Racial Influences on Diabetes Management among Adults in North Carolina

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Objective: To examine the impact race and socioeconomic status (SES) has on diabetes management among adults in North Carolina.

Design: Our study utilized data from the 2008 BRFSS to conduct a retrospective study and secondary data analysis. To account for the multistage survey design of BRFSS, SAS/SUDAAN was used to calculate adjusted and unadjusted odds ratios and 95% confidence intervals (CIs). Multiple regression analysis was performed to examine the impact race and SES has on diabetes management among North Carolina adults.

Results: The majority of the participants (63.34%) did not have good diabetes management based on the education and blood glucose criteria of our study. Non-Whites had higher odds than Whites to have good diabetes management practices (OR=1.56, CI: 1.19, 2.03). Individuals who were low SES had poorer diabetes management than individuals who were identified as being high SES (OR=.81, CI: .60, 1.09).

Conclusions: Disparities in good diabetes management practices were found among the variables of race, and SES. Findings from the study indicate that non-White adults had higher odds of good diabetes management practices than Whites in North Carolina. The results of this study could be used for policies and recommendations for health organizations. If health insurance policies required diabetes education classes a reduction in diabetes complications may be observed. Future studies should have a more accurate measurement of diabetes management; proxy measures were used in this study that relied on self-report and may not have provided the best measurement for diabetes management. (*Ethn Dis.* 2013;23[3]:316–321)

Key Words: Diabetes Mellitus, Disease Management, Health Status Disparities, Adults

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Introduction

Diabetes is the fastest growing worldwide epidemic with the majority of diabetes cases attributable to type 2 diabetes. The United States is ranked in the top 30 countries with the highest prevalence rate of diabetes of >10% of the population.[1] An estimated 3.2 million deaths every year are attributable to complications of diabetes, which is equivalent to six deaths every minute.[2] In the United States, minority groups have higher prevalence rates of diabetes than their White counterparts and though rates are increasing among all populations, minorities show the greatest increases.[3] Over the last five decades, the number of Blacks with diabetes has tripled, leading to a near epidemic in a community that is already twice as likely as the general population to have the disease.[4] Studies have shown strong associations between individuals with low SES and high diabetes prevalence, especially among individuals aged 40–69 years.[5] A study conducted by Rabi et al found the prevalence of diabetes was twice as high in low income populations compared to wealthy ones.[6]

In the United States, diabetes is the leading cause of many complications, including new blindness, end-stage renal disease, and non-traumatic lower extremity amputations in adults aged 20 to 65 years.[7–8] The American Diabetes Association suggest ways to manage diabetes such as encouraging healthy diets, regular doctor visits, and physical activity.[9] Blood glucose monitoring is the main tool to check diabetes control and it can be a very complex procedure for some individuals.[9] Diabetics who have low SES and cannot afford the test strips, individuals who have some sort of visual impairment, and individuals who never learned how to accurately interpret the results may have a problem with proper diabetes management. One study indicated that race and education were independently related to self-monitoring blood glucose demonstrating that Blacks were less likely to test their blood glucose at least once a day and individuals that were more educated were more likely to test their blood glucose once a day.[10] Income has also been associated with monitoring blood glucose levels; one study determined that low-income Hispanics and non-Hispanic Blacks were less likely to check their blood glucose than Whites.[11]

Diabetes education courses have positive effects on knowledge, dietary habits, and the self-monitoring of blood glucose levels and thus reduced diabetes related complications.[12] According to the National Standards for Diabetes Self-Management Education, diabetes self-management education is an intricate component to improving patient outcomes.[13] A study by Norris et al reviewed 72 studies and provided evidence that supports the effectiveness of education on diabetes management; indicating positive effects on knowledge, frequency and accuracy of glucose self-monitoring, dietary habits, and glycemic control.[12]

Effective management of diabetes can reduce diabetes related complications.[9] However, medical treatment requires individuals to not only have access to health care but to visit the doctor regularly and adhere to the prescribed regimens which may require diet changes and increased physical activity along with prescribed medical treatment.[9] Challenges due to the disparities associated with health care may prevent diabetic patients from

adequately managing their diabetes, which in turn will increase diabetes related complications. Studies show that Hispanics and Blacks with diabetes record over 20% fewer visits to a physician than Whites and that individuals who have a low SES are less likely to visit the physician for health checks.[5] One study indicated that race and education were independently related to self-monitoring blood glucose demonstrating that Blacks were less likely to test their blood glucose at least once a day and individuals who were more educated were more likely to test their blood glucose once a day.[12] Based on the literature race and SES are risk factors that affect the prevalence and management of diabetes and thus likely proxy measures to test the management of the disease.

North Carolina is no exception to the burden of diabetes. In 2007, diabetes was the 7th leading cause of death in North Carolina accounting for 2.8% of all deaths.[14] Diabetes is one of seven common chronic diseases that, when combined, affected more than 5 million North Carolina residents in 2003.[15] In North Carolina 360,000 adults are diagnosed with diabetes each year, and about 6000 residents die each year from diabetes-related complications.[16]

Similar to statistics for the US population, North Carolina has disparities in diabetes prevalence, complications, and mortality among varying populations. Blacks show the highest prevalence rates of diabetes in the state of North Carolina at 15.6% followed by Native Americans at 12.4% compared to 8.4% for Whites.[14] Diabetes is also the fourth and third leading cause of death among Blacks and American Indians, respectively.[14]

A correlation between high prevalence rates of diabetes and lower education in North Carolina is noticeable.[14] In 2008, 13.6% of those who had less than a high school education also had diabetes, compared to only 6.3% of those who had graduated from college.[17] In North Carolina, reports confirm that the higher the household income, the lower the prevalence rate of diabetes.[17] The association between income and diabetes prevalence is evident in the *Burden of Diabetes* report and shows that individuals with a household income $<$\$15,000 are 3 times more likely to develop diabetes than individuals with a household income of $\geq$\$75,000.[17]

North Carolinians with diabetes have high rates of diabetes-related complications, hospitalizations, and mortality.[14] High blood pressure and high cholesterol were reported in more than 65% of diabetic individuals, and 25.1% of adults with diabetes reported a history of heart disease and stroke.[14] Kidney disease affects 7.6% of North Carolina diabetics and 17% reported that diabetes had some negative effect on their eyes.[14] Lower limb amputations occurred in 2,608 individuals with diabetes, and diabetes accounted for almost 4% of all hospitalizations in North Carolina in 2007.[14]

Diabetes is a major public health issue because it is 80% preventable with behavior modifications.[18–19] Studies have investigated the prevalence of diabetes among various populations and have even assessed different variables.[5] However, to our knowledge, no studies have examined the association between race and SES, in the management of diabetes among adults in North Carolina. Using data from the Behavioral Risk Factor Surveillance System (BRFSS), the objective of our study was to examine race and SES and its association with the management of diabetes among adults in North Carolina.

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METHODS

Our study is a secondary data analysis of the 2008 BRFSS. The study included 1,601 adults who live in the state of North Carolina and who answered yes to the question "Have you ever been told by a doctor that you have diabetes?" Women who answered yes to gestational diabetes were excluded from the sample. Alpha was set at .05 with the power at 80%. The ratio of unexposed to exposed was 7:1; therefore the smallest detectable odds ratio (OR) was .76. The dependent outcome variable of this study was diabetes management, which was determined by self report. In order to determine diabetes management two variables were used as proxy measures: diabetes education and daily blood sugar checks. The variables were assessed using the following BRFSS questions, "Have you ever taken a course or class in how to manage your diabetes yourself?" and "About how often do you check your blood for glucose or sugar?" Participants responded to question 1 with yes or no. Participants responded to question 2 with times per day, times per week, times per month, or times per year. Question 2 was re-coded into a dichotomous variable to determine if individuals checked their blood glucose or sugar at least once a day. These questions were then combined to create a new variable representing diabetes management. If North Carolina adults with diabetes had taken a diabetes management course and checked their

blood glucose or sugar at least once a day, they were coded as having good diabetes management. All other responses were coded as having bad diabetes management.

The independent covariate variables that were measured included race, sex, SES, doctor visits, health status, and insurance. Race was classified as White or non-White. Sex was classified as male or female. Socioeconomic status was a combination of individual income and education. Low SES was classified as: income <$25,000 and no college degree, or persons with no high school diploma but an income between $25,000–$49,999. Middle SES consisted of respondents with income <$25,000 and college graduate, or individuals with income $25,000–$49,999 and who had a high school diploma, some college or a college degree. High SES respondents reported income >$50,000 and college graduate. A doctor visit was classified as yes if participants had visited the doctor for a routine checkup at least once within the past 12 months. The participant's health status was classified as favorable health or non-favorable health. Favorable health included respondents who self-reported their health as excellent, very good, or good. Non-favorable health included respondents who reported their health as fair or poor. Health care coverage was classified as yes if the participant had some form of insurance.

The BRFSS utilizes a complex sample design and to account for clustering and stratification of the survey design, SAS 9.2 Statistical Analysis Software was used to calculate adjusted and unadjusted odds ratios and 95% confidence intervals (CIs) (SAS Institute, Cary, NC).[20] The data was further analyzed using SAS callable SUDAAN to account for the complex multistage sampling design of the BRFSS. Multiple regression analysis was performed to examine diabetes management. The Chi Square test statistic was used to test for independence between the covariates.

Table 1. Demographic information and characteristics of individuals with diabetes in North Carolina, 2008 BRFSS

Variables	*n*	%
Diabetic		
Yes	1601	100
Sex		
Male	684	43.11
Female	917	56.89
Race/ethnicity		
White	1100	67.69
Non-White	501	32.31
Education		
<HS graduate	333	19.79
High School graduate	944	58.76
College graduate or above	324	21.45
Income		
$1-$24,999	774	46.65
$25,000-$49,999	463	28.88
≥$50,000	364	24.47
Socioeconomic status		
Low	771	52.86
Middle	169	12.51
High	466	34.63
Insurance coverage		
Yes	1450	90.55
No	151	9.45
Health status		
Favorable	804	50.22
Non favorable	797	49.78
Doctor visit		
Yes	1436	89.67
No	165	10.33
Diabetes education		
Yes	884	55.81
No	717	44.19
Daily blood glucose check		
Yes	1004	63.00
No	597	37.00
Good diabetes management		
Yes	587	36.66
No	1014	63.34

Summary statistics were obtained to describe the demographics of the study sample; specifically, frequencies and percentages were calculated (Table 1).

Unadjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated using logistic regression to determine to what extent race, and SES accounted for differences in diabetes management in North Carolina. Additionally, other risk factors associated with diabetes management were identified.

Adjusted odds ratios and 95% confidence intervals were calculated and multiple regression analysis was use to examine the association between race and SES, and diabetes management among North Carolina adults. Multiple regression analysis for each outcome variable was used to adjust for other

demographic factors and dichotomous variables. For all analysis statistical significance was set at $P<.05$.

The University of North Carolina Charlotte institutional review board approval was obtained before conducting the study: Protocol number 11-02-54.

RESULTS

Table 1 summarizes the descriptive statistics of the 1,601 BRFSS responses for the sample of North Carolina adults with diabetes aged ≥18 years during the 2008 study period. The majority (67.69%) of the study participants classified themselves as White and females (56.89%) outnumbered males. The majority (58.76%) of the study participants were high school graduates or had some college. Income and education were combined to determine socioeconomic status, which resulted in the majority (52.86%) of the participants being classified as low socioeconomic status. Half the sample (50.22%) classified themselves as having favorable health. Approximately 90% of the participants had some form of health care coverage (90.55%) and had been to the doctor for a routine visit within the last twelve months (89.67%). Over half (55.81%) of the participants had attended a course in diabetes management. A large portion of the participants (63%) reported checking their blood sugar at least once a day. Nearly two-thirds (63.34%) did not have good diabetes management based on the education and blood glucose checking criteria of this study.

Table 2 summarizes characteristics in an unadjusted model. Statistically significant results were found between race and diabetes management among non-Whites, who had higher odds of practicing good diabetes management than Whites (OR=1.47, CI: 1.14, 1.89). Although analysis of SES and diabetes management showed that low SES individuals were less likely to practice good diabetes management than those with higher SES, the results were not statistically significantly (Table 2). Individuals who reported non-favorable health had higher odds of good diabetes management practices than those who reported favorable health (OR=1.47, CI: 1.16, 1.85) while those without insurance were less likely to have good diabetes management compared to those with insurance (OR=.88, CI: .57, 1.35). Males had increased odds of practicing poorer diabetes management than their female counter parts (OR=.67, CI: .52, .85). Individuals who did not attend doctors' visit on a routine basis had decreased odds of having good diabetes management (OR=.69, CI: .45, 1.05).

In the multiple regression analyses, the magnitude of the association between race, SES, and health status, remained largely unchanged. In this model, the results of race were still statistically significant and showed that Non-Whites had higher odds than Whites to have good diabetes management practices (OR=1.56, CI: 1.19, 2.03). Individuals who reported non-favorable health had increased odds of having good diabetes management than individuals who reported favorable health (OR=1.46, CI: 1.12, 1.90) (Table 3).

Table 2. Unadjusted association between various demographics and lifestyle characteristics and diabetes management, 2008 BRFSS

Variables	Unadjusted Odds Ratio	95% Confidence Interval	*P*
Sex			
Male	.67	(.52, .85)	.0011[a]
Female	1.00	1.00	
Race/ethnicity			
White	1.00	1.00	.0029[a]
Non-Whites	1.47	(1.14, 1.89)	
Socioeconomic status			
Low	.95	(.71, 1.25)	.9140
Middle	1.00	(.65, 1.54)	
High	1.00	1.00	
Insurance coverage			
Yes	1.00	1.00	.5487
No	.88	(.57, 1.35)	
Health Status			
Favorable health	1.00	1.00	.0013[a]
Non favorable health	1.47	(1.16, 1.85)	
Doctor visit			
Yes	1.00	1.00	.0812
No	.69	(.45, 1.05)	

[a] Statistically significant.

DISCUSSION

Disparities in good diabetes management practices were found among the variables of race and health status but SES association was not statistically significant. Based on the criteria used in this study, approximately one third of adults with diabetes had good diabetes management. Findings from our study indicated that non-White adults had higher odds of good diabetes management practices than Whites in North Carolina. Individuals who classified themselves as having non-favorable health had increased odds of good diabetes management than individuals who considered themselves to have favorable health. Males had decreased

Table 3. Adjusted multivariate analysis of diabetes management and race and socioeconomic status and health status diabetes education, 2008 BRFSS

Variables	Adjusted Odds Ratio	95% Confidence Interval	*P*
Race			
White	1.00	1.00	.0012[a]
Non-Whites	1.56	(1.19, 2.03)	
Socioeconomic status			
Low	.81	(.60, 1.09)	.3541
Middle	.94	(.61, 1.45)	
High	1.00	1.00	
Health status			
Favorable health	1.00	1.00	.0047[a]
Non-favorable health	1.46	(1.12, 1.90)	

[a] Statistically significant.

odds of having good diabetes management than females and those results proved statistically significant in the unadjusted model.

Several studies have examined the relationship between demographic disparities and diabetes.[6,21–23] These studies indicate that there are disparities in diabetes prevalence rates when variables such as race and SES are examined. In our study, we found similar results for diabetes management, however, the SES results were not significant.

The variables of diabetes education and blood glucose checks were the determinants of diabetes management in our study. Several studies reported on the importance of diabetes management courses and its role in reducing diabetes related morbidity and mortality rates.[24,25] Attending a diabetes management course directly correlates with better diabetes management practices; therefore, non-Whites being more likely to attend diabetes management courses is consistent with our study that determined that non-Whites had greater odds of having good diabetes management practices compared to Whites.[10] The frequency of blood sugar checks was the second variable assessed to determined diabetes management.

Based on the criteria used in this study, approximately one third of adults with diabetes had good diabetes management.

Compare to other research, our study provided contradictory findings, wherein non-Whites were more likely to test their blood glucose at least once a day than Whites. In another study, race and education were independently related to self-monitoring blood glucose demonstrating that Blacks were less likely to test their blood glucose at least once a day.[12]

Selection bias was a potential limitation of our study. Individuals without landline telephones were not included in the BRFSS. The BRFSS also does not include vulnerable populations such as the elderly, illegal immigrants, transient populations, and individuals who are institutionalized. Another limitation of our study was recall bias. The BRFSS is conducted through self-reporting methods and participants were asked questions regarding past diagnoses and specific information regarding doctor visits, income, and management. If individuals were unable to recall some information then they were more likely to guess or estimate the answers, which may have had an effect on the accuracy of the information provided.

Question selection was another limitation encountered in our study. The BRFSS had few questions that were related to diabetes management therefore the choice to combine diabetes education and blood sugar checks to measure diabetes management may have not been the most accurate representation of proper diabetes management. Due to the limitations of the research design and data being used, generalizing the research findings is not possible.

The use of the BRFSS is a strength of our study. The BRFSS provided a large representative sample of North Carolina adults along with the accuracy and reliability of the data set. The use of SUDAAN for all data analysis increased the preciseness and validity of our results. Our study considers the disparities in diabetes and diabetes management and is one of few studies that have examined the disparities of race and SES and their effect on diabetes management.

The results of our study could inform policies, recommendations and interventions developed by health organizations. For example, since attending a diabetes education class correlates with having better diabetes management practices, policymakers could make diabetes education classes mandatory to help in reducing diabetes and related complications. While SES association with good diabetes management was not statistically significant, data trend pointed to the influence of SES on poor diabetes management, which could be explained by lack of necessary resources (eg, test strips). In our study, non-Whites had greater odds of good diabetes management practices than Whites, however, non-Whites also have higher rates of the disease than other populations. Providing diabetes prevention messages directly targeting non-White populations may reduce the prevalence of the disease.

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