

Racial differences in diabetes-related psychosocial factors and glycemic control in patients with type 2 diabetes

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Background: We examined whether diabetes-related psychosocial factors differ between African American and white patients with type 2 diabetes. We also tested whether racial differences in glycemic control are independent of such factors.

Methods: Baseline glycosylated hemoglobin (HbA_{1c}) and survey measures from 79 African American and 203 white adult participants in a diabetes self-management clinical trial were analyzed.

Results: Several psychosocial characteristics varied by race. Perceived interference of diabetes with daily life, perceived diabetes severity, and diabetes-related emotional distress were higher for African Americans than for whites, as were access to illness-management resources and social support. Mean HbA_{1c} levels were higher among African Americans than whites (8.14 vs 7.40, beta = 0.17). This difference persisted after adjusting for demographic, clinical, and diabetes-related psychosocial characteristics that differed by race (beta = 0.18). Less access to illness-management resources (beta = -0.25) and greater perceived severity of diabetes (beta = 0.21) also predicted higher HbA_{1c}.

Discussion: Although racial differences in diabetes-related psychosocial factors were observed, African Americans continued to have poorer glycemic control than whites even after such differences were taken into account. Interventions that target psychosocial factors related to diabetes management, particularly illness-management resources, may be a promising way to improve glycemic control for all patients.

Keywords: diabetes mellitus, type 2, minority health, health status disparities, psychosocial factors, disease management

An estimated 17.9 million people in the United States had a diagnosis of diabetes in 2007, with direct and indirect costs associated with diabetes totalling \$174 billion.¹ The burden of this prevalent and costly disease falls disproportionately on African Americans, with recent estimates indicating that 14.7% of non-Hispanic African American adults have diabetes, compared with 9.8% of non-Hispanic whites.¹ Not only is diabetes more prevalent among African Americans,²⁻⁶ but among those diagnosed with diabetes, African Americans are less likely than whites to achieve adequate control of blood glucose levels⁷⁻¹⁹ and are more likely than whites to suffer diabetes-related complications such as nephropathy, end-stage renal disease, retinopathy, lower-extremity amputations, and mortality.^{15,20-30}

Given that maintaining near-normal levels of blood glucose can greatly reduce the risk of experiencing diabetic complications,³¹ it is important to understand why disparities exist in glycemic control. Identifying factors that facilitate or hinder effective

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diabetes management, and determining whether these factors operate the same for African American and white patients, would allow the strategic development and implementation of interventions designed to reduce disparities between groups. However, few factors underlying the racial gap in glycemic control have been identified. Several studies have shown that racial differences in glycemic control persist after controlling for demographic, clinical, and behavioral factors such as age, sex, body mass index, education, socioeconomic status, physical comorbidities, depression, diabetes treatment regimen, access to health care, adherence to diabetes medications, and physical activity levels.^{7,8,11–13,16,32–34} Racial differences in glycemic control are also not fully explained by differences in processes of care, as rates of obtaining standard tests and screenings for comprehensive diabetes management are often equivalent or higher for African Americans compared with whites.^{10,15,35–41}

Achieving and maintaining adequate glycemic control can require the adoption of multiple behaviors that involve diet, exercise, and appropriate intake of insulin and/or oral hypoglycemic medications, resulting in a complicated regimen that poses significant challenges to patients. Social cognitive theory (SCT) maintains that whether patients adopt desired behaviors is influenced by the interaction of intrapersonal factors (eg, belief in one's ability to adopt the behavior or the expected utility of adopting the behavior) and environmental factors (eg, social support for the behavior or lack of external barriers).⁴² The basic tenets of SCT are supported by a large body of evidence showing that factors such as self efficacy in disease management and social support are associated with increased adherence to recommended diabetes self-management behaviors and improved glycemic control.^{43–48} Much of the early work applying SCT to diabetes management, however, did not examine whether there were racial differences in intrapersonal and environmental factors related to diabetes management (heretofore referred to as diabetes-related psychosocial factors) or whether such factors had different effects on diabetes outcomes for these groups.

More recent work has begun to focus on whether the tenets of SCT generalize to diabetes management among African American patients, but studies have yielded mixed results.^{49–54} The influence of social support and self efficacy on various self-care domains has been inconsistent in African American samples, with some studies finding no relationships⁵⁴ and others finding relationships with some, but not all, self-care domains (eg, glucose monitoring and exercise, but not medication adherence).^{49,50,53} There is also

evidence that diabetes-related emotional distress, which may interfere with diabetes management behaviors, is not related to glucose control among African Americans.⁵⁵ However, few studies have directly examined whether diabetes-related psychosocial factors such as these differ between African Americans and whites or whether racial differences in glycemic control persist after taking into account racial differences in diabetes-related psychosocial factors.

We attempted to address this gap in the literature by exploring whether racial differences exist for several psychosocial factors found in past research to be associated with improved diabetes self-care and/or glycemic control. These included factors pertaining to self-care and quality of life (eg, self-efficacy in diabetes self-management, diabetes-related social support, perceived severity of one's disease), access to resources that support disease management, and emotional distress related to diabetes. We further examined whether racial differences in glycemic control remained after taking into account race differences in these factors. We examined these issues using baseline data from African American and white patients enrolled in a clinical trial of a behavioral intervention to improve diabetes self-management.

Methods

Patient population

Data for this analysis consisted of baseline measures collected from patients enrolled in the ENHANCE study, a single-center, randomized controlled trial of a behavioral intervention designed to foster adherence of individuals with type 2 diabetes to their self-management regimen. Participants were recruited from Pittsburgh, Pennsylvania and the surrounding area. Adults with a self-reported diagnosis of type 2 diabetes were eligible for enrollment in the trial. Exclusion criteria included (1) history of hypoglycemic coma/seizure within the last 12 months, (2) hypoglycemia requiring 3rd party assistance within the last 3 months, (3) unwillingness to do capillary blood testing, (4) history consistent with type 1 diabetes, (5) unwillingness or inability to participate in scheduled group classes, (6) renal dialysis or expectation of dialysis within the next 6 months, (7) history of dementia, alcohol, or substance abuse, (8) plans to move outside of the study region within the next 8 months, and (9) participation in another clinical study. Eligible participants were scheduled for a baseline fasting laboratory measurement visit and completed a baseline survey (described below). Data collected from participants during their baseline visit were used in the current analyses. Complete details regarding the intervention and study design are available elsewhere.⁵⁶

Measurements

Two weeks prior to their baseline assessment visit, eligible participants were sent a packet of questionnaires that contained measures of demographic, clinical, and diabetes-related psychosocial factors used in the current analyses. Demographic and clinical factors included self-reported race and ethnicity, gender, years of formal education, annual household income, employment status, health insurance status, and diabetes medication regimen (coded as 'includes insulin vs does not include insulin' for analyses). Total caloric expenditure through physical activity was also assessed using the Community Health Activities Model Program for Seniors questionnaire (CHAMPS).⁵⁷ Physical and mental comorbidities were assessed using the Rigler comorbidity checklist⁵⁸ and Beck Depression Inventory-II,⁵⁹ respectively. Descriptions of the diabetes-related psychosocial factors and how they were measured are provided in Table 1.

During the baseline assessment visit, signed informed consent was obtained, after which questionnaires were

collected and reviewed for completeness. Staff also obtained measures of height and weight at that time, which were used to calculate body mass index (BMI). Glycemic control was determined by serum hemoglobin A1c (HbA_{1c}) levels obtained via venipuncture. At the completion of the baseline visit, participants were given a \$20 gift certificate to a local grocery store and parking vouchers or bus passes were provided as needed. The study was approved by the Institutional Review Board of the University of Pittsburgh.

Statistical analysis

We first determined whether there were significant ($P < 0.05$) racial differences in each demographic, clinical, and diabetes-related psychosocial factor by examining bivariate associations between race and each variable. Continuous variables were summarized using means and standard deviations; categorical variables were summarized by frequencies and percentages. Bivariate associations between race and each variable were assessed using Student's *t*-test or its nonpara-

Table 1 Summary of psychosocial measures

Variable	Description	Measurement tool	# of items	Possible range	Cronbach's alpha
Access to illness-management resources	Support (eg, informational or emotional) for the management of chronic illness available from one's physician/health care team, family/friends, personal actions, neighborhood, community, media/policy, community organizations, and workplace	CIRS ⁶⁵	64	1–5	0.91
Interference of diabetes with daily life	Interference caused by diabetes to daily activities, work, and social/recreational activities	MDQ Subscale ⁴⁵	9	0–6	0.93
Perceived severity of diabetes	Extent to which diabetes is a severe health problem and causes concern/worry	MDQ Subscale ⁴⁵	3	0–6	0.87
Perceived diabetes-related social support	Social support received from significant others, family, friends, and health professionals	MDQ Subscale ⁴⁵	4	0–6	0.74
Positive reinforcing behaviors	Reinforcement received from significant others for engaging in desirable self-management behaviors	MDQ Subscale ⁴⁵	8	0–6	0.91
Misguided support behaviors	Nonsupportive behaviors by significant others to encourage self-management behaviors (eg, nagging)	MDQ Subscale ⁴⁵	4	0–6	0.82
Self efficacy in diabetes self management	Confidence in ability to perform desirable self-management behaviors	MDQ Subscale ⁴⁵	7	0–100	0.91
Outcome expectancies for self-care behaviors	Perceptions of the effects of desirable self-management behaviors on metabolic control and prevention of complications	MDQ Subscale ⁴⁵	6	0–100	0.88
Diabetes-related emotional distress	Emotional responses to issues unique to living with diabetes	PAID ⁶⁶	20	0–100	0.94

Abbreviations: CIRS, Chronic Illness Resources Survey; MDQ, Multidimensional Diabetes Questionnaire; PAID, Problem Areas in Diabetes Scale.

metric equivalent (eg, Wilcoxon rank sum test) for continuous variables and by the χ^2 statistic for categorical variables.

Next, we used linear regression to examine whether race was associated with HbA_{1c} level prior to adjusting for any additional variables. We then examined multiple linear regression models to determine whether race was associated with HbA_{1c} level after adjustment for variables that were found to differ by race in the bivariate analyses at a *P* value of at least marginal significance (*P* < 0.10). The first multivariable model included race and patient demographic and clinical factors that differed by race. The second multivariable model consisted of the first model plus the psychosocial factors that differed by race. Finally, we examined an additional set of models that tested the interaction effects of race and each variable on HbA_{1c} to determine whether the effects of these variables on glycemic control differed for African American and white patients. All analyses were performed using SAS software (version 9.2; SAS Institute, Cary, NC, USA).

Results

Racial differences in demographic and clinical characteristics

African Americans and whites differed on several demographic and clinical characteristics (Table 2). Compared with whites, African Americans were significantly younger (mean age = 51.1 vs 57.3), had fewer years of education

(13.4 vs 15.0), expended more calories during physical activity (4228.3 vs 3354.8), and had fewer comorbid conditions (3.3 vs 3.9). There was a marginal trend for African Americans to score higher than whites on the Beck Depression Index (0.6 vs 0.5). African Americans were also more likely than whites to be female (79.8% vs 62.7%) and had lower incomes than whites (51.3% vs 19.5% had incomes <US\$20K). There were no racial differences in body mass index, likelihood of being employed, having health insurance, or having a diabetes-medication regimen that included insulin.

Racial differences in psychosocial characteristics

African Americans and whites differed significantly on several diabetes-related psychosocial characteristics (see Table 3). Compared with whites, African Americans reported more interference of diabetes with daily life, greater severity of diabetes, and more diabetes-related emotional distress. In contrast, African Americans reported having access to more resources to support illness management and more diabetes-related social support. African Americans and whites did not differ in positive reinforcing behaviors or misguided support behaviors from significant others, or on levels of self efficacy or outcome expectancies for diabetes self-care behaviors.

Table 2 Demographic and clinical characteristics of white and African American adults with type 2 diabetes

	Non-hispanic white (n = 203)		African American (n = 79)		P ^a
Age (mean ± SD)	57.3	± 11.1	51.1	±8.9	0.001
Years of formal education	15.0	± 3.0	13.4	±2.4	0.0001
Body mass index	34.6	±7.0	35.3	±9.5	0.55
Caloric expenditure/week	3354.8	± 2612.9	4228.3	±3175.5	0.03
Comorbidity disease index	3.9	± 2.1	3.3	±2.0	0.02
Beck's depression index	0.5	± 0.4	0.6	±0.5	0.08
Women (n %)	126	62.7%	63	79.8%	0.006
Income					0.0001
Less than \$20,000	38	19.5%	40	51.3%	
\$20,000–\$50,000	87	44.6%	23	29.5%	
Greater than \$50,000	70	35.9%	15	19.2%	
Employment status					0.34
Employed	122	60.7%	43	54.4%	
Not employed	79	39.3%	36	45.6%	
Health insurance status					0.91
Insured	190	94.5%	74	94.9%	
Not insured	11	5.5%	4	5.1%	
Medication regimen					0.28
Includes insulin	37	19.4%	19	25.3%	
Does not include insulin	154	80.6%	56	74.7%	

Notes: ^aComparisons between white and African American participants were made using t-tests (or non-parametric equivalent) for means and χ^2 tests for frequencies.

Table 3 Psychosocial characteristics (mean \pm SD) of white and African American patients with type 2 diabetes

	Non-hispanic white		African American		P ^a
Access to illness-management resources	2.5	\pm 0.5	2.8	\pm 0.6	0.0005
Interference of diabetes with daily life	1.3	\pm 1.3	1.7	\pm 1.4	0.01
Perceived severity of diabetes	3.3	\pm 1.7	3.8	\pm 1.8	0.04
Perceived diabetes-related social support	3.2	\pm 1.5	3.6	\pm 1.4	0.047
Positive reinforcing behaviors	2.1	\pm 1.6	2.5	\pm 1.9	0.16
Misguided support behaviors	1.9	\pm 1.7	2.4	\pm 2.0	0.17
Self-efficacy in diabetes self-management	40.7	\pm 20.0	38.1	\pm 19.5	0.35
Outcome expectancies for self-care behaviors	61.4	\pm 7.9	59.9	\pm 12.1	0.31
Diabetes-related emotional distress	33.4	\pm 20.8	40.1	\pm 22.9	0.02

Notes: ^aComparisons between white and African American participants were made using *t*-tests (or nonparametric equivalent).

Race differences in HbA_{1c}

African Americans (mean = 8.14, standard deviation = 2.53) had significantly higher HbA_{1c} levels than whites (mean = 7.40, standard deviation = 1.71) in analyses not adjusting for any demographic, clinical, or psychosocial characteristics (standardized beta = 0.17, $P < 0.01$) (Table 4, Model 1). This race difference persisted after adjusting for demographic and clinical factors that varied by race in bivariate analyses (standardized beta = 0.15, $P = 0.02$) (Table 4, Model 2). In a model that also included diabetes-related psychosocial factors that

differed by race, race continued to be a significant predictor of HbA_{1c} (standardized beta = 0.18, $P < 0.01$) (Table 4, Model 3). In this model, access to illness-management resources was negatively associated with HbA_{1c} (standardized beta = -0.25 , $P < 0.01$) and perceived severity of diabetes was positively associated with HbA_{1c} (standardized beta = 0.21, $P = 0.02$). HbA_{1c} was not associated with interference of diabetes with daily life, diabetes-related social support, or diabetes-related emotional distress in the final adjusted model. We ran a series of additional models to test whether there were significant

Table 4 Multiple linear regression models examining the association of race with HbA_{1c} after adjusting for demographic, clinical, and diabetes-related psychosocial factors that differ by race

Variables	Model 1: race				Model 2: model 1 + demographic and clinical factors				Model 3: model 2 + diabetes-related psychosocial factors			
	B	SE	Beta	P	B	SE	Beta	P	B	SE	Beta	P
African American	0.73	0.26	0.17	<0.01	0.69	0.30	0.15	0.02	0.82	0.31	0.18	<0.01
Age					-0.008	0.01	-0.05	0.50	0.005	0.01	0.03	0.68
Years of formal education					-0.0003	0.04	-0.0004	1.00	0.01	0.04	0.02	0.81
Caloric expenditure/week (Kcal)					-0.09	0.04	-0.13	0.04	-0.06	0.05	-0.08	0.22
Comorbidity disease index					-0.13	0.06	-0.14	0.04	-0.16	0.07	-0.17	<0.01
Beck's depression index					0.67	0.30	0.15	0.03	0.13	0.35	0.03	0.71
Women					-0.19	0.27	-0.05	0.47	-0.22	0.28	-0.05	0.42
Income								0.45				0.54
\$20,000–\$50,000					0.41	0.31	0.10	0.19	0.31	0.31	0.07	0.32
Greater than \$50,000					0.28	0.34	0.06	0.41	0.07	0.34	0.02	0.84
Access to illness-management resources									-0.95	0.30	-0.25	<0.01
Interference of diabetes with daily life									0.02	0.12	0.01	0.87
Perceived severity of diabetes									0.25	0.10	0.21	0.02
Perceived diabetes-related social support									0.08	0.10	0.06	0.44
Diabetes-related emotional distress									-0.0008	0.009	-0.008	0.93

Abbreviations: B, unstandardized regression coefficient; SE, standard error; Beta, standardized regression coefficient.

interactions between race and each of the demographic, clinical, or diabetes-related psychosocial factors that were included in the multivariable analyses. No interactions were significant (data not shown), indicating that the associations between each variable and HbA_{1c} were similar across the two racial groups.

Discussion

The current study examined whether African American and white patients with type 2 diabetes differ on diabetes-related psychosocial factors, and whether race differences in glycemic control persist after taking into account such differences. We found race differences in some, but not all psychosocial factors examined in this study. Compared with whites, African Americans reported more interference of diabetes with daily life, greater severity of diabetes, and more diabetes-related emotional distress. However, African Americans may have more supportive environments to help them cope, as they reported more overall access to support resources to help them manage their illness and more diabetes-related social support from their family, friends, and health professionals. Interestingly, African Americans and whites did not differ on self-management self-efficacy or perceived benefits of engaging in self-care behavior. This pattern of results suggests that coping with diabetes may pose more challenges for African Americans than for whites, but that African Americans may have more supportive environments than whites to help them cope, and that both groups have equal confidence in their ability to manage their disease and the utility of doing so.

That being said, we found that African Americans had higher HbA_{1c} levels than whites, even after controlling for racial differences in the diabetes-related psychosocial factors noted above. This suggests that the persistent race disparity in glycemic control is independent of diabetes-related psychosocial factors such as support received from significant others or the broader community, self efficacy in diabetes management, beliefs about the utility of engaging in recommended self-care behaviors, interference of the disease with daily life, or distress caused by the disease. Even though race differences were found in some of these areas, the race difference in glycemic control was still observed after taking those psychosocial factors into account.

Explanations for the race difference in glycemic control therefore remain elusive. Recent work has emphasized the role of socioeconomic status (SES) on diabetes prevalence, as SES is often confounded with race.⁶⁰⁻⁶² For instance, in a sample of white, African American, and Hispanic

adults, race differences in diabetes prevalence were greatly reduced after controlling for a combination of education and income.⁶¹ Moreover, no racial differences in diabetes prevalence were found in a sample of African American and white adults drawn from a racially integrated urban community where members of both races lived in similar social conditions and did not differ in socioeconomic status.⁶² The current study, which focused on glycemic control rather than diabetes prevalence, found that race differences in glycemic control persisted even after controlling for education and income, demographic characteristics that serve as indicators of SES. It is possible, however, that our measures of SES did not capture other important racial differences in life circumstances that affect glycemic control. For instance, African American and white patients in the current study were likely drawn from poorly integrated communities, as rates of racial segregation remain high in many Pittsburgh neighborhoods. Residential segregation has been proposed as a contributing factor to racial disparities in health, given that it leads to differences in access to high-quality health care, exposure to environmental hazards, access to healthy and unhealthy foods, and recreational facilities that promote physical activity, all of which can influence health.⁶³ Additional research is needed to determine whether environmental factors not examined in the current analysis contribute to race disparities in glycemic control.

Even though this study found that the race disparity in glycemic control was independent of diabetes-related psychosocial factors, its results can inform the development of interventions to improve diabetes management for both African American and white patients. Our findings suggest that interventions may not need to be designed to target different psychosocial factors for African Americans and whites. Our results indicate that access to illness-management resources is related to glycemic control for both African Americans and whites. Interventions designed to increase access to support from a variety of sources ranging from close friends and family to more distal sources such as the workplace, community, and the media may be a promising way to improve glycemic control for all patients. Such resources may already be more available to African Americans than whites, as African Americans reported more access to illness-management resources than whites in the current study, and a similar trend has been reported in a previous study with a much smaller sample.⁶⁴ The relatively greater

access to resources reported by African Americans in the current study may reflect the effects of multiple community-based programs designed to provide African American communities in Pittsburgh with support related to chronic disease management, disease prevention, and promotion of healthy lifestyles. The task of optimizing the impact of such resources on glycemic control remains an important area for future efforts.

The current study has several limitations. First, the sample consisted of patients who self-selected into a study of a behavioral intervention designed to improve diabetes self-management. Therefore, the study sample may not be representative of the general population of patients with diabetes in terms of disease severity or motivation to engage in diabetes self-care behaviors. Second, while the study recruited the expected number of African Americans given the race distribution in the region, the number of African Americans in the sample is small, limiting the generalizability of the findings. Finally, the cross-sectional nature of the study prevents conclusions about causal relationships between the variables examined. For example, it is possible that having poorly controlled diabetes may lead patients to perceive their disease as more severe rather than poor glycemic control being caused by perceptions that one's disease is severe.

Despite these limitations, the current study adds to existing literature by identifying differences and similarities in diabetes-related psychosocial factors across African American and white patients with diabetes, and by showing that the race disparity in glycemic control is independent of differences in such factors. Access to illness-management resources is associated with better glycemic control for both African Americans and whites, which suggests one potential area for the development of interventions to improve diabetes management.

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Disclosure

The authors report no conflicts of interest in this work.

References

- Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2007. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention; 2008.
- Brancati FL, Kao WH, Folsom AR, Watson RL, Szklo M. Incident type 2 diabetes mellitus in African American and white adults: the Atherosclerosis Risk in Communities Study. *JAMA*. 2000;283(17):2253–2259.
- Brancati FL, Whelton PK, Kuller LH, Klag MJ. Diabetes mellitus, race, and socioeconomic status. A population-based study. *Ann Epidemiol*. 1996;6(1):67–73.
- Harris MI. Epidemiological correlates of NIDDM in Hispanics, whites, and blacks in the US population. *Diabetes Care*. 1991;14(7):639–648.
- Robbins JM, Vaccarino V, Zhang H, Kasl SV. Excess type 2 diabetes in African-American women and men aged 40–74 and socioeconomic status: evidence from the Third National Health and Nutrition Examination Survey. *J Epidemiol Community Health*. 2000;54(11):839–845.
- McBean AM, Li S, Gilbertson DT, Collins AJ. Differences in diabetes prevalence, incidence, and mortality among the elderly of four racial/ethnic groups: whites, blacks, Hispanics, and Asians. *Diabetes Care*. 2004;27(10):2317–2324.
- Adams AS, Trinacty CM, Zhang F, et al. Medication adherence and racial differences in A1C control. *Diabetes Care*. 2008;31(5):916–921.
- Bertoni AG, Clark JM, Feeney P, et al. Suboptimal control of glycemia, blood pressure, and LDL cholesterol in overweight adults with diabetes: the Look AHEAD Study. *J Diabetes Complications*. 2008;22(1):1–9.
- Boltri JM, Okosun IS, Davis-Smith M, Vogel RL. Hemoglobin A1c levels in diagnosed and undiagnosed black, Hispanic, and white persons with diabetes: results from NHANES 1999–2000. *Ethn Dis*. 2005;15(4):562–567.
- Brown AF, Gregg EW, Stevens MR, et al. Race, ethnicity, socioeconomic position, and quality of care for adults with diabetes enrolled in managed care: the Translating Research Into Action for Diabetes (TRIAD) study. *Diabetes Care*. 2005;28(12):2864–2870.
- de Rekeneire N, Rooks RN, Simonsick EM, et al. Racial differences in glycemic control in a well-functioning older diabetic population: findings from the Health, Aging and Body Composition Study. *Diabetes Care*. 2003;26(7):1986–1992.
- Holcomb WL Jr, Mostello DJ, Leguizamon GF. African-American women have higher initial HbA_{1c} levels in diabetic pregnancy. *Diabetes Care*. 2001;24(2):280–283.
- Wendel CS, Shah JH, Duckworth WC, Hoffman RM, Mohler MJ, Murata GH. Racial and ethnic disparities in the control of cardiovascular disease risk factors in Southwest American veterans with type 2 diabetes: the Diabetes Outcomes in Veterans Study. *BMC Health Serv Res*. 2006;6:58.
- Harris MI, Eastman RC, Cowie CC, Flegal KM, Eberhardt MS. Racial and ethnic differences in glycemic control of adults with type 2 diabetes. *Diabetes Care*. 1999;22(3):403–408.
- Bonds DE, Zaccaro DJ, Karter AJ, Selby JV, Saad M, Goff DC Jr. Ethnic and racial differences in diabetes care: The Insulin Resistance Atherosclerosis Study. *Diabetes Care*. 2003;26(4):1040–1046.

16. Heisler M, Faul JD, Hayward RA, Langa KM, Blaum C, Weir D. Mechanisms for racial and ethnic disparities in glycemic control in middle-aged and older Americans in the health and retirement study. *Arch Intern Med.* 2007;167(17):1853–1860.
17. Bell RA, Summerson JH, Konen JC. Racial differences in psychosocial variables among adults with non-insulin-dependent diabetes mellitus. *Behav Med.* 1995;21(2):69–73.
18. Sequist TD, Adams A, Zhang F, Ross-Degnan D, Ayanian JZ. Effect of quality improvement on racial disparities in diabetes care. *Arch Intern Med.* 2006;166(6):675–681.
19. Kirk JK, D'Agostino RB Jr, Bell RA, et al. Disparities in HbA_{1c} levels between African-American and non-Hispanic white adults with diabetes: a meta-analysis. *Diabetes Care.* 2006;29(9):2130–2136.
20. Quenan L, Remington P. Diabetes mortality trends in Wisconsin, 1979–1997: the increasing gap between whites and blacks. *WMJ.* 2000;99(3):44–47.
21. Sanchez-Thorin JC. The epidemiology of diabetes mellitus and diabetic retinopathy. *Int Ophthalmol Clin.* 1998;38(2):11–18.
22. Krop JS, Coresh J, Chambless LE, et al. A community-based study of explanatory factors for the excess risk for early renal function decline in blacks vs whites with diabetes: the Atherosclerosis Risk in Communities study. *Arch Intern Med.* 1999;159(15):1777–1783.
23. Massing MW, Henley N, Biggs D, Schenck A, Simpson RJ Jr. Prevalence and care of diabetes mellitus in the Medicare population of North Carolina. Baseline findings from the Medicare Healthcare Quality Improvement Program. *N C Med J.* 2003;64(2):51–57.
24. Kamel HK, Rodriguez-Saldana J, Flaherty JH, Miller DK. Diabetes mellitus among ethnic seniors: contrasts with diabetes in whites. *Clin Geriatr Med.* 1999;15(2):265–278.
25. Karter AJ, Ferrara A, Liu JY, Moffet HH, Ackerson LM, Selby JV. Ethnic disparities in diabetic complications in an insured population. *JAMA.* 2002;287(19):2519–2527.
26. Harris EL, Sherman SH, Georgopoulos A. Black-white differences in risk of developing retinopathy among individuals with type 2 diabetes. *Diabetes Care.* 1999;22(5):779–783.
27. Wong TY, Klein R, Islam FM, et al. Diabetic retinopathy in a multi-ethnic cohort in the United States. *Am J Ophthalmol.* 2006;141(3):446–455.
28. Stephens GW, Gillaspay JA, Clyne D, Mejia A, Pollak VE. Racial differences in the incidence of end-stage renal disease in types I and II diabetes mellitus. *Am J Kidney Dis.* 1990;15(6):562–567.
29. Young BA, Maynard C, Reiber G, Boyko EJ. Effects of ethnicity and nephropathy on lower-extremity amputation risk among diabetic veterans. *Diabetes Care.* 2003;26(2):495–501.
30. Young BA, Maynard C, Boyko EJ. Racial differences in diabetic nephropathy, cardiovascular disease, and mortality in a national population of veterans. *Diabetes Care.* 2003;26(8):2392–2399.
31. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med.* 1993;329(14):977–986.
32. Sequist TD, Fitzmaurice GM, Marshall R, Shaykevich S, Safran DG, Ayanian JZ. Physician performance and racial disparities in diabetes mellitus care. *Arch Intern Med.* 2008;168(11):1145–1151.
33. Saydah S, Cowie C, Eberhardt MS, De Rekeneire N, Narayan KM. Race and ethnic differences in glycemic control among adults with diagnosed diabetes in the United States. *Ethn Dis.* 2007;17(3):529–535.
34. Glasgow RE, Fisher L, Skaff M, Mullan J, Toobert DJ. Problem solving and diabetes self-management: investigation in a large, multiracial sample. *Diabetes Care.* 2007;30(1):33–37.
35. Kurian AK, Borders TF. Racial and ethnic differences in the effects of regular providers and self-management education on diabetes preventive care. *Ethn Dis.* 2006;16(4):786–791.
36. Lee JA, Liu CF, Sales AE. Racial and ethnic differences in diabetes care and health care use and costs. *Prev Chronic Dis.* 2006;3(3):A85.
37. Oladele CR, Barnett E. Racial/ethnic and social class differences in preventive care practices among persons with diabetes. *BMC Public Health.* 2006;6:259.
38. Thackeray R, Merrill RM, Neiger BL. Disparities in diabetes management practice between racial and ethnic groups in the United States. *Diabetes Educ.* 2004;30(4):665–675.
39. Harris MI. Racial and ethnic differences in health care access and health outcomes for adults with type 2 diabetes. *Diabetes Care.* 2001;24(3):454–459.
40. Nwasuruba C, Osuagwu C, Bae S, Singh KP, Egede LE. Racial differences in diabetes self-management and quality of care in Texas. *J Diabetes Complications.* 2009;23(2):112–118.
41. DuBard CA, Yow A, Bostrom S, Attiah E, Griffith B, Lawrence W. Racial/ethnic differences in quality of care for North Carolina Medicaid recipients. *N C Med J.* 2009;70(2):96–101.
42. Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, NJ: Prentice-Hall; 1986.
43. Whittemore R, D'Eramo Melkus G, Grey M. Metabolic control, self-management and psychosocial adjustment in women with type 2 diabetes. *J Clin Nurs.* 2005;14(2):195–203.
44. Gallant MP. The influence of social support on chronic illness self-management: a review and directions for research. *Health Educ Behav.* 2003;30(2):170–195.
45. Talbot F, Nouwen A, Gingras J, Gosselin M, Audet J. The assessment of diabetes-related cognitive and social factors: the multidimensional diabetes questionnaire. *J Behav Med.* 1997;20(3):291–312.
46. Toljamo M, Hentinen M. Adherence to self-care and social support. *J Clin Nurs.* 2001;10(5):618–627.
47. Glasgow RE, Toobert DJ, Hampson SE, Wilson W. Behavioral research on diabetes at the Oregon Research Institute. *Ann Behav Med.* 1995;17(1):32–40.
48. Hurley AC, Shea CA. Self-efficacy: strategy for enhancing diabetes self-care. *Diabetes Educ.* 1992;18(2):146–150.
49. Rosland AM, Kieffer E, Israel B, et al. When is social support important? The association of family support and professional support with specific diabetes self-management behaviors. *J Gen Intern Med.* 2008;23(12):1992–1999.
50. Sarkar U, Fisher L, Schillinger D. Is self-efficacy associated with diabetes self-management across race/ethnicity and health literacy? *Diabetes Care.* 2006;29(4):823–829.
51. Brody GH, Kogan SM, Murry VM, Chen YF, Brown AC. Psychological functioning, support for self-management, and glycemic control among rural African American adults with diabetes mellitus type 2. *Health Psychol.* 2008;27(1 Suppl):S83–S90.
52. Shaw BA, Gallant MP, Riley-Jacome M, Spokane LS. Assessing sources of support for diabetes self-care in urban and rural underserved communities. *J Community Health.* 2006;31(5):393–412.
53. Skelly AH, Marshall JR, Haughey BP, Davis PJ, Dunford RG. Self-efficacy and confidence in outcomes as determinants of self-care practices in inner-city, African-American women with non-insulin-dependent diabetes. *Diabetes Educ.* 1995;21(1):38–46.
54. Chlebowy DO, Garvin BJ. Social support, self-efficacy, and outcome expectations: impact on self-care behaviors and glycemic control in Caucasian and African American adults with type 2 diabetes. *Diabetes Educ.* 2006;32(5):777–786.
55. Spencer MS, Kieffer EC, Sinco BR, et al. Diabetes-specific emotional distress among African Americans and Hispanics with type 2 diabetes. *J Health Care Poor Underserved.* 2006;17(2 Suppl):88–105.
56. Seveck MA, Zickmund S, Korytkowski M, et al. Design, feasibility, and acceptability of an intervention using personal digital assistant-based self-monitoring in managing type 2 diabetes. *Contemp Clin Trials.* 2008;29(3):396–409.
57. Stewart AL, Mills KM, King AC, Haskell WL, Gillis D, Ritter PL. CHAMPS physical activity questionnaire for older adults: outcomes for interventions. *Med Sci Sports Exerc.* 2001;33(7):1126–1141.

58. Rigler SK, Studenski S, Wallace D, Reker DM, Duncan PW. Co-morbidity adjustment for functional outcomes in community-dwelling older adults. *Clin Rehabil.* 2002;16:420–428.
59. Beck AT, Steer RA, Brown GK. *BDI-II Manual*. San Antonio, TX: Harcourt Brace & Co; 1996.
60. Signorello LB, Schlundt DG, Cohen SS, et al. Comparing diabetes prevalence between African Americans and Whites of similar socioeconomic status. *Am J Public Health.* 2007;97(12):2260–2267.
61. Link CL, McKinlay JB. Disparities in the prevalence of diabetes: is it race/ethnicity or socioeconomic status? Results from the Boston Area Community Health (BACH) survey. *Ethn Dis.* 2009;19(3):288–292.
62. Laveist TA, Thorpe RJ Jr, Galarraga JE, Bower KM, Gary-Webb TL. Environmental and socio-economic factors as contributors to racial disparities in diabetes prevalence. *J Gen Intern Med.* 2009;24(10):1144–1148.
63. Landrine H, Corral I. Separate and unequal: residential segregation and black health disparities. *Ethn Dis.* 2009;19(2):179–184.
64. O'Dell K, O'Dell M. Socio-ecological resources for diabetes self-management. *J Miss State Med Assoc.* 2006;47(4):99–103.
65. Glasgow RE, Strycker LA, Toobert DJ, Eakin E. A social-ecologic approach to assessing support for disease self-management: the Chronic Illness Resources Survey. *J Behav Med.* 2000;23(6):559–583.
66. Polonsky WH, Anderson BJ, Lohrer PA, et al. Assessment of diabetes-related distress. *Diabetes Care.* 1995;18(6):754–760.

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