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Sex Differences in Factors Contributing to the Racial Disparity in Diabetes Risk

April P. Carson, PhD[1], **D. Leann Long, PhD**[2], **Andrea Cherrington, MD**[3], **Gareth R. Dutton, PhD**[3], **Virginia J. Howard, PhD**[1], **Todd M. Brown, MD, MSPH**[4], **George Howard, DrPH**[2], **Monika M. Safford, MD**[5], **Mary Cushman, MD**[6]

[1]Department of Epidemiology, School of Public Health, University of Alabama at Birmingham, Birmingham, Alabama

[2]Department of Biostatistics, School of Public Health, University of Alabama at Birmingham, Birmingham, Alabama

[3]Division of Preventive Medicine, School of Medicine, University of Alabama at Birmingham, Birmingham, Alabama

[4]Division of Cardiovascular Disease, School of Medicine, University of Alabama at Birmingham, Birmingham, Alabama

[5]Division of General Internal Medicine, Weill Cornell Medical College, Cornell University, New York, New York

[6]Department of Medicine, Larner College of Medicine, University of Vermont, Burlington, Vermont

Abstract

Introduction: Diabetes incidence differs by race in the U.S., with a persistent reported Black–White disparity. However, the factors that contribute to this excess risk in middle-aged and older adults are unclear.

Methods: This prospective cohort study included 7,171 Black and White adults aged ≥45 years without diabetes at baseline (2003–2007) who completed a follow-up exam (2013–2016). Modified Poisson regression was used to obtain sex-stratified RRs for diabetes. Mediation analyses using change in β coefficient assessed individual and neighborhood factors that contribute to the racial disparity in diabetes incidence. Statistical analyses were conducted in 2018–2019.

Results: The cumulative incidence of diabetes was higher for Black men (16.2%) and women (17.7%) than White men (11.0%) and women (8.1%). Adjusting for age and prediabetes, diabetes

Address correspondence to: April P. Carson, PhD, University of Alabama at Birmingham, 1720 2nd Avenue South, RPHB 220, Birmingham AL 35294. apcarson@uab.edu.

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risk was higher for Black women than White women (RR=1.75, 95% CI=1.47, 2.07) and Black men than White men (RR=1.33, 95% CI=1.09, 1.64). The individual factors that attenuated the racial disparity the most were Southern dietary pattern (42.8% change in β) and neighborhood socioeconomic environment (26.3% change in β) among men and BMI (34.4% change in β) and waist circumference (32.4% change in β) among women. When including all factors collectively, the racial disparity in diabetes incidence was similar for men (RR=1.38, 95% CI=1.04, 1.83) and was attenuated for women (RR=1.41, 95% CI=1.11, 1.81).

Conclusions: The racial disparity in diabetes incidence remained after accounting for individual and neighborhood factors. Further investigation of additional factors underlying this racial disparity is needed to inform multilevel strategies for diabetes prevention.

INTRODUCTION

The incidence of diabetes is higher for Black adults compared with White adults across the age spectrum.[1–4] Although trends in diabetes incidence have begun to plateau overall in the last decade, the diabetes incidence rate for Black adults increased at a greater rate than that for White adults from 1997 to 2012.[5] Moreover, changes in trends by age group occurred with diabetes incidence rates leveling off for adults aged 45–64 years while continuing to increase for adults aged 65–79 years.[5] These divergent trends may lead to a widening of the racial disparity in diabetes incidence at older ages, which suggests a need to identify which factors may contribute to this excess risk.

Prior studies investigating the factors that underlie the racial disparity in diabetes incidence among middle-aged and older adults have reported varying findings. In the Atherosclerosis Risk in Communities (ARIC) study of middle-aged adults (1987–1996), the magnitude of the racial disparity in diabetes incidence was larger among women than men and remained after adjustment for sociodemographic and cardiovascular risk factors.[2] The investigation of non-traditional factors (e.g., lung function) in the ARIC Study further attenuated the racial disparity.[6] Similarly, the Northern Manhattan Study (1993–2014) reported a higher risk of diabetes for Black adults versus White adults that remained after adjustment for cardiovascular risk factors.[7] By contrast, the racial disparity in incident diabetes among older adults was not present after adjustment for SES and comorbidities in the Health and Retirement Study (1995–2006).[8]

Given these mixed findings and changing trends in diabetes incidence, the aim of this study is to identify the contribution of individual and neighborhood factors, separately and collectively, to the racial disparity in diabetes incidence and determine whether these factors vary by sex in a contemporary cohort of Black and White middle-aged and older adults.

METHODS

Study Sample

The REasons for Geographic And Racial Differences in Stroke (REGARDS) study is a prospective cohort study designed to investigate risk factors for stroke morbidity and mortality. Details of the study design were published previously.[9] Briefly, 30,239 non-Hispanic Black and non-Hispanic White adults aged ≥45 years from the continental U.S.

were enrolled. At baseline (2003–2007), participants completed a structured telephone interview, questionnaires, and an in-home examination. During the examination, blood pressure, height, weight, and blood and urine samples were obtained following standardized protocols. A second in-home examination with a similar protocol was conducted in 2013–2016. The IRBs at each participating institution approved the study protocol and all participants provided written informed consent.

Of the 30,239 participants at baseline, 25% died and 22% withdrew during 10 years of follow-up, leaving 16,150 participants who completed the second in-home exam. Of those who completed the second in-home exam, participants were excluded from this analysis if they had diabetes at baseline (*n*=2,729), were missing diabetes status at baseline or follow-up (*n*=2,101), or were missing covariate data (*n*=4,149). The final sample size was 7,171 (*n*=3,145 men; *n*=4,026 women) (Appendix Figure 1).

Measures

Age, sex, race, education, marital status, annual household income, health insurance status, smoking status, alcohol consumption, and physical activity were self-reported.

Blood pressure and anthropometrics were measured by trained staff. Two blood pressure measurements were taken, with the average used for analysis. BMI was calculated as weight in kg divided by height in m^2. Waist circumference was measured at the midway point between the lowest rib and iliac crest.

Diet was assessed using the Block 98 food frequency questionnaire and principal components analysis was used to derive dietary patterns.[10] The identified patterns were: (1) convenience (e.g., fast foods), (2) plant-based (e.g., leafy vegetables, fruits), (3) sweets/fats (e.g., mostly sugar, breads, oils), (4) Southern (e.g., mostly fried foods, sugar-sweetened beverages), and (5) alcohol/salads (e.g., alcoholic beverages, leafy greens). Additionally, a Mediterranean diet score was calculated as the sum of scores in 9 categories (vegetables, fruits, legumes, cereals, fish, meat, dairy, fat intake, and alcohol intake).[11] Higher scores indicated higher adherence to the dietary pattern or diet score.

The residential address for each participant was geocoded and linked to 2000 U.S. Census data. Geographic region was categorized as Northeast, Midwest, South, and West. Urbanicity was defined as rural (census tract ≤25% urban), mixed (census tract 25% to <75% urban), or urban (census tract ≥75% urban). Neighborhood socioeconomic environment was assessed using a composite z-score based on census tract data,[12] with higher scores reflecting more-advantaged neighborhoods.

Depressive symptoms were assessed using the 4-item Centers for Epidemiologic Studies Depression Scale[13] and perceived stress was assessed using the Cohen Perceived Stress Scale short version.[14] The 12-item Short Form Health Survey was used to obtain a physical component score and a mental component score, with higher scores indicating better function.[15]

Blood samples were analyzed at a central laboratory.[16] Glucose and cholesterol were measured in serum using colorimetric reflectance spectrophotometry on the Ortho Vitros

950 IRC Clinical Analyzer. Chronic kidney disease was defined as an eGFR<60 mL/minute/1.73m^2 or albumin-to-creatinine ratio ≥30 mg/g.[17] Use of antihypertensive medications was self-reported and statin use was determined from a medication inventory done during the in-home exam.

Incident diabetes was defined as a fasting glucose ≥126 mg/dL or a random glucose ≥200 mg/dL or self-reported use of diabetes medications at the second in-home exam. Prediabetes at baseline was defined as a fasting glucose between 100 and 125 mg/dL or a random glucose between 140 and 199 mg/dL.

Statistical Analysis

Participant characteristics at baseline were calculated by race–sex group. Modified Poisson regression,[18] stratified by sex, was used to obtain RRs for incident diabetes comparing Black with White adults. Mediation analyses using change in β coefficient and bootstrapping were done to evaluate the contribution of factors to the racial disparity in diabetes incidence by comparing the base model to a model with factor adjustments. Splines were used to assess the racial disparity in incident diabetes by BMI, separately for men and women, with adjustment for age and prediabetes status.

The base model included age, age^2, and prediabetes status at baseline. Each factor was investigated individually in separate regression models and compared with the base model (dietary factor individual models also included total energy intake). Additional models compared the base model with grouped variables separately and all combined. The grouped variable categories were demographics (education, income, marital status, and health insurance status); anthropometrics (BMI, waist circumference), lifestyle factors (smoking, alcohol use, and physical activity), dietary factors (dietary patterns, Mediterranean diet score, and total energy intake), neighborhood factors (geographic region, urbanicity, and neighborhood socioeconomic environment), psychosocial factors (depressive symptoms, perceived stress, physical component score, and mental component score), and clinical factors (systolic blood pressure, use of antihypertension medications, chronic kidney disease, ratio of triglycerides to high-density lipoprotein cholesterol, and statin use).

Sensitivity analyses using inverse probability weighting (IPW) were done to assess the observed associations after accounting for the potential effect of selection bias. For this approach, participants who completed follow-up were weighted to reflect the original cohort and estimate the probability of attrition. This allowed for the inverse of this probability to be applied to the analysis of those who completed follow-up to obtain IPW effect estimates that may be interpreted as what would have been observed had the cohort not experienced attrition.[19] Additionally, given that dietary data was the covariate with the most missing data, analyses were repeated without excluding those missing dietary data to investigate associations with each variable grouping (except dietary factors). All analyses were performed using SAS, version 9.2 and R, version 3.5.1. Statistical analyses were conducted from fall 2018 to fall 2019.

RESULTS

Participant characteristics are presented by race–sex group in Table 1. Black men and women were younger, and were less likely to have health insurance than White men and women. Additionally, Black men and women were more likely to reside in less-advantaged neighborhoods, and have hypertension, but were less likely to report statin use compared with White men and women.

During a median 9.3 years of follow-up, 834 participants developed incident diabetes. The cumulative incidence was 12.9% for those aged 55–64 years at the follow-up exam, 12.6% for those aged 65–74 years at the follow-up exam, and 10.2% for those aged ≥75 years at the follow-up exam. The cumulative incidence by race–sex group was 17.7% for Black women, 8.1% for White women, 16.2% for Black men, and 11.0% for White men. The racial disparity in diabetes risk decreased as BMI increased (Figure 1), and was more pronounced among those with overweight (25≤ BMI <30 kg/m^2) for women and men.

In the base model adjusted for age, age^2, and prediabetes, the risk of diabetes was 75% higher for Black women compared with White women (RR=1.75, 95% CI=1.47, 2.07). The factors that attenuated the racial disparity among women the most individually were BMI (34.4%, 95% CI=26.3, 44.1), waist circumference (32.4%, 95% CI=24.6, 41.6), Southern dietary pattern (29.2%, 95% CI=11.9, 47.2), and neighborhood socioeconomic environment (28.1%, 95% CI=13.4, 41.8) (Figure 2). Among men, the risk of diabetes was 33% higher for Black men compared with White men (RR=1.33, 95% CI=1.09, 1.64). In analyses of factors among men, Southern dietary pattern (42.8%, 95% CI=9.5, 75.2), neighborhood socioeconomic environment (26.3%, 95% CI=3.9, 49.0), and education (24.9%, 95% CI=9.1, 41.7) attenuated the racial disparity the most individually (Figure 2). For both men and women, the model with the ratio of triglycerides to high-density lipoprotein cholesterol individually resulted in an exacerbation of the racial disparity.

The adjusted RRs for incident diabetes, by sex, for each group of variables are presented in Table 2. Among women, adjustment for each group of variables separately attenuated the racial disparity in diabetes incidence. Models that adjusted for dietary factors, anthropometrics, and neighborhood factors separately had the greatest attenuation of the racial disparity in diabetes incidence. In a model adjusting for all variables, 38% of the disparity was explained by these variables (change in β=37.9%, 95% CI= –0.0, 74.2), yet the excess risk of diabetes remained for Black women compared with White women (RR=1.41, 95% CI=1.11, 1.81). By contrast, dietary factors and lifestyle factors were the only groups of variables that significantly attenuated the racial disparity in diabetes incidence among men, whereas clinical factors strengthened the magnitude of the racial disparity. In a model adjusting for all variables, the racial disparity in diabetes incidence among men remained (change in β= −11.9%, 95% CI= −84.4, 57.6).

In sensitivity analyses that used IPW to account for loss to follow-up, the correlation of the results from the original analysis to the IPW analysis was 0.81 for women and 0.66 for men (Appendix Figure 2). In the IPW analysis, the racial disparity was not attenuated after adjustment for all factors for women (change in β=13.9%, 95% CI= −58.0, 68.5) or men (change in β= −35.9%, 95% CI= −279.0, 133.6) (Appendix Table 1).

Participants with missing dietary data who were excluded from the analysis were more likely to be Black and have less than a high school education. (Appendix Table 2). By contrast, participant characteristics were similar for those included versus those excluded for missing other covariate data (Appendix Table 2). In sensitivity analyses where analyses were repeated in the full cohort without excluding those missing dietary data (N=9,162), findings were similar for women (RR=1.54, 95% CI=1.24, 1.92) and men (RR=1.40, 95% CI=1.10, 1.79) after adjustment for all other individual and neighborhood factors except dietary data (Appendix Table 3).

DISCUSSION

In this population-based study of middle-aged and older U.S. adults, Black men and women continued to have a higher risk of diabetes compared with White men and women, although the individual and neighborhood factors underlying the racial disparity in diabetes incidence differed by sex.

The current study extends findings from prior studies that investigated the racial disparity in diabetes incidence. In the National Health and Nutrition Examination Survey (NHANES) I Study (1971–1992) of adults aged 25–74 years and the ARIC Study of middle-aged adults (1987–1998), the magnitude of the racial disparity in diabetes risk was greater for women than men,[2,20] which is consistent with the findings in this study. Moreover, different associations were identified by sex for individual and grouped variables. Whereas BMI had a non-linear association with diabetes risk in NHANES for both men and women,[20] BMI attenuated the racial disparity among women only in NHANES and ARIC.[2] In the current study, both BMI and waist circumference attenuated the racial disparity among women, whereas only BMI was significant among men. In addition to BMI and waist circumference, diet and lifestyle factors were evaluated separately to quantify their effects on the racial disparity in incident diabetes. Few studies have investigated dietary factors as contributors to the racial disparity in diabetes incidence. In the ARIC Study, adjustment for total dietary energy intake together with alcohol use, smoking, and physical activity slightly attenuated the racial disparity among women only.[2] Further investigation of total fiber, cereal fiber, and coffee intake in the ARIC Study showed that these dietary factors were not significant individual mediators of the racial disparity in diabetes incidence.[6] In the Coronary Artery Risk Development in Young Adults Study, an ideal diet score based on intake of fruits and vegetables, whole grains, fish, sodium, and sugar-sweetened beverages was not associated with incident diabetes but did attenuate the racial disparity for women (16%) and men (13%) when analyzed in combination with alcohol use, smoking, and physical activity.[1] A previous investigation in the REGARDS Study reported that a higher ideal cardiovascular health score, which included a dietary component, decreased the risk of diabetes among adults with normal glucose, with the association being stronger among Black adults than White adults.[21] In the current analysis, dietary factors, particularly the Southern dietary pattern, attenuated the racial disparity among women and men in individual and grouped analyses.

Education, income, and neighborhood socioeconomic environment were identified as contributors to the racial disparity in diabetes incidence among both men and women in analyses of individual factors among REGARDS participants. Though several,[2,7,8,20,22] but not all,[6] prior studies have reported individual socioeconomic factors were associated with the racial disparity in diabetes incidence, the investigation of neighborhood socioeconomic environment has been limited. In the Coronary Artery Risk Development in Young Adults Study, residential racial segregation and neighborhood poverty attenuated the racial disparity in diabetes incidence 23% in women but not in men.[1] In the current study, neighborhood socioeconomic environment attenuated the racial disparity for both men and women in individual analyses, whereas in analyses of multiple neighborhood factors together (neighborhood socioeconomic environment, geographic region, and urbanicity), the attenuation was present among women only.

Similar to findings in NHANES and ARIC, adjustment for individual and neighborhood factors together attenuated the racial disparity in diabetes incidence among women but not men in the current study. The Coronary Artery Risk Development in Young Adults Study (1985–2015), with 30 years of follow-up from young adulthood to middle age, also reported that adjustment for individual and neighborhood factors at baseline attenuated the racial disparity more among women (81%) than men (25%), whereas adjustment for time-updated clinical factors fully explained the racial disparity for both men and women.[1] Moreover, in the Health and Retirement Study (1995–2006), Black adults had an increased risk of diabetes compared with White adults that was no longer present after adjustment for SES, comorbidities, and updated health status.[8] In light of national data from 2008–2012 that showed the increase in the incidence of diagnosed diabetes has plateaued for White adults while it increased for Black adults,[5] these findings suggest prevention efforts to address individual and neighborhood factors that contribute to sex differences in the racial disparity in diabetes incidence among middle-aged and older adults are needed.

Prior studies suggest lifestyle intervention programs may be effective for diabetes prevention, particularly among older adults. In the Diabetes Prevention Program Outcomes Study, the lifestyle intervention, which included a curriculum that addressed weight loss/ maintenance and nutrition, reduced the risk of diabetes by 49% among older adults, whereas diabetes risk did not differ for older adults in the metformin and placebo groups.[23] Additionally, the lifestyle intervention demonstrated the greatest reduction in diabetes risk for those aged 60–85 years at randomization, compared with those aged 25–44 years and 45–59 years.[23] Because this lifestyle intervention reduces medical expenditures among Medicare recipients,[24] the Centers for Medicare and Medicaid Services recently added the Medicare Diabetes Prevention Program to its covered services.[25]

It is well established that the prevalence of diabetes is highest among older adults.[26] However, the burden of diabetes incidence is less clear among older adults. The incidence of diabetes peaked at age 55–64 years in NHANES,[27] whereas diabetes incidence was highest among adults age 65–74 years in a consortium of 11 integrated health delivery systems.[28] Regardless of age of onset, diabetes among older adults is of particular concern because of the management challenges associated with concomitant geriatric conditions, including polypharmacy, comorbidities, and limited life expectancy,[29] and the potential for overtreatment.[30] Although individualized treatment and less stringent glycemic control goals are recommended for older adults with diabetes,[31] the primary prevention of diabetes and its sequelae among older adults is paramount.

Limitations

This study has several potential limitations. Diabetes status was based on a single fasting or random glucose measurement or use of hypoglycemic medications and additional glycemic measures (e.g., HbA1c) were not collected. Also, it is possible that changes in the individual and neighborhood factors investigated here may have occurred over time and data were not available to assess how changes in these factors may have affected findings. Lastly, data on some predictors identified in other studies, as well as those not previously investigated such as structural racism and healthcare quality, were not available. Despite these limitations, the REGARDS study has several strengths, including its prospective follow-up and extensive data collection following standardized protocols.

CONCLUSIONS

Black adults had a higher risk of diabetes than White adults in this prospective study of middle-aged and older adults in the U.S. Although this racial disparity was somewhat attenuated among women but not men after adjustment for individual and neighborhood factors, these findings underscore the need for investigating additional factors that may underlie this disparity as well as developing multilevel diabetes prevention strategies to address known individual and structural factors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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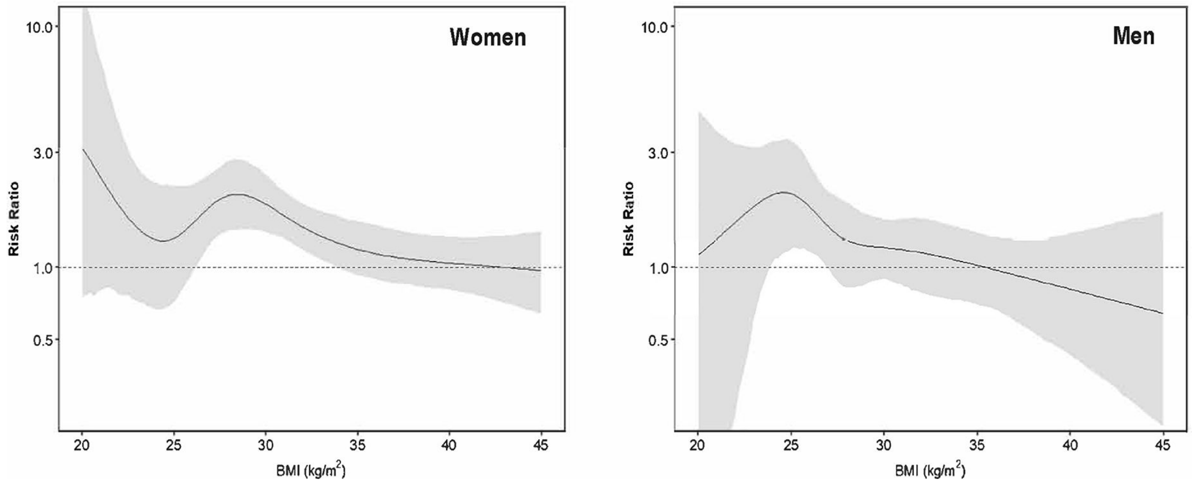

Figure 1.
Risk ratios for diabetes for Black adults versus White adults according to BMI.
Note: Presented separately for women and men. Adjusted for age and prediabetes. Shaded area represents 95% bootstrapped CI.

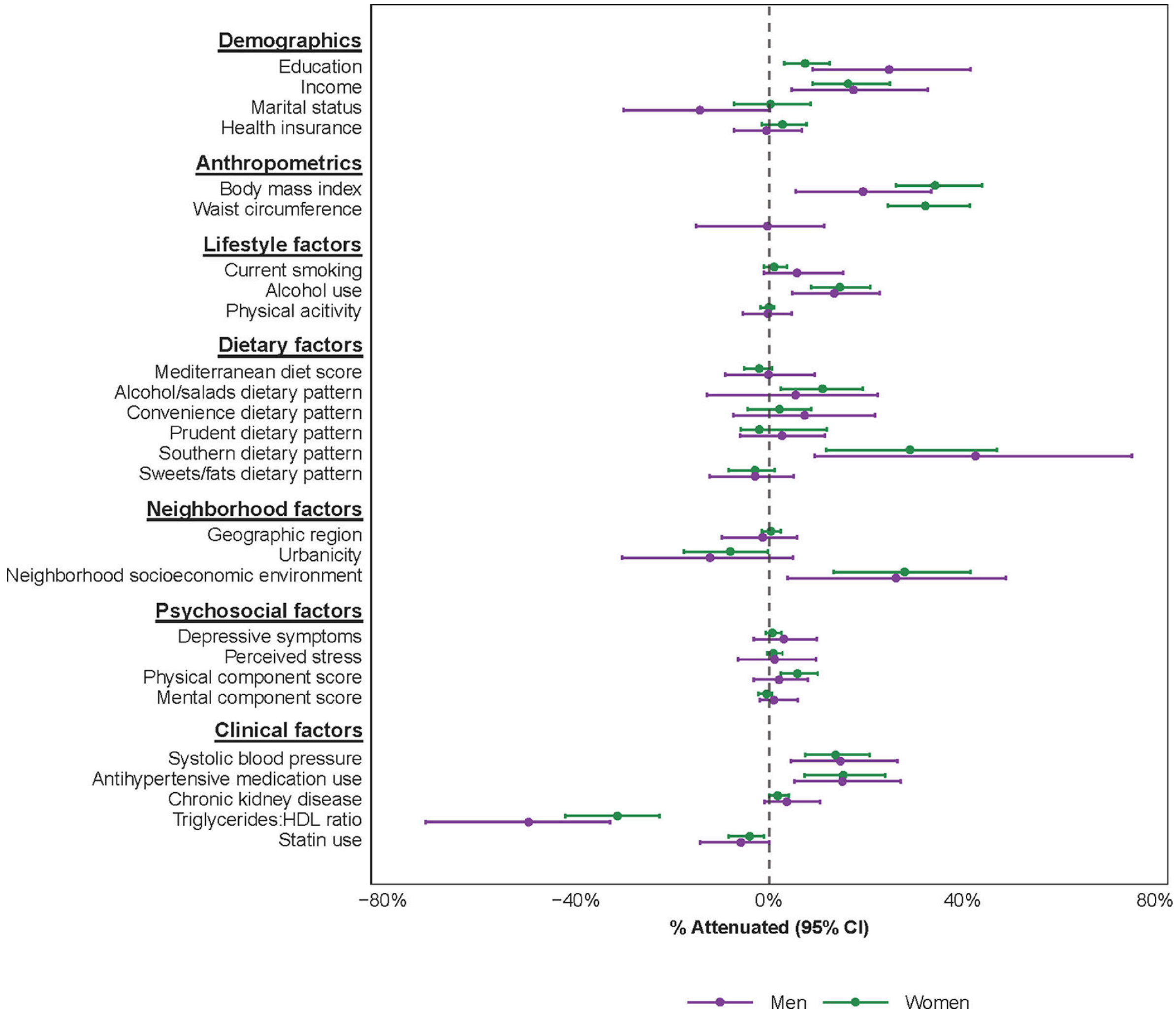

Figure 2.

Percentage attenuation of excess diabetes risk for Black adults compared with White adults by sex.

Note: Calculated as the difference in the β coefficient for the race variable in the reference model (adjusted for age and prediabetes) and a model further adjusted for each group of variables. Dietary factor models also adjusted for total energy intake.

Table 1.

Participant Characteristics for Those Without Prevalent Diabetes at Baseline, the REGARDS Study (2003–2007) N=7,171

Characteristics	Women		Men	
	Black	White	Black	White
	N=1,333	N=2,693	N=628	N=2,517
Demographics				
Age, years, mean (SD)	61.9 (8.2)	63.0 (8.7)	62.3 (8.0)	64.5 (8.2)
Education, %				
Less than high school	9.7	4.1	7.2	3.3
High school graduate	26.4	24.0	27.2	17.0
Some college	29.6	27.0	29.1	21.8
College graduate	34.4	45.0	36.5	57.9
Annual household income, %				
<$20,000	20.3	9.8	9.9	3.7
$20,000-<$35,000	27.1	21.6	24.4	16.7
$35,000-<$75,000	33.3	32.3	39.3	38.3
≥$75,000	10.3	22.4	19.9	33.7
Refused	9.0	13.9	6.5	7.6
Married, %	38.5	62.1	71.5	88.2
Has health insurance, %	89.9	96.4	91.1	97.2
Anthropometrics				
BMI (kg/m^2), mean (SD)	31.2 (6.7)	27.5 (5.6)	28.8 (4.9)	27.8 (4.3)
Waist circumference (cm), mean (SD)	93.7 (14.2)	86.4 (14.1)	98.3 (12.6)	98.5 (12.4)
Lifestyle factors				
Current smoking, %	13.5	9.9	14.8	8.1
Alcohol consumption, %				
Heavy	2.5	5.9	4.6	6.4
Moderate	24.4	39.4	44.3	52.9
None	73.1	54.7	51.1	40.8
Physical activity frequency, %				
≥4 times per week	24.2	28.8	34.4	39.4
1–3 times per week	40.7	40.7	43.2	40.3
None	35.2	30.5	22.5	20.3
Dietary factors				
Mediterranean diet score, mean (SD)	4.55 (1.69)	4.37 (1.69)	4.87 (1.63)	4.58 (1.76)
Alcohol/salads dietary pattern, mean (SD)	−0.31 (0.89)	0.16 (0.98)	−0.19 (0.94)	0.33 (1.03)
Convenience dietary pattern, mean (SD)	−0.25 (0.93)	0.03 (0.92)	−0.04 (1.02)	0.33 (1.03)
Plant-based dietary pattern, mean (SD)	0.19 (1.08)	0.07 (0.97)	−0.02 (0.99)	−0.14 (0.98)
Southern dietary pattern, mean (SD)	0.30 (0.89)	−0.59 (0.74)	0.72 (1.13)	−0.25 (0.85)
Sweets/fats dietary pattern, mean (SD)	−0.18 (0.99)	0.02 (0.95)	−0.10 (1.08)	0.13 (1.00)
Total energy intake (kcal), mean (SD)	1,587 (726)	1,595 (597)	1,850 (809)	1,900 (664)

Characteristics	Women		Men	
	Black N=1,333	White N=2,693	Black N=628	White N=2,517
Neighborhood factors				
Geographic region				
Northeast	7.1	6.5	7.2	7.4
Midwest	16.1	14.3	22.3	17.2
South	66.8	67.5	61.9	64.0
West	10.1	11.8	8.6	11.4
Urbanicity, %				
Rural	3.7	16.4	2.6	15.7
Mixed	6.6	15.5	7.3	14.9
Urban	89.7	68.1	90.1	69.5
Neighborhood socioeconomic environment, mean (SD)	−2.11 (4.06)	2.43 (5.59)	−1.43 (4.39)	2.84 (5.73)
Psychosocial factors				
Depressive symptoms, mean (SD)	1.10 (1.89)	0.95 (1.80)	0.83 (1.64)	0.51 (1.30)
Perceived stress scale, mean (SD)	3.29 (2.94)	3.11 (2.70)	2.74 (2.77)	2.20 (2.30)
Mental component score, mean (SD)	54.1 (8.3)	54.2 (7.8)	55.2 (7.5)	55.8 (6.2)
Physical component score, mean (SD)	46.9 (9.9)	48.9 (9.5)	49.6 (8.3)	50.6 (7.9)
Clinical factors				
Systolic blood pressure (mm Hg), mean (SD)	127.2 (16.1)	121.1 (15.1)	128.0 (14.7)	125.0 (14.3)
Antihypertensive medication use, %	61.7	37.3	52.4	37.9
Chronic kidney disease, %	13.4	11.6	13.5	11.4
Triglycerides: HDL cholesterol ratio, mean (SD)	1.94 (1.31)	2.48 (1.77)	2.55 (1.76)	3.25 (2.31)
Statin use, %	20.9	24.8	29.0	36.1
Prediabetes, %	24.1	15.5	28.3	23.8

REGARDS, REasons for Geographic and Racial Differences in Stroke; HDL, high-density lipoprotein.

Table 2.

Risk Ratios for Diabetes for Black Adults Versus White Adults, by Sex, the REGARDS Study

Model[a]	Women		Men	
	Adjusted risk ratio (95% CI)	% Change in β[b] (95% CI[c])	Adjusted risk ratio (95% CI)	% Change in β[b] (95% CI[c])
Model 1: Adjusted for age and prediabetes	1.75 (1.47, 2.07)	ref	1.33 (1.09, 1.64)	ref
Model 2: Adjusted for Model 1 + demographics	1.61 (1.34, 1.92)	**15.0 (4.8, 26.1)**	1.27 (1.03, 1.57)	15.8 (−6.9, 39.0)
Model 3: Adjusted for Model 1 + anthropometrics	1.44 (1.22, 1.70)	**34.6 (26.0, 44.7)**	1.29 (1.05, 1.59)	11.7 (−7.5, 28.8)
Model 4: Adjusted for Model 1 + lifestyle factors	1.60 (1.35, 1.90)	**15.8 (9.2, 22.1)**	1.26 (1.02, 1.55)	**20.3 (7.3, 33.4)**
Model 5: Adjusted for Model 1 + dietary factors	1.42 (1.16, 1.74)	**37.2 (16.5, 58.6)**	1.22 (0.95, 1.57)	30.6 (−13.6, 76.0)
Model 6: Adjusted for Model 1 + neighborhood factors	1.54 (1.26, 1.89)	**22.4 (2.1, 40.2)**	1.31 (1.04, 1.63)	7.6 (−23.3, 40.2)
Model 7: Adjusted for Model 1 + psychosocial factors	1.69 (1.43, 2.01)	**5.5 (1.2, 10.1)**	1.33 (1.09, 1.64)	0.4 (−10.9, 11.2)
Model 8: Adjusted for Model 1 + clinical factors	1.92 (1.59, 2.30)	**−16.7 (−32.0, −1.6)**	1.48 (1.19, 1.84)	**−36.0 (−63.7, −11.4)**
Model 9: Adjusted for Model 1 + demographics + anthropometrics + lifestyle + dietary + neighborhood + psychosocial + clinical factors	1.41 (1.11, 1.81)	37.9 (−0.03, 74.2)	1.38 (1.04, 1.83)	−11.9 (−84.4, 57.6)

Note: Boldface indicates statistical significance ($p<0.05$).

[a]Demographics include education, income, marital status, and health insurance; Anthropometrics include BMI and waist circumference; Lifestyle factors include current smoking, alcohol use, and physical activity; Dietary factors include Mediterranean diet score, 5 dietary patterns, and total energy intake; Neighborhood factors include geographic region, urbanicity, and neighborhood socioeconomic environment; Psychosocial factors include depressive symptoms, perceived stress, mental component score, and physical component score; Clinical factors include systolic blood pressure, antihypertensive medication use, chronic kidney disease, ratio of triglycerides to high-density lipoprotein cholesterol ratio, and statin use. Quadratic terms included for age, BMI, and waist circumference.

[b]Calculated as the difference in the β coefficient for the race variable in the reference model (adjusted for age and prediabetes) and a model further adjusted for each group of variables.

[c]Bootstrapped CI.

REGARDS, REasons for Geographic and Racial Differences in Stroke.