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Sex differences in the association of psychosocial resources with prevalent type 2 diabetes among African Americans: The Jackson Heart Study

LáShauntá M. Glover [a,*], Alain G. Bertoni [b], Sherita H. Golden [c], Peter Baltrus [d], Yuan-I Min [e], Mercedes R. Carnethon [f], Herman Taylor [g], Mario Sims [e]

[a] Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, NC, USA
[b] Department of Epidemiology and Prevention, Wake Forest University School of Medicine, Winston-Salem, NC, USA
[c] Department of Medicine and Epidemiology, Johns Hopkins University, Baltimore, MD, USA
[d] Community Health and Preventive Medicine, Morehouse School of Medicine, Atlanta, GA, USA
[e] Department of Medicine, University of Mississippi Medical Center, Jackson, MS, USA
[f] Department of Preventive Medicine, Northwestern University, Chicago, IL, USA
[g] Cardiovascular Research Institute, Morehouse School of Medicine, Atlanta, GA, USA

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ABSTRACT

Aim: To examine the association of psychosocial resources with prevalent type 2 diabetes (T2D) in 5104 African American men and women.
Methods: Using data from the Jackson Heart Study (JHS), we evaluated the cross-sectional associations of four psychosocial resources (social support, optimism, religiosity, and social networks) with T2D [fasting glucose ≥126 mg/dL, or HbA1c ≥ 6.5%, or use of diabetic medication]. Multivariable Poisson regression estimated prevalence ratios (PR, 95% confidence interval-CI) of T2D by each psychosocial measure, adjusting for demographics, SES, waist circumference, health behaviors, and depressive symptoms.
Results: Women reported greater religiosity and had more social networks than men ($p < 0.001$). High (vs. low) *social support* was associated with a lower prevalence of T2D among men after full adjustment (PR 0.74, 95% CI 0.59–0.91). Women with high (vs. low) *social networks* had a 16% lower prevalence of T2D (PR 0.84, 95% CI 0.73–0.96) after full adjustment. High (vs. low) *optimism* was associated with a 20% lower prevalence of T2D after adjustment for age (PR 0.80, 95% CI 0.65–0.98). Religiosity was not associated with T2D.
Conclusion: Social support and networks should be considered in efforts to prevent T2D among a high-risk group such as African Americans.

1. Introduction

Type 2 Diabetes (T2D) is the 7th leading cause of death,[1] a risk factor for cardiovascular disease (CVD) and a contributor to complications that severely impair quality of life (e.g., retinopathy, chronic kidney disease and amputations).[2] The prevalence of T2D among African Americans in the US is approximately 13.2% for women and 12.2% for men, which is second highest to Native Americans.[1] Research has shown that positive affect, the extent to which an individual subjectively experiences positive moods, is associated with better health outcomes and may be important in the regulation of physiological processes.[3] For example, dispositional optimism, defined as expecting positive outcomes in the future, has been reported to be associated with optimal health behaviors, such as greater physical activity, which could protect against the development of T2D.[4] Similarly, positive psychosocial resources, such as beneficial social support within a social network, are associated with larger reductions in Hemoglobin (Hb)A1c among individuals with diabetes when compared to those without social networks.[5] Religiosity, measured as church attendance and religious coping strategies used when confronting difficult life situations, has also been linked to better glycemic control among individuals with diabetes relative to non-religious persons.[6,7] Additionally, research has reported inverse associations of social support,[8,9] positive affect,[10] and self-esteem,[11,12] with diabetes after accounting for health behaviors.

Abbreviations: T2D, Type 2 Diabetes; JHS, Jackson Heart Study; HbA1c, Hemoglobin A1c; PR, Prevalence Ratio; CI, Confidence Interval.

* Corresponding author at: Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, 123 W. Franklin Street, Building C, Suite 4240, Chapel Hill, NC 27599, USA.
E-mail address: lmglover@unc.edu (L.S.M. Glover).

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These psychosocial resources are considered markers of resilience, which promote healthy emotion regulation, and the absence of adverse health outcomes despite exposure to risk.[13] There is limited research that examines the link between psychosocial resources and a lower risk of disease among African Americans. Most studies of positive psychosocial resources in African Americans have utilized a small sample size, and/or examined only one psychosocial resource, and/or examined the effects of low (vs. high) resources on risk of disease. For this reason, the current study examined the associations of high (vs. low) psychosocial resources (social support, optimism, religiosity, and social networks) with prevalent T2D (defined by the American Diabetes Association (ADA)) among African American men and women in the Jackson Heart Study (JHS). We hypothesized that greater psychosocial resources would be associated with a lower prevalence of T2D and there will be significant differences by sex.

2. Methods

2.1. Study population

The JHS is a longitudinal, epidemiologic study examining the etiology of CVD among a large cohort of African Americans (n = 5306) residing in the tri-county area (Hinds, Rankin, and Madison) of Jackson, MS. Participants (21–95 years old) were enrolled at baseline (2000–2004) and were selected from 4 sources: 1) community random sample (17%), 2) volunteer sample (30%), 3) the Atherosclerosis Risk in Communities Study (31%), and family members of participants (22%). Participants completed home interviews, self-administered questionnaires, and in-clinic examinations to obtain demographic, psychosocial, behavioral, anthropometric, and clinical data. Recruitment, sampling[14] and study methods[15–19] have been reported elsewhere. The study was approved by the institutional review boards of the University of Mississippi Medical Center, Jackson State University, and Tougaloo College, and all participants provided informed consent.

2.2. Type 2 diabetes

Prevalent T2D status was defined by the 2010 ADA guidelines. Participants with T2D were those who had a fasting glucose ≥126 mg/dL, or HbA1c ≥ 6.5%, or those who reported use of diabetic medication (actual or self-reported) within 2 weeks prior to the clinic visit.

2.3. Psychosocial resources

Social support was measured using the Interpersonal Social Support Evaluation List (ISEL).[20] The list is comprised of 16 items that describe 1) emotional support (appraisal), 2) others with whom one can interact (belonging), 3) material aid (tangible), and 4) others with whom one believes s/he compares favorably (self-esteem). The continuous score ranged from 18 to 62, where a higher score indicated greater social support. Cronbach's alpha was 0.83.

Dispositional *optimism* was measured using the 6-item Life Orientation Test-Revised (LOT-R) Scale,[21] which consists of three positively worded items (optimism – e.g., "In uncertain times, I expect the best") and three negatively worded items (pessimism – e.g., "If something can go wrong for me, it will"). The negatively worded items were coded to indicate lower optimism. The total optimism score ranged 6–24, where a higher score indicated greater optimism. Cronbach's alpha was 0.64.

Religiosity was measured using the Daily Spiritual Experiences Scale.[22] Participants were asked 1) how often they attended worship service, 2) prayed somewhere other than a church/place of worship, and 3) to what extent was religion involved with dealing with stress. Items were reverse coded; higher scores indicated greater worship service attendance, greater use of prayer outside of church/place of worship, and greater use of religion when dealing with stress. The religiosity score ranged from 7 (low religiosity) to 22 (high religiosity). Cronbach's alpha was 0.78.

The *social networks* measure was adapted from the Berkman Social Network Index (SNI), which consists of 5 items.[23] The 5-item scale asked participants about types of social connections: marital status, number of friends, number of relatives, membership in community groups, and frequency of social contact. Items were recoded, and scores ranged from 0 to 5, where higher scores indicated larger social networks. Cronbach's alpha was 0.47, due to the non-covariance of items within the measure.

Each psychosocial parameter was summed to create a continuous score. The score for each measure was then split at the median to examine the effect of high vs. low psychosocial resources on T2D prevalence. Scores were also examined continuously by transforming the total scores into standard deviation (SD) units.

2.4. Covariates

Covariates for this study included non-modifiable and modifiable factors that could influence the association between psychosocial resources and T2D. Demographic variables (non-modifiable) included age (continuous) and sex (men/women). Modifiable factors included socioeconomic status (SES), waist circumference, and health behaviors. SES was approximated using self-reported educational attainment, based on years of schooling. The categories included less than high school (<HS), high school graduate/general equivalency diploma to some college/associate's degree (HS4-C1-3), and college degree or more (C4+). Total waist circumference was measured in centimeters (cm). Health behaviors included alcohol intake (none/light/heavy), physical activity (ideal vs. non-ideal-adopted from Life's Simple 7 categorization), and smoking (ideal vs. non ideal-adopted from Life's Simple 7 categorization).[24] Participants had "ideal physical activity" if they reported >150 min of moderate physical activity and >75 min of vigorous physical activity; participants had "non-ideal physical activity" if they reported <150 min of moderate physical activity and <75 min of vigorous physical activity. Participants who reported that they never smoked or quit smoking more than a year prior to examination were categorized as "ideal"; those who were current smokers or had quit smoking <12 months prior to examination were considered "non-ideal". We also included depressive symptoms as a covariate to account for potential confounding of negative affect. The scale was adopted from the Centers for Epidemiologic Studies, and ranged from 0 to 48, where a higher score indicated greater depressive symptoms.

2.5. Statistical analyses

There were 5306 participants in the JHS cohort. We excluded 137 due to missing covariates [education (n = 13), smoking (n = 88), alcohol use (n = 30), waist circumference (n = 6)]. Those missing data for diabetes (n = 56) were also excluded. Missing depression data (over 40%) were coded as a separate missing dummy category, so that participants could be retained in analyses, leaving 5104 participants who were examined for prevalent diabetes. In order to avoid multicollinearity, each psychosocial resource measure was analyzed in separate models. Regression models for each measure of psychosocial resources and T2D were restricted to 3928, 4049, 3984, and 5074 participants for social support, optimism, religiosity, and social networks, respectively.

Chi-Square and analysis of variance (ANOVA) tests were performed to examine the univariate associations between psychosocial resources and select characteristics. We used Poisson regression with robust standard errors to examine the association of each psychosocial resource variable (low vs. high and SD units) with T2D, where prevalence ratios (PR, 95% confidence interval – CI) estimated the prevalence of T2D (vs. no T2D). Models were estimated sequentially: model 1 adjusted for age, model 2 additionally adjusted for education, model 3 additionally adjusted for waist circumference, physical activity, smoking, and alcohol use. Model 4 adjusted for all covariates plus depressive symptoms. A test for effect modification by sex demonstrated that associations of psychosocial

resources varied by sex (p values for interaction =0.004 and 0.038 for social support and optimism respectively); therefore, we stratified the analyses by sex. A (two-tailed) p-value < 0.05 was considered significant. Analyses were conducted using Stata 14.0 (StataCorp, College Station, TX).

3. Results

Table 1 demonstrates select characteristics and psychosocial resources by sex. The average age was 55.3 years, 63.5% were women. Women were more likely to have ideal smoking behaviors than men (88.5% vs. 80.2%, $p < 0.001$). Men were more likely to have ideal physical activity ($p < 0.001$), lower depressive symptoms ($p < 0.001$), and a lower prevalence of diabetes (20.3% vs 22.7%, $p = 0.039$). Women reported greater use of religion and social networks than men ($p < 0.001$).

Table 2 shows the PRs of T2D by high (vs. low) psychosocial resources stratified by sex. Sex modified the association of prevalent T2D with social support after full adjustment (p value for interaction = 0.004). Social support was associated with lower T2D prevalence among men but not women. For example, high (vs. low) *social support* was associated with a 31% lower prevalence of T2D in model 1 (PR 0.69, 95% CI 0.56–0.85) and model 2 (PR 0.69, 95% CI 0.56–0.86) among men. In model 3, high (vs. low) social support was associated with a 28% decrease in T2D prevalence (PR 0.72 95% CI 0.59–0.89). After full adjustment, high social support was associated with a 26% lower prevalence of T2D. A 1-SD unit increase in *social support* was associated with a 17% lower prevalence of T2D in models 1 and 2 (PR 0.83, 95% CI 0.75–0.91; PR 0.83, 95% CI 0.75–0.92, respectively). In models 3 and 4, a 1-SD unit increase in social support was associated with a 14% decrease in T2D prevalence (PR 0.86, 95% CI 0.78–0.94 and PR 0.86 95% CI 0.79–0.95, respectively). High (vs. low) *optimism* was not significantly associated with T2D among women. However, among men, high optimism was associated with a 20% decrease in T2D prevalence in model 1 (PR 0.80, 95% CI 0.65–0.98). The association attenuated in models 2–4. High (vs. low) *religiosity* was not associated with T2D prevalence among men or women. High (vs. low) *social networks* were associated with a lower prevalence of T2D in models 1 through 4 among women. In the fully adjusted model, high *social networks* were associated with a 16% decrease in T2D prevalence among women (PR 0.84, 95% CI 0.73–0.96). A 1-SD unit increase in social networks was associated with a 6% decrease in T2D among women in the fully adjusted model (PR 0.94, 95% CI 0.89–0.99). Social networks in SD units were significantly associated with a 13% decrease in T2D among men, only in models 1 and 2 (PR 0.87, 95% CI 0.76–0.98 and PR 0.87, 95% CI 0.77–0.98, respectively).

Table 1
Select characteristics and psychosocial resources by sex: Jackson Heart Study (2000–2004).

	Total	Men (36.5%)	Women (63.5%)	*P* value
Select characteristics				
Age (mean)	55.3	54.6	55.8	<0.001
% College degree	39.2	37.8	40.1	0.231
% Ideal smoking	85.5	80.2	88.5	<0.001
% Ideal physical activity	19.1	22.8	17.0	<0.001
Waist circumference (mean)	100.7	101.3	100.4	0.06
Depression (mean)	11.0	9.8	11.6	<0.001
% Diabetes	21.9	20.3	22.7	0.039
Psychosocial resources				
Social support (3913)				0.110
Low	51.2	49.6	52.2	
High	48.8	50.4	47.8	
Optimism (4441)				0.142
Low	55.3	53.9	56.1	
High	44.7	46.1	43.9	
Religiosity (3963)				<0.001
Low	55.9	62.9	52.1	
High	44.1	37.1	47.9	
Social networks (5044)				<0.001
Low	75.8	88.4	68.6	
High	24.2	11.6	31.4	

Note: Ideal physical activity was defined as >150 min of moderate physical activity and >75 min of vigorous physical activity. Ideal smoking was defined as had never smoked cigarettes or had quit smoking over a year prior to examination. *P* value based on chi square and Analysis of Variance (ANOVA) tests.

4. Discussion

The present study examined associations of psychosocial resources with T2D among a large sample of African American men and women. Men had a lower prevalence of T2D when they reported high social support after full adjustment and high optimism after adjustment for age. After full adjustment, women had a lower prevalence of T2D when they reported greater social networks. Since optimism and religiosity were not consistently associated with a lower prevalence of T2D, partial support was found for our hypothesis.

4.1. Social support

Studies have reported significant inverse associations between increasing social support and decreased prevalence of diabetes. In one study of 914 adults from the Health and Retirement Study, Mondesir et al.[25] found that women who reported having illness-related social support had a 6% higher prevalence of having "good" glycemic control (HbA1c <8.0%). Tang et al.[8] found that social support was associated with better monitoring of glucose and a greater likelihood of eating a better diet among a small sample of African Americans (n = 89). Our findings demonstrated that increasing tangible aid and emotional support from family and friends was significantly associated with a lower prevalence of T2D only among men. Women reported greater depressive symptoms than men, which may be due to repeated exposure to stress and release of excess cortisol leading to hyperglycemia, and, therefore, increasing the risk of diabetes despite having social support.[26,27] It is also possible that women in this sample were not satisfied with the social support they received, which can place them at risk for illnesses.[28]

4.2. Optimism

There are limited studies that have examined the association between optimism and prevalent diabetes. Boehm et al.[12] examined the association between positive psychological well-being and incident type 2 diabetes. Their study reported that among 7800 British men and women, optimism was not associated with incidence diabetes; however, significant associations between diabetes, life satisfaction, and emotional vitality were found. In a racially and ethnically diverse sample of 3443 post-menopausal women, Tindle et al.[29] found that optimism was negatively associated with insulin resistance in unadjusted analyses, but the association was not significant after adjustment for clinical factors and depressive symptoms. In our study, optimism was only associated with a lower prevalence of diabetes among men after adjustment for age. Perhaps optimism does not capture positive affect well in this sample, and thus did not have the expected association with diabetes, and other measures of positive affect (joy, emotional vitality) may need to be considered. A further exploration of the behavioral pathway (i.e., diet) may need to be examined as optimistic persons likely have healthier diets,[4] which should delay the onset of T2D or improve diabetes status.

4.3. Religiosity

Findings on the association between religiosity and diabetes have been mixed. One study found that spirituality, defined as perception of life's purpose and meaning without religious reference, was inversely associated with prevalent diabetes among 220 participants of the SPILI III cohort.[6] On the other hand, Newlin et al.[30] found that religion and spirituality were positively associated with HbA1c in a sample of 109 African

Table 2
Sex-stratified prevalence ratios of type 2 diabetes status by psychosocial resources among Jackson Heart Study Participants (2000–2004).

Psychosocial Resources	Diabetic (vs. non-diabetic) prevalence ratios (PR 95% CI)							
	Model 1		Model 2		Model 3		Model 4	
	Women	Men	Women	Men	Women	Men	Women	Men
Social support								
Low	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
High	1.00(0.86–1.15)	**0.69 (0.56–0.85)***	1.02(0.88–1.18)	**0.69 (0.56–0.86)***	1.06(0.92–1.22)	**0.72 (0.59–0.89)***	1.08(0.93–1.24)	**0.74 (0.59–0.91)***
SD units	0.96(0.90–1.03)	**0.83 (0.75–0.91)***	0.97(0.91–1.04)	**0.83 (0.75–0.92)***	0.99(0.93–1.06)	**0.86 (0.78–0.94)***	1.00(0.94–1.07)	**0.86 (0.79–0.95)***
Optimism								
Low	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
High	1.05(0.91–1.20)	**0.80 (0.65–0.98)***	1.07(0.93–1.22)	0.83(0.68–1.03)	1.09(0.95–1.25)	0.87(0.70–1.07)	1.10(0.96–1.26)	0.87(0.71–1.08)
SD units	0.98(0.91–1.05)	0.96(0.86–1.04)	0.99(0.92–1.06)	0.97(0.88–1.07)	1.00(0.94–1.07)	0.99(0.90–1.08)	1.01(0.94–1.08)	0.99(0.90–1.09)
Religiosity								
Low	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
High	1.09(0.95–1.26)	1.19(0.97–1.47)	1.09(0.94–1.26)	1.17(0.95–1.44)	1.07(0.93–1.23)	1.10(0.89–1.36)	1.07(0.93–1.23)	1.09(0.89–1.34)
SD units	1.00(0.92–1.09)	1.05(0.95–1.16)	1.00(0.92–1.09)	1.05(0.95–1.16)	1.00(0.92–1.08)	1.01(0.92–1.11)	1.00(0.92–1.08)	1.01(0.91–1.11)
Social networks								
Low	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
High	**0.85 (0.74–0.97)***	0.93(0.71–1.21)	**0.83 (0.72–0.96)***	0.92(0.70–1.20)	**0.84 (0.73–0.96)***	1.01(0.78–1.32)	**0.84 (0.73–0.96)***	1.01(0.83–1.22)
SD units	0.95(0.90–1.01)	**0.87 (0.76–0.98)***	**0.94 (0.89–0.99)***	**0.87 (0.77–0.98)***	0.94 (0.89–0.99)*	0.90(0.79–1.02)	**0.94 (0.89–0.99)***	0.90(0.80–1.02)

Abbreviations: PR prevalence ratio; CI confidence interval; SD standard deviation.
Model 1 adjusted for age.
Model 2 adjusted for Model 1 + education.
Model 3 adjusted for Model 2 + waist circumference, alcohol use, physical activity, and smoking.
Model 4 was fully adjusted + depressive symptoms.
* **Bold** = *P*-value ≤ 0.05.

American women in southern New England, when accounting for age, income, education, and BMI. Correlational and descriptive reports have also found that religious beliefs were positively associated with diabetic outcomes.[31–33] Our study demonstrated that religious practices such as church attendance, praying, and religious coping were not associated with T2D, but the findings were in the positive direction.

4.4. Social networks

Few studies have also examined the association between social networks and prevalent T2D among African Americans. However, some studies have found significant associations between social networks and incident T2D, specifically social isolation was associated with greater incidence of T2D,[34] while higher social relations were associated with a lower incidence of T2D among 6839 men and women from southern Germany.[35] A randomized intervention study conducted by Shaya et al.[5] assessed the effect of social networks (consisting of peer support, education sessions) on the management of diabetes among 150 African Americans (mean age: 54 years). Among those who had greater social networks, there was a greater reduction of HbA1c and glucose than the control group. We found that women with high (vs. low) social networks had a reduced prevalence of T2D, even after adjusting for health behaviors and depressive symptoms. Social networks differ from social support, in that it accesses social contact and connections instead of tangible or emotional support. Women may be more likely to join and participate in organizations or groups, which could provide mental and physical health benefits. Social networks may also be a more robust predictor of better health, as it did not attenuate with depressive symptoms.

4.5. Strengths and limitations

To our knowledge, this is the first study to simultaneously examine the association of four (4) psychosocial resources with prevalent T2D in a large sample of African American men and women. Also, this study included high-risk participants (prevalence of T2D was 21.9%). Although we show evidence that social support and social networks are associated with a lower likelihood of T2D, this study has limitations. First, it is possible that we may not have identified all factors that may affect the association between psychosocial resources and T2D. For example, family history of diabetes, stress, and other social environmental constructs could mediate the observed associations. Additionally, these findings are limited exclusively to African Americans in a single metropolitan area, limiting its generalizability to African Americans in other regions of the U.S. Our study design was also cross-sectional, which limited our ability to draw causal inferences and determine directionality of associations. For example, it is possible that lifestyle changes could alter social networks after diabetes diagnosis.

5. Conclusion

This study found that having greater social support was associated with lower T2D prevalence among African American men and greater social networks were most consistently associated with lower T2D prevalence among African American women. In order to reduce the prevalence of diabetes among African Americans, it is important to consider the role of social support and social networks among African American men and women with diabetes. More research needs to consider how positive factors are protective against chronic illnesses among high-risk groups for purposes of tailoring prevention interventions that will reduce the burden of chronic disease among African Americans.

Disclaimer

The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the National Heart, Lung, and Blood Institute; the National Institutes of Health; or the U.S. Department of Health and Human Services.

Ethical approval

All procedures performed in involving human participants 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.

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Conflict of interests

None.

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