Race, Socioeconomic Status, and Rurality Influences on Type 2 Diabetes Management among North Carolina Adults

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Purpose: To examine the impact of race, socioeconomic status, and rurality on Type 2 diabetes education among adults in North Carolina.

Methods: Our study utilized data from the 2008 Behavioral Risk Factor Surveillance System (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). Univariate, bivariate, and multivariate analyses were performed to examine the association between race, socioeconomic status, and rurality and its effects on type 2 diabetes education among adults in North Carolina.

Main Findings: The majority of the participants (63%) did not have good diabetes education. Non-Whites had higher odds than Whites of good diabetes education (OR=1.56, 95%CI: 1.19, 2.03). Individuals who lived in rural North Carolina had lower odds of having good diabetes education than their urban counterparts, but the results remained insignificant (OR= .88, CI: .67, 1.15). Individuals who were of low socioeconomic status (SES) had poorer diabetes education than individuals who were identified as being high SES, but the results were insignificant (OR=.81, CI: .60, 1.09).

Principal Conclusions: Findings from the study indicate that non-White adults had higher odds than Whites of good type 2 diabetes education in North Carolina. The results of our study could be used for policies and recommendations for health organizations. Policy makers should make diabetes education mandatory for individuals who are diagnosed with this disease. Future studies should have a more accurate measurement of type 2 diabetes education. (*Ethn Dis.* 2015;25[1]:46–51)

Key Words: Diabetes Mellitus, Disease Education, Healthcare Disparities, Self-Care

Introduction

In the United States, type 2 diabetes represents the majority of all diabetes cases. Based on US death certificates in 2007, diabetes was the seventh leading cause of death, accounting for a total of 231,404 certificates with diabetes as any-listed cause of death.[1] In 2010, diabetes affected 8.3% (25.8 million) of the US population.[1] Among minority groups, Blacks have the highest rates of diabetes and are twice as likely to develop the disease compared to Whites.[2] Geographic disparities are also associated with the prevalence of diabetes; in the United State, rural residents have a 17% higher prevalence rate of diabetes compared to urban residents.[3,4] Individuals living in rural areas also engage in less physical activity and have poorer diets than their urban counterparts, which increases their risk of developing diabetes.[5]

Type 2 diabetes is a chronic disease known to cause serious long term health complications if not managed properly. Medical treatments, such as the use of insulin medications, are an effective method for diabetes management for many individuals. According to the National Standards for Diabetes Self-Management Education, education is an intricate component to improving patient outcomes.[6] Attending a diabetes education class has positive effects on self-testing.[7] Diabetes management education has demonstrated positive effects on knowledge, frequency and accuracy of glucose self-monitoring, dietary habits, and glycemic control.[8]

Challenges due to the disparities associated with health care may prevent diabetic patients from adequately managing the disease, which in turn will increase diabetes related complications and co-morbidities. Studies show that Hispanics and Blacks with diabetes have more than 20% fewer visits to a physician than Whites.[9,10] An individual's residence may also influence diabetes education and hence management. Rural populations report the poorest health status and are less likely to access health care facilities that include outpatient services.[11,12] Individuals that reside in rural areas may have limited access to medical care, health insurance, emergency services, and lack knowledge of the disease, known causes and its treatment.[3,13] The seriousness of this disease is evident in the Rural Healthy People 2010 Survey that ranked diabetes number three in rural health concerns.[14]

The effects of type 2 diabetes in the United States are also consistent in North Carolinian adults, who are also impacted by the burden of the disease. In 2009, North Carolina ranked 13th in the prevalence of diabetes among adults with about 674,000 diagnosed with the disease.[15] Similar to US statistics, North Carolina has disparities in diabetes prevalence, complications, and mortality among varying populations. Prevalence of diabetes, according to the 2009 BRFSS data in North Carolina, was highest among Blacks at 15.6% followed by Native Americans at 14.2% compared to Whites at 8.4%.[15] From 2000 to 2006, diabetes was ranked the third and fourth leading cause of death

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among American Indians and Blacks, respectively.[16]

A disparity among individuals who reside in rural areas compared to those that live in urban areas is apparent in North Carolina. Individuals in rural North Carolina had a poverty rate of about 20.3% compared to 16.2% of urban individuals.[17] A higher percentage of rural residents in North Carolina also reported they had not completed high school and they had higher unemployment rates.[17] Urban residents made, on average, $4,172 more per capita than rural residents.[17] Of 114 hospitals in North Carolina, 60 of them are in rural areas in addition to 86 rural health clinics, yet there are noticeable disparities when accessing health care for North Carolina residents living in these areas.[17] According to the Rural Health Research and Policy Analysis Center, urban residents have more health coverage and lower rates of diabetes than rural residents in North Carolina.[17]

High rates of diabetes related complications, hospitalizations, and mortality have been reported in North Carolina.[15] Among adults with diabetes, 27.7% reported a history of heart disease and stroke, 69.5% had hypertension, and 59.6% had high cholesterol.[16] The prevalence of kidney disease and retinopathy are also high among diabetic patients in North Carolina.[16] In 2007, a total of 2,608 individuals with diabetes underwent lower extremity amputation in North Carolina.[15]

Diabetes is a leading cause of disability affecting mostly ethnic minorities, individuals of low socioeconomic status (SES) populations, the elderly, and rural dwellers in North Carolina.[17] Previous studies have shown that minority individuals have difficulty accessing primary and specialty health care, have less access to care, and have scarce diabetes self-management resources, leading to poor glycemic control and poor disease management.[10,13,18] We can infer, from the statistics on complications and hospitalizations associated with diabetes, that self-management of diabetes mellitus is poor in North Carolina. However, few studies have assessed the variables of race, and geographical location combined, and the impact these variables have on the diabetes education. Our study examined the association between race and rural/urban geographic location and its effects on the type 2 diabetes education among North Carolina adults.

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MATERIALS AND METHODS

This study is a secondary data analysis of the 2008 Behavioral Risk Factor Surveillance System (BRFSS). The dependent outcome variable of this study was diabetes education which was determined by self-report. In order to determine diabetes education two variables were used as proxy measures: diabetes management course and daily blood sugar checks. The variables were assessed using the following BRFSS questions: 1) Have you ever taken a course or class in how to manage your diabetes yourself? and 2) 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, 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 yes or no. These questions were then combined to create a new variable representing diabetes education. If North Carolina adults with diabetes had taken a diabetes management course and checked their blood glucose or sugar at least once a day then they were coded as having good diabetes education. All other responses were coded as not having good diabetes education.

The independent variables that were measured included: race, sex, SES, geographic location, 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 income and education. Low SES was classified as: income $<$\$25,000 and no high school diploma. Middle SES consisted of respondents with income \$25,000–\$49,999 and who had a high school diploma. High SES respondents reported income $>$\$50,000 and a college degree. Geographic location was classified as urban (metropolitan statistical area of $\geq$50,000 inhabitants) or rural (micropolitan statistical area with $<$50,000 inhabitants). 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 or no if they had not. 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 or no if the participant did not.

The BRFSS utilizes a complex sample design. 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

Table 1. Demographic information and characteristics of individuals with diabetes in North Carolina; 2008 BRFSS, *N*=1,601

Variables	*n*	%
Diabetic		
Yes	1601	100
Sex		
Male	684	43
Female	917	57
Race/ethnicity		
White	1100	68
Non-White	501	32
Education		
< High school graduate	333	20
High school graduate	944	59
College graduate or above	324	21
Income		
<$25,000	774	47
$25,000–$49,999	463	29
≥$50,000	364	24
Socioeconomic status		
Low	870	54
Middle	211	13
High	520	33
Geographical location		
Urban	993	64
Rural	608	36
Insurance Coverage		
Yes	1450	91
No	151	9
Health status		
Favorable	804	50
Non favorable	797	50
Doctor visit		
Yes	1436	90
No	165	10
Diabetes education		
Yes	884	56
No	717	44
Daily blood glucose check		
Yes	1004	63
No	597	37
Good diabetes management		
Yes	1014	63
No	587	37

(CIs). Data were further analyzed using SAS callable SUDAAN to account for the complex multistage sampling design of the BRFSS. Parametric testing using univariate/bivariate/multivariate analyses were performed to examine the association with the independent variables and diabetes management. The Chi Square test statistic was used to test for independence between race, sex, SES, residence, diabetes education, and health status.

Univariate Analysis

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

Bivariate Analysis

Unadjusted odds ratios (OR) and CI were calculated using logistic regression to determine to what extent differences in race, SES, and geographic location accounted for differences in diabetes education in North Carolina. Additionally, other risk factors associated with diabetes education were identified (Table 2).

Multivariate Analysis

Adjusted OR and CI were calculated and multivariate logistic regression was used to examine the association between the model variables including race, SES, and geographical location and diabetes education among North Carolina adults. Multivariate analysis for the outcome variable was used to adjust for other demographic factors and dichotomous variables.

The fitting of the multivariate model involved backward elimination. The partial *t* test in the model was taken into consideration with the presence of other variables in the model. When the partial *t* test was significant, the variable was assumed to be needed in the model, given that the other variables were present. The model was re-run without the insignificant variables, producing a reduced model. For all analyses statistical significance was set at $P<.05$.

Our study included 1,601 adults who lived 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?" Participants with missing responses to the proxy measure variables and independent variable and 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. University of North Carolina Charlotte IRB approval was obtained before conducting the study.

RESULTS

Using SAS 9.2, descriptive statistics were obtained from the BRFSS data on adults with diabetes in the United States. The 2008 original weighted sample population consisted of approximately 414,509 adults aged ≥18 years. A subset of the data was analyzed to account for the 1,601 North Carolina adults identified as having diabetes based on the question in the survey (Have you ever been told by a doctor that you have diabetes?).

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 study population included participants classified as White and non-White. The majority of the study participants classified themselves as White (*n*= 1100, 68%). The sex distribution was 57% (*n*= 917) female. Among the adults in the sample population, participants identified their family income as <$25,000 (47%), $25,000–$49,999 (29%), and ≥$50,000 (24%). The majority of the study participants were high school graduates (*n*= 944, 59%). Income and education were combined to determine SES, which resulted in the majority of the participants being classified as SES (54%). Half the sample classified themselves as having favorable health (50%). Among the adults in the sample population (*n*= 608, 36%) resided in a rural area. The majority of the participants (63%) had good diabetes education based on the

Table 2. Unadjusted association between various demographics and lifestyle characteristics and diabetes education; 2008 BRFSS

Variables	Unadjusted Odds Ratio	95% CI	*P*
Sex			
Male	.67	(.52, .85)	.0011[a]
Female	1.00	1.00	
Race/ethnicity			
White	1.00	1.00	
Non-Whites	1.47	(1.14, 1.89)	.0029[a]
Socioeconomic status			
Low	.95	(.71, 1.25)	.9140
Middle	1.00	(.65, 1.54)	
High	1.00	1.00	
Geographical location			
Urban	1.00	1.00	
Rural	.95	(.74, 1.22)	.7014
Insurance coverage			
Yes	1.00	1.00	
No	.88	(.57, 1.35)	.5487
Health status			
Favorable	1.00	1.00	
Non favorable	1.47	(1.16, 1.85)	.0013[a]
Doctor Visit			
Yes	1.00	1.00	
No	.69	(.45, 1.05)	.0812

[a] Statistically significant , $P<.005$.

two criteria, attending a diabetes management course and daily checking of blood glucose, of this study.

Table 2 summarizes bivariate characteristics in an unadjusted model. Statistically significant results were found between race and diabetes education among non-Whites. Non-Whites had higher odds of practicing good diabetes education than Whites (OR=1.47, 95% CI: 1.14, 1.89). Individuals who reported non-favorable health had higher odds of good diabetes education practices then those who reported favorable health (OR=1.47, 95% CI: 1.16, 1.85). Males had reduced odds of good diabetes education than their female counter parts (OR=.67, CI: .52, .85).

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

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

Variables	Adjusted Odds Ratio	95% CI	*P*
Race			
White	1.00	1.00	
Non-Whites	1.56	(1.19, 2.03)	.0012[a]
Socioeconomic status			
Low	.81	(.60, 1.09)	.3541
Middle	.94	(.61, 1.45)	
High	1.00	1.00	
Geographical location			
Urban	1.00	1.00	
Rural	.88	(.67, 1.15)	.3518
Health status			
Favorable	1.00	1.00	
Non favorable	1.46	(1.12, 1.90)	.0047[a]

[a] Statistically significant, $P<.005$.

DISCUSSION

Based on the criteria used in our study, approximately one-third of adults with type 2 diabetes had good diabetes education. Findings from our study indicate that non-White adults had higher odds of good diabetes education compared to Whites in North Carolina. Individuals that classified themselves as having non-favorable health had increased odds of good diabetes education than individuals who considered themselves to have favorable health. Both of these results were statistically significant. Geographic location and SES did not provide statistically significant results. Individuals with low SES had poorer diabetes education than individuals with high SES.

Previous studies that examined the association between demographic disparities and diabetes,[2,4,12,18] indicated the existence of disparities in diabetes prevalence rates when variables such as race, SES, and geographical location were examined. In our study, variables of diabetes management course and blood glucose checks were the determinants of diabetes education. Several studies

reported the importance of diabetes management courses and the role they have in reducing diabetes related morbidity and mortality rates.[19,20] Studies have concluded that attending a diabetes education class can also lead to improvements in glycemic control.[21,22] Studies have also shown that there has been increased recognition of the importance of developing diabetes programs targeting under-served and minority populations.[23] Our current findings may reflect the success of various programs.

Limitations and Strengths

One potential limitation of this study is recall bias because of the self-reporting method used in BRFSS. Participants were asked questions regarding past diagnoses and specific information regarding doctor visits, income, and self-management. Inability to recall some information may cause the participant to guess or estimate the answers, which in turn may have had an effect on the accuracy of the information provided. Another limitation is the inability to address minority groups separately. Due to the small number of respondents, minority groups were classified as non-Whites. One strength of our study was the use of BRFSS, which included a large representative sample of North Carolina adults and is known for its accuracy and reliability of the dataset.

IMPLICATIONS

Diabetes is a major public health issue affecting many individuals.[24] In North Carolina, this disease is the seventh leading cause of death and is a major contributing factor to the increased rates of health complications.[15] Researchers have shown that a variety of variables may contribute to disparities associated with diabetes.[2,11,25] However, there are no known studies that have assessed the variables of race and geographical location and the impact these variables have on diabetes education particularly in the state of North Carolina. Studies are needed to assess this association because disparities in diabetes education can lead to serious diabetes related complications that can result in death.[26,27]

Our study provided evidence that race, socioeconomic status, and geographic disparities did have some impact on good diabetes education.

Our study provided evidence that race, socioeconomic status, and geographic disparities did have some impact on good diabetes education; although some of these findings were insignificant. Addressing the issue of diabetes education may not only have an impact on individuals that reside in North Carolina but may have a global impact on improving health outcomes of those with diabetes and reducing the disease complications.

The results of our study could be used for recommendations for health organizations as it provides evidence that individuals residing in rural areas have decreased odds of having good diabetes education practices. A correlation exists between attending diabetes management class and better diabetes education. Health care practice guidelines should make diabetes education mandatory for individuals who are diagnosed with the disease. Individuals who did not attend routine doctor visits had decreased odds of having good diabetes management classes. For rural residents, this may be a result of fewer doctors in rural areas; policymakers should consider offering better incentives for health care providers to practice in rural areas.

Though some of the findings in this study were insignificant, the relevance of the study is important and still needs to be assessed further. Because the measurements used in this study were proxy measures for diabetes education that relied solely on self-report, future studies with a more accurate measurement of diabetes education are needed, Future studies could offer a more detailed questionnaire with questions directly related to diabetes education, use diary logs, and/or a biological marker to accurately test for good diabetes education.

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Design and concept of study: Piper, Polite-Middleton, Chalakalal
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