Illuminating Racial Inequity in Diabetes Control: Differences Based on Gender and Geography

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Charles R. Senteio[1] · Ayse Akincigil[2,3]

Abstract

The objective of this study is to describe racial differences in type 2 diabetes mellitus "diabetes" control among the adults in the USA, and to examine attributes that may exacerbate racial differences. Secondary analyses of data from the National Ambulatory Medical Care Survey (NAMCS) collected in years 2012–2014 in the USA. Study sample was limited to White or African American patients aged 25 or older and living with diabetes ($n = 4106$). Outcome measure, poor diabetes control, was based on lab values for HbA1c ($> 7\%$). Covariates include demographics, insurance, comorbid conditions, and continuity of care and location (urban vs. rural). Overall, African Americans have 33% higher odds of poor diabetes control compared with Whites. Adjusted probability of poor diabetes control was 48% overall, 65% for African American women and 69% for African Americans living in rural areas. African Americans continue to have poorer diabetes control compared to Whites. This difference is exacerbated for African American women, and for all African Americans living in rural areas. Policy should include concentrated screening and treatment resources for African Americans in rural settings.

Keywords Diabetes · Heath equity · Health policy · Rural health

Introduction

When compared with White, Hispanic, and Asian American adults, African American adults experience higher rates of type 2 diabetes mellitus "diabetes" prevalence and diabetes-related complications. African Americans have higher diabetes prevalence (13.4%) than White (7.3%), Hispanic (11.9%), or Asian American (10.3%) adults. [1] African Americans' risk of diabetes diagnosis is 77% higher than non-Hispanic White adults. [2] Furthermore, African Americans with diabetes suffer disproportionate morbidity and early mortality; they have higher rates diabetes-related complications which include cardiovascular disease, kidney disease, blindness, amputations, and mortality. [3] Decades of health equity research have described four fundamental factors which influence racial disparities for health outcomes over the life course: (1) environment (e.g., geographic, socioeconomic, healthcare access), (2) sociocultural (e.g., prejudice, social stressors, stigma/bias), (3) behavioral (e.g., coping, social support, nutrition), and (4) biological (e.g., comorbidity, telomere attrition, cellular stress response). [4]

Racial disparities in diabetes-related morbidity and mortality result from individuals enduring a convergence of the four factors which contribute to outcomes disparities. For this analysis, our outcome of interest is glycemic control (HbA1c $> 7\%$). [5] We acknowledge that establishing a target for glycemic control is quite complex and is dependent upon various patient factors, including comorbidity, age, complexity of treatment regimen, and social factors. [6] However, this threshold is generally used in health equity research to determine control because it remains consistent with guidelines for standard of care. [7] Reaching and maintaining glycemic control require that patients and practitioners identify and successfully address barriers to consistently following four recommended, inter-related self-management behaviors: (1) attending primary care appointments, (2) regular physical activity, (3) consistent medication practices, and (4) specific dietary behavior. [8] Regular attendance at preventative care appointments results in a continuum of care that enables access to recommended eye and foot exams and support in following

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behavioral recommendations. However, routinely following recommended diabetes self- management behaviors increases complexity of treatment and burden of care for the patient, and can decrease quality of life. [3]

African Americans experience barriers to following each of the four recommended self- management behaviors. [9] First, African Americans are less likely to access preventative care than Whites. [10] Also, several factors present barriers to routinized physical activity; neighborhood factors like unsafe walking areas, transportation barriers, and lack of child care [11] all contribute to lower levels of physical activity for African American adults. [12] African Americans also experience barriers to recommended medication behavior that are closely associated with perceptions and access. In studies investigating African Americans' medication behavior, diabetic patients cite negative perceptions of side effects and fear associated with needles, along with access barriers to information concerning medications, such as clarification as to why medications are recommended if individuals perceive that they are not experiencing diabetes symptoms. [13] African Americans experience barriers to recommended dietary behavior (i.e., timing and amount of meals) and food choices. Barriers include personal food preferences and disruption of daily routines. [3, 14] Interestingly, African American women describe the emotional symbolism of food associated with traditional food practices that conflict with recommended dietary behavior. [14]

Research using limited, practice-level samples describe gender disparities for African Americans for diabetes control, [15] but research using practice-level samples does not enable examinations of variations by urban and rural settings. [3] Investigation based on setting is important because neighborhood characteristics influence self-management behavior, and consequently outcomes. [16] To help generalize these findings, in this study, we investigate racial differences for diabetes control using a large, national probability sample, the National Ambulatory Medical Care Survey (NAMCS) between the years 2012 and 2014. The purpose of this paper is to describe any association between race, gender, location (i.e., urban or rural), and diabetes control in a large sample of adult diabetes patients.

Methods

This study is based on secondary analyses of publicly available data from 2012 to 2014 NAMCS, which is an ongoing annual survey conducted by Center for Disease Control and Prevention (CDC). The unit of observation in NAMCS is a physician-patient encounter, and the sample is a representative probability sample from all 50 US states and the District of Columbia of visits representing office-based patient care. [17] It employs a stratified two-stage sample, with physicians (engaged in patient care activities) selected in the first stage and visits in the second stage (a randomly selected week of practice and systematic sample of visits within reporting week). The response rate ranged between 45 and 48% within the years used in this study. Survey weights included in the public use data were further adjusted for nonresponse. [18] Data are stripped of identifiers with masked variables to account for interdependencies due to the complex sampling design. [19]

Data were generally collected by Census Field Representatives (FR), who abstracted records from medical charts using a laptop computer and an automated survey instrument. Also at the initial visit, the FR obtained the practice characteristics. The data collection instrument captures all aspects of the physician-patient encounter (e.g., presenting reason, exams and diagnostic tests, diagnoses, services performed/ordered, and medications prescribed), in addition to patient level information (e.g., demographic characteristics, vital signs, continuity of care, current chronic conditions, and selected set of blood laboratory test values obtained in the last 12 months available in the medical chart). Details on the survey, data collection instruments, data collection procedures, and sampling design are available. [19]

Our target population is adults with type 2 diabetes mellitus "diabetes" because the factors that impact inequity, such as care pathways for prevention, access, care quality, behavior, and downstream impact on diabetes control, are different for type 1 and type 2. The instrument in 2012 or 2013 did not distinguish between type 1 and type 2 diabetes. To limit the study population to people with type 2 to best of our ability, we restricted the sample to patients aged 25 or older and excluded pregnant women. The sensitivity analyses of 2014 data reveal that within the population that fits our inclusion criteria, only 4% of the patients were diagnosed with type 1. As the focus of this current work is disparities between African Americans and Whites, we limited the sample to observations on which patient race was reported to be one or the other. Furthermore, we excluded observations if HbA1c value (variable used to depend the dependent variable) is missing. These restrictions yielded a sample size of 4106 physician patient encounters.

Outcome of interest is a binary variable indicting poor diabetes control, which was operationalized as HbA1c values greater than 7%. Study years were selected to be 2012–2014 because HbA1c values were available in the public use files only for those years. Independent variables include gender and age of the patient, a binary variable indicating expected source of payment is private insurance (vs. public insurance, self-pay, or other forms of payment), whether the location of the practice is in a Metropolitan Statistical Area (MSA) or in a rural location, new vs. established patient and whether the patient is living with three specific comorbid conditions (i.e., hypertension, depression, and asthma). We selected these specific

comorbidities because each may be associated with primary care physician encounters for individuals with diabetes. Hypertension is a common diabetic comorbidity and treatment guidelines include blood pressure control. Depression is associated with decreased likelihood of self-management behavior concordant with recommendations. Last, asthma patients are comparatively high users of health care services, so they may be more likely to access care more regularly. Control variables also included number of chronic conditions the patient is living with.

Analyses start with describing the differences between African American and White cohorts: bivariate differences in rates were tested by Pearson chi-square statistics and number of conditions with *t* tests. Next, we describe unadjusted rates of poor diabetes control, for the overall population and subpopulations of interest. Odds of poor diabetes control were modeled with logistic regressions. Model 1 adjusts for covariates mentioned above, examining if racial difference can be, at least partially, explained away by the differences in the characteristic of the two populations that were captured by these covariates. Model 2 includes interaction terms between African American race and each of the covariates, to identify factors that may exacerbate or reduce the racial differences.

Results

There were 3558 encounters by White patients and 548 by African American patients that fit the inclusion criteria (Table 1). These two subgroups were not statistically

equivalent across demographics. For example, 64% of the African Americans were female, compared with 50% of the Whites. The African American group was younger than the White group (51.3% vs. 43.7%, < 65). For 38% of the visits by Whites private insurance was the primary payer, compared with 30% of African Americans. More of the Whites were visiting an office located in a rural area compared with African Americans (14% vs. 9%). Prevalence of hypertension or depression, as well as number of chronic conditions, was statistically equivalent across the two groups. However, prevalence of asthma was larger for African Americans, compared with Whites (12% vs. 6%).

Among African Americans, 49% had poor diabetes control, vs. 42% among Whites (Table 2). We then examined the magnitude of racial gap, within subpopulations. The gap was significant among females (52% vs. 40%), but not among males. The racial difference among those who are privately insured was not statistically significant. Meanwhile, the racial gap among those with other sources of payment was statistically significant (49% vs. 40%). The magnitude of racial gap was larger in rural areas (59.8% vs. 39.2%) compared with the gap in urban locations (48.0% vs. 42.5%).

In the multivariate models, adjusting for all the covariates, African Americans showed increased odds of poor diabetes control (Table 3). This increase corresponds to a 32% increased odds of poor diabetes control for African Americans, compared with Whites (Table 3, Model 1). Model 1 also revealed that, compared with the oldest, younger groups had lower odds of poor diabetes control. Furthermore, those living with comorbid asthma were less likely to have

Table 1 Association of race and patient characteristics

	White (n = 3558)	African American (n = 548)
Female (%)*	50.0	64.0
Age (%)*		
< 65	43.7	51.3
65–74	30.6	29.4
> 75	25.7	19.2
Privately insured (%)*	37.6	29.6
New patient (%)	3.7	5.0
Living in rural area (%)*	14.1	9.4
Prevalence of chronic conditions (%)		
Hypertension	76.4	81.4
Asthma*	6.3	11.6
Depression	15.1	13.0
Average no. of chronic conditions *	3.6	3.7
	SD = 0.461	SD = 0.103
	95% CI [3.53, 3.71]	95% CI [3.53, 3.93]

Data from National Ambulatory Medical Care Survey, 2012–2014

*p value of chi-square (for categorical variables) or *t* test (for continuous variables) < 0.05

Table 2 Unadjusted rates of poor diabetes control (%)

Population	White	African American
All*	42.0	49.1
Gender		
Male	43.9	42.6
Female*	40.1	52.3
Age		
< 65	49.4	52.1
65–74	37.1	50.6
> 75	35.3	38.7
Insurance		
Private	45.1	49.9
Other*	40.2	48.7
Continuity of care		
Established patient *	41.8	49.1
New patient	48.8	48.1
Practice location		
MSA	42.5	48.0
Rural*	39.2	59.8
Hypertension		
No*	45.6	60.9
Yes	40.9	46.4
Asthma		
No*	42.6	51.1
Yes	34.1	33.4
Depression		
No*	41.6	49.4
Yes	44.6	49.3

Data from National Ambulatory Medical Care Survey, 2012–2014

*p value of chi-square (for categorical variables) or t test (for continuous variables) < 0.05

Table 3 Odds of poor diabetes control

Covariates	Model 1	Model 2
African American	1.32*	1.61
Female	0.96	0.89
Female and African American		1.82*
Age < 65	0.64*	0.60*
Age < 65 & African American		1.76
Age 65–74	0.56*	0.55*
Age 65–74 and African American		1.06
Privately insured	0.86	0.86
Private insurance and African American		0.99
Rural residence	0.96	0.91
Rural and African American		1.90*
New patient	1.21	1.28
New patient and African American		0.64
No chronic conditions	0.99	1.00
No chronic cond. and African American		0.91
Hypertension	0.89	0.92
Hypertension and African American		0.61
Asthma	0.61*	0.65*
Asthma and African American		0.83
Depression	1.14	1.15
Depression and African American		0.90

Data from National Ambulatory Medical Care Survey, 2012–2014

Reported coefficients are odds ratios calculated from logistic regression models

*p value of coefficient estimates < 0.05

Discussion

In this study, we investigated racial differences in diabetes control using a nationally representative probability sample from 2012 to 2014. There are four key findings, (1) African Americans in rural areas had increased odds of poor control, (2) African American women had poorer diabetes control, and (3) having asthma decreases odds of poor control.

First, African Americans living in rural areas had increased odds of poor control. This finding is consistent with the literature describing how individuals living in rural environments experience individual and structural barriers that influence diabetes self-management, and these barriers may affect African Americans more than Whites. Financial strain is a barrier to recommended self-management for individuals who live in rural areas, in part because health care expenses account for a larger share of household income compared with those who live in metropolitan areas. [20] Furthermore, structural factors such as neighborhood esthetics and access barriers to healthy foods all impact diabetes self-management. For example, individuals living in rural settings must travel farther for scheduled appointments, and rural settings have

poor diabetes control (odds ratio = 0.61, $p < 0.05$). The bivariate associations we reported regarding hypertension and depression were no longer significant after the remaining covariate was adjusted for. Still, controlling for these factors and others presented in the model have not changed the finding that African Americans had higher odds of poor diabetes control (odds ratio = 1.32, $p < 0.05$). Furthermore, effect sizes between the two models were similar.

When interaction terms between African American race and each of the covariates were included in the model, we identified the factors that exacerbate the racial differences (Table 3, Model 3). In this model, the estimate for the main effect of African American race, albeit large, was not statistical significant. Meanwhile, the interaction effects for female African Americans (odds ratio = 1.82, $p < 0.05$) and African Americans living in rural areas (odds ratio = 1.90, $p < 0.05$) did show significance.

lower distribution of practitioners and facilities. This results in less frequent routine visits and later detection of complications, which contribute to worse diabetes outcomes. [21]

Second, while African Americans had higher odds of poor control—consistent with the extensive literature concerning racial disparities for diabetes outcomes [3, 22]—African American women had the highest probability of poor control (60.5%), when compared with African American men (53.6%), White men (48.8%), and White women (45.7%). This finding is consistent with earlier findings that African American women have poorer diabetes control than African American men, and poorer control than any other ethnic group. [23]

Third, while comorbidity prevalence is higher for African Americans, we did not find differential associations by race for comorbidity examined. However, individuals with asthma are less likely to have poor diabetes control. We identify three factors that may account for this reduced likelihood. First, asthma patients have higher healthcare utilization, so they may be more connected to healthcare services and seek care more regularly. In one large observational study of severe asthma patients ($N=$ 1234; mean age 50.1), individuals had an office visit every 3 months and one out of seven had either an emergency department admission or inpatient hospital stay every 12 months. [24] Second, asthma patients experience symptoms that may impact quality of life more so than hypertensive and depressed patients, at least in earlier stages. When compared with asthma, hypertension and diabetes can be largely asymptomatic. In fact, individuals with diabetes can be undiagnosed for several years because hyperglycemia tends to develop over a long period of time. [25] Last, individuals living with asthma may have self-management skills and routinized identification of symptoms which trigger self-management also concordant with diabetes recommendations. Asthma self-management includes consistent self-monitoring, using regular medication, and action plans based on recognized symptoms and individual preferences. [26]

Fourth, there was no statistically significant difference for individuals with hypertension or depression to have poor diabetes control. This was unexpected because while individualized goals and therapies are stressed, multiple randomized control trials describe reduced morbidity with blood pressure control (< 140/80 mmHg) for individuals with diabetes. [27] Also, depression is associated with decreased likelihood of self-management behavior consistent with diabetes recommendations. [28] We speculate that perhaps since depression is common and independently associated with diabetes, [29] primary care practitioners are attuned to the importance of treating barriers to self-management those with depression may face. [30] Also, diabetes self-management education (DSME) programs tend to emphasize depression as a risk factor. [31]

Implications

Much of the existing disparities literature focuses the analyses on population-level data of a particular state or geographic region. This paper adds to the literature by quantifying racial disparities for a commonly measured chronic disease outcome (i.e., HbA1c) by comparing outcomes in rural communities with urban settings. NAMCS provides the opportunity to analyze national data for lab results. In fact, NAMCS is one of the few sources that enable analysis of specific chronic disease outcomes (e.g., HbA1c) at the national level. Earlier studies indicate that when examining difference in healthcare outcomes, population level analysis prevents identification of important factors, such as access to care, and lifestyle challenges [32]. Findings from our analysis of a large, national probability sample, enable a heightened understanding of the magnitude of racial disparities based upon the interaction of sociodemographic factors (i.e., location and gender). These insights are valuable to help inform the design and delivery of interventions aimed to identify and address barriers to recommended diabetes self-management which include addressing gender specific barriers to health equity. Practitioners who provide care in rural settings to African American patient populations should consider the following location-specific factors when designing diabetes care management plans.

Summary points to consider:

1. Practitioners in rural settings are less likely than those in non-rural locations to discuss diabetes prevention and risk reduction, including dietary and physical activity recommendations
2. African Americans in rural settings experience persistent barriers to preventative care, particularly screenings vital to determine risk for diabetes, like cholesterol screenings
3. Greater distance to travel to healthcare facilities, having less than a high school diploma and lower household income are all associated with living in rural settings, and they present barriers to recommended self-management—policy should include concentrated prevention and treatment resources in rural settings, given that rural communities continue to have higher rates of diabetes incidence and rates of associated complications (e.g., cardiovascular disease)
4. African Americans in rural locations cite social support as a primary factor in facilitating diabetes self-management behavior consistent with recommendations, and family support, social support groups, and support from practitioners are known sources of social support

5. African American women with diabetes from rural communities indicate barriers to following recommended self-management which include caregiver responsibilities and the psychological toll of having diabetes, specifically fear of suffering and both physical and emotional fatigue

Our findings reveal a generalizable finding that African Americans who reside in rural areas may experience distinctive barriers. In fact, urban-rural geographic classification has been acknowledged as a means to track public health issues and target interventions appropriate for specific locations. [33] Practitioners in rural settings are less likely than those in non-rural locations to discuss diabetes prevention and risk reduction, including dietary and physical activity recommendations. [34] Limited time to address risk and disease prevention in primary care makes early diagnosis and management difficult, for both urban and rural settings. [35] Consequently, African Americans in rural settings experience persistent barriers to preventative care, particularly screenings vital to determine risk for diabetes, like cholesterol screenings. [36]

Living in rural settings appears to present specific barriers to care caused by the confluence of known structural factors that drive health inequity. For example, greater distance to travel to healthcare facilities, having less than a high school diploma and lower household income, is all associated with living in rural settings, and they present barriers to recommended self-management. [37–40] Policy should include concentrated prevention and treatment resources in rural settings, given that rural communities continue to have higher rates of diabetes incidence and rates of associated complications (e.g., cardiovascular disease). [41]

In addition, level of social support has been identified as an area of emphasis for interventions aimed at addressing persistent diabetes disparities for individuals who reside in rural areas. [21] African Americans in rural locations cite social support as a primary factor in facilitating diabetes self-management behavior consistent with recommendations, and family support, social support groups, and support from practitioners are known sources of social support. [3] African American women with diabetes from rural communities indicate barriers to following recommended self-management which include caregiver responsibilities and the psychological toll of having diabetes, specifically fear of suffering and both physical and emotional fatigue. [42] These factors help explain gender differences which should inform interventions that consider incorporating psychosocial assessments and make available services to help address social support needs.

Structural barriers to preventative care include medical mistrust which emanates from decades of systematic racism. [43] In fact, direct pathways have been shown between discrimination and health outcomes, specifically through stress to HbA1c for individuals with diabetes, [44] but few studies have focused on designing interventions pointedly to address discrimination. Future research should investigate race of the patient and the provider in rural settings to describe any associates according to racial discordance between patient and provider. Given this barrier, practitioners in rural settings should evaluate the feasibility and potential efficacy of integrating community health workers (CHWs) into care teams given that they are particularly suited for interventions focused on participant engagement due to their established role as liaisons between healthcare systems and communities. [45] CHWs, who may also be referred to as lay health advisors or promotores de salud, are more trusted because they have culturally specific insights on communities which experience persistent disparities, in large part because they come from these same communities. [46] In fact, in small scale studies focused on African American participants, use of CHWs showed increased efficacy in reducing HbA1c. [47]

Individuals who develop and evaluate disparity interventions should consider findings in light of the substantial research recommending that interventions consider the importance of socio-economic status, [22] social support, mistrust, and rural factors. [16] These recommendations have included tailored approaches specifically for African American women in rural communities. [48]

There are several potential limitations of this study. Despite the analysis based on a large probability sample, we excluded observations due to limitations of the dataset. First, we excluded observations which were missing a HbA1c value. Second, we restricted years between 2012 and 2014. Third, we made assumptions to isolate type 2 diabetes (i.e., aged 25 or older, excluded pregnant women). Fourth, urban or rural location was based on the Metropolitan Statistical Area (MSA) of the reporting practice, not the residence of the patient. Despite these limitations, we believe that we have made reasonable assumptions in order to leverage the scale of the NAMCS dataset.

This paper represents a unique contribution because it uses a large-scale data set to detail sociodemographic interactions which result in uncontrolled diabetes. African American women in rural areas are particularly at risk for uncontrolled diabetes. Future investigations should consider generalizable findings accordant with the considerable literature detailing risk factors associated with African American women, such as obesity. Emergent research using comparatively smaller samples has identified auspicious approaches for African American woman such as motivational interviewing for dietary behavior and use of CHWs. [49] Thus, practitioners must be aware and responsive to environmental and cultural factors that influence self-management in order to develop and recommend effective regimens which help address persistent inequity. [3] Furthermore, as reporting tools become more sophisticated in identifying risk groups and directing resources to help address barriers to care, practitioners should use these capabilities, in conjunction with population health studies

such as this, to craft outcomes reporting and care capabilities to help address persistent inequity. [50]

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