Using BRFSS Data to Examine the Relationship between Race and Self-Care Behaviors in US Elderly Adult Diabetics

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**Abstract**

The Centers for Disease Control and Prevention (CDC) reported over 100 million U.S. adults currently live with either diabetes or prediabetes. 25% of the U.S. diabetic population are age 65 and older. Diabetes can be managed through physical activity, diet, use of insulin, and other methods that regulate blood sugar levels. Members of minority populations are at an increased risk for diabetes.

However, few studies have assessed the self-care behaviors of different US racial/ethnic groups that are age 65 and older. Using 2017 cross-sectional data from the Behavioral Risk Factor Surveillance System (BRFSS), the objective of our study was to determine if race predicts the diabetic self-care behaviors of elderly U.S. adults. We looked at five diabetes self-care behaviors: diabetes education, physical activity, feet check, eye exam, and blood glucose use. We computed the composite self-care behavior variable by adding up the five binary self-care behavior variables. Since our outcome variable was number of different types of diabetes self-care behaviors (count), we used Poisson regression to identify factors associated with the outcome after accounting for the complex survey design. Our results showed that the majority of our study population engaged in four self-care behaviors. There were significant differences in the self-care behaviors of Non-Hispanic Blacks compared to Non-Hispanic Whites. Blacks were more likely than Hispanics and other racial groups to engage in a higher mean number of self-care behaviors. In conclusion, future studies should further explore how increased access to healthcare resources influences diabetes management and thus self-care behaviors in elderly diabetics.

Key Words: blood glucose, health management, quality of life

**Introduction**

Since 2017, diabetes has been the 7th leading cause of death in the U.S. The Centers for Disease Control and Prevention (CDC) reported that more than 100 million U.S. adults are currently living with either diabetes or prediabetes. Twenty-five percent of adults ages 65 and older make up the US diabetic population. People with diabetes are at increased risk of serious health complications including vision loss; amputation of toes, feet, or legs; heart disease; and kidney failure. Diabetes can be managed through physical activity, diet, use of insulin, and other medications that regulate blood sugar levels.[1] In addition, members of the minority populations in the US are at a disproportionately increased risk for a diabetes diagnosis compared to Non-Hispanic Whites. In 2015, the rates of diabetes found in Non-Hispanic Blacks (12.7%), American Indians/Alaska Natives (15.1%), Hispanics (12.1%), and Asians (8.0%) was much higher than that of Non-Hispanic Whites (7.4%).[1] Moreover, it has been shown that diabetes prevalence varies by education level. The prevalence of diabetes in US adults with more than a high school education (7.2%) is lower than that of those with either a high school education (9.5%) or less than a high school education (12.6%).[1]

Self-care behavior refers to “the decisions and actions that an individual can take to cope with a health problem or to improve his or her health”.[2] Self-management education or training focuses on self-care behaviors, such as healthy eating, being active, adhering to medications, learning coping skills, and monitoring blood glucose. Diabetes can be treated and managed through healthy eating, regular physical activity, and use of medications to lower blood glucose levels.[3, 4] Previous research shows that a correlation exists between race, education, socioeconomic status, and self-monitoring of blood glucose levels.[5] Although U.S. adults age 65 and older are the predominant population that has diabetes, few studies have assessed their self-care behaviors.[6, 7] Though several studies have investigated the relationship between diabetes self-management and race, the most recent study we could find analyzed data from at least ten years ago. [5, 8-11] Therefore, further research is needed that looks at sociodemographic factors and self-care behaviors of different US racial/ethnic groups ages 65 and older. Using 2017 data from the Behavioral Risk Factor Surveillance System (BRFSS), the objective of our study was to determine if race predicts the diabetic self-care behaviors of elderly U.S. adults.

**Methods**

*Study Setting and Sample*

We performed a cross-sectional study using 2017 Behavioral Risk Factor Surveillance System (BRFSS) data. The BRFSS, sponsored by the Center for Disease Control and Prevention (CDC), is a statewide data collection program from the 50 states, the District of Columbia, and Puerto Rico via monthly telephone interviews that is designed to measure behavioral risk factors for people 18 years of age or older.[12] The goal of collecting this data was to determine state-specific preventive health practices and risk behaviors that were associated with chronic diseases, injuries, and preventable infectious diseases.[12] Respondents gave self-reported information about their diabetes status. There were 450,016 total records for 2017. We restricted our sample population to respondents age 65 years and older with a diabetes diagnosis. The total sample size used for 2017 was 32,950 respondents.

*Diabetes Self-Care Behaviors*

We looked at five variables for diabetes self-care behaviors: diabetes education, physical activity, feet check, eye exam, and blood glucose use. The diabetes education variable was based on “Have you ever taken a course or class in how to manage your diabetes yourself?”. The physical activity variable was based on “during the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?” and was coded as yes or no. The feet check variable was based on the question “about how often do you check your feet for any sores or irritations? Include times when checked by a family member or friend, but do not include times when checked by a health professional”. The result was dichotomized as “never” or “at least one time per year”. The eye exam variable was based on the question “when was the last time you had an eye exam in which the pupils were dilated? This would have made you temporarily sensitive to bright light.” and was coded as never or at least once. The blood glucose check variable was based on the question “About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do not include times when checked by a health professional.” The result was dichotomized as never or at least once per year.

*Composite of Self-Care Behaviors*

We computed the composite self-care behavior variable by adding up the five binary self-care behavior variables. The composite variable then had five categories: engaged in zero, one, two, three, four, and five self-care behaviors, which can be interpreted as the number of different types of diabetes self-care behaviors that the respondent had.

*Independent Variables*

The independent variables in this study were selected based on previous literature.[5, 13, 14] There were 4 race categories: Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic Other. There were four age categories: 65-69, 70-74, 75-79, 80 and older. There were 3 marital status categories: married/living as married, divorced/widowed/separated, and never married. Education level had 4 categories: less than high school, high school graduate, some college, and college graduate. Income level had 5 categories: less than $15,000, $15,000 to less than $25,000, $25,000 to less than $35,000, $35,000 to less than $50,000, and $50,000 or more. BMI was defined as underweight, normal weight, overweight, and obese. Insurance status was defined as either yes or no. Regular provider was defined as either yes or no. General health status had three categories: excellent/very good, good, and fair/poor.

Insulin use was based on the question “Are you now taking insulin?” The insulin use response was categorized as either yes or no. Diabetes education was based on the question “Have you ever taken a course or class in how to manage your diabetes yourself?” The diabetes education response was categorized as either yes or no.[15] Smoking was dichotomized as yes or no. We also included five chronic disease measures: coronary heart disease, chronic kidney disease, chronic heart attack, high cholesterol level, and hypertension. They were coded as binary variables with one indicating yes and zero indicating no.

*Statistical Analyses*

We accounted for the complex survey design of the data using the weight variable\_LLCPWT. Means and standard errors were reported to describe the sampled population dependent and independent variables. Since our outcome variable was the number of different types of diabetes self-care behaviors the respondent engaged in (count), we used Poisson regression to identify the factors associated with the outcome. Incidence rate ratios and their corresponding 95% confidence intervals (CI) were reported. A p-value of less than 0.05 was considered as statistically significant in our analyses. All data cleaning and statistical modeling were conducted using the statistical computing environment R (version 3.6.0).[16] The complex survey design was accounted for using the R package survey.[17]

**Results**

[Table 1](#gjdgxs) summarizes the inferred descriptive statistics of self-care behaviors in the study sample using means and standard errors. Overall, the total sample size was 32,945 respondents. After accounting for the weights, strata, and ID in the complex survey design, about 0.1% of the population had no self-care behaviors, 2.4% had one self-care behavior, 9% had two self-care behaviors, 25.1% had three self-care behaviors, 37.1% had four self-care behaviors, and 26.4% had five self-care behaviors.

[Table 2](#30j0zll) shows the descriptive statistics of the predictor variables. After accounting for the weights, strata, and ID in the complex survey design, it was inferred that 73.9% of the population were Non-Hispanic whites, 12.9% Non-Hispanic Black, 9% Hispanic, and 4.2% other races. The population was composed of an approximately equal proportion of males (52.5%) and females (47.5%). There were more married respondents (52.9%) compared to divorced/widow/separated (42.9%) and never married (4.3%) respondents. Additionally, a greater number of respondents fell into the age range of 65 to 69 (33.8%) compared to the age ranges of 70 to 74 (28.6%), 75-79 (19.9%), and greater than 79 (17.6%). For education, a greater proportion of respondents were high school graduates (32.5%) compared to less than high school (17.5%), some college (28.7%), and college graduates (21.2%). Looking at income, those who fell in the income range of $50,000 or more (31.0%) made up a greater proportion of the sample than respondents that fell in the income ranges of $35,000 to $ 50,000 (15.6%), $25,000 to $35,000 (15.6%), $15,000 to $25,000 (24.7%), and less than $15,000 (12.8%). When looking at overall health status, a greater proportion of respondents reported being obese (48.3%), having fair or poor health (41.1%), having insurance (98%), having a regular provider (96.5%), and not using insulin (67.7%).

[Table 3](#1fob9te) summarizes our findings for the predictors of diabetes self-care management and other variables of interest. After adjusting for other covariates, Non-Hispanic Blacks had a 5.1% times higher mean number of self-care behaviors (IRR: 1.051; 95% CI: 1.027, 1.075) than Non-Hispanic Whites. For Hispanic (IRR: 0.970; 95% CI: 0.921, 1.022) or other races (IRR: 0.972; 95% CI: 0.931, 1.014), the incidence rate ratios were not statistically different from Non-Hispanic Whites. Respondents ages 75-79 (IRR: 0.953; 95% CI: 0.928, 0.979) and greater than age 80 (IRR: 0.936; 95% CI: 0.913, 0.959) had 4.7% and 6.4% times less mean number of self-care behaviors than respondents ages 65-69. The mean number of diabetes self-care behaviors for respondents who were divorced/widowed/separated (IRR: 0.978; 95% CI: 0.958, 0.999) was 2.7% less than that of those who were married. For education, the mean numbers of self-care behaviors for high school (IRR: 1.047; 95% CI: 1.014, 1.08), some college (IRR: 1.075; 95% CI: 1.041, 1.11), and college graduate (IRR: 1.084; 95% CI: 1.047, 1.122) respondents increased significantly by 4.7%, 7.5%, and 8.4% respectively compared to respondents that had less than high school education. For income level, the mean number of self-care behaviors for respondents that fell in the income range of $15,000 to 25,000 (IRR: 1.043; 95% CI: 1.008, 1.078) increased by 4.3% compared to that of respondents in the less than $15,000 income range. The mean number of diabetes self-care for those who had one person as their health care provider (IR: 1.077; 95% CI: 1.014, 1.143) increased by 7.7% compared to those who did not have one person as their health care provider. The mean number of diabetes self-care behaviors among those who reported a good health status (IRR: 1.045; 95% CI: 1.025, 1.066) increased by 4.5% compared to respondents who reported a fair or poor health status. For respondents with an excellent/very good health status (IRR: 1.024; 95% CI: 0.999, 1.05), the incidence rate ratios were not significantly different from those who had a fair/poor health status. The mean number of diabetes self-care behaviors among insulin users (IRR: 1.119; 95% CI: 1.099, 1.139) increased by 11.9% compared respondents that did not use insulin. However, the mean number of the diabetes self-care behaviors among smokers (IRR: 0.972; 95% CI: 0.947, 0.999) decreased by 2.8% compared to non-smokers. The mean number of the diabetes self-care behaviors among respondents with chronic kidney disease (IRR: 1.027; 95% CI: 1.004, 1.05) increased by 2.7% compared to those with no chronic kidney disease. We did not find significant differences between any of the respondents and the reference groups for BMI, insurance, chronic coronary heart, chronic heart attack, high cholesterol level, and hypertension.

**Discussion**

*Significant Findings*

Of the total sample size of 32,945 elderly respondents with diabetes, the majority practiced four self-care behaviors. Past studies have also looked at how diabetes management varies across different demographic variables. They used diabetes education and blood glucose monitoring as their determinants of diabetes management. Their findings showed that disparities in diabetes management existed based on socioeconomic status.[4-7] Our results were consistent with past literature. We found that there were significant differences in the self-care behaviors of Non-Hispanic Blacks compared to Non-Hispanic Whites. In addition, Blacks were more likely than Hispanics and other racial groups to engage in a higher mean number of self-care behaviors. Respondents in the higher income level ranges ($35000 to $50000; more than $50000) had a higher mean number of self-care behaviors than respondents in lower income level ranges (less than $15,000). College graduates had a higher mean number of self-care behaviors compared to respondents in the other education levels.

*Strengths*

One strength of our study is that we used BRFSS data. It is a nationally representative collection of health survey results that has been previously validated for its reliability and accuracy.[8,9] Another strength is the large sample size that was used, which allowed us to detect any differences that may have existed between the different categories of self-care behaviors. In addition, our study took into account other factors besides socioeconomic status (SES) that influence ability to engage in diabetes self-care behaviors. Therefore, we controlled for key factors that would have influenced the association seen between race and self-care behaviors. To our knowledge, this is one of few studies that have created self-care behavior categories in order to determine the relationship that exists between race and how well elderly adults manage their diabetes.

*Limitations*

One limitation is that we used self-reported data, which may have biased our results due to recall bias. Furthermore, our study sample was not truly representative of the U.S. diabetic population since the respondents in this sample had an overall higher SES. A large percent of this population had insurance and a healthcare provider, so it makes sense that they would have better diabetes management.

In addition, this was a cross-sectional study, so we cannot make any casual projections from our findings. The self-care behaviors that were used to assess diabetes management were created based on the availability of the relevant diabetes questions included in the BRFSS survey questions. Also, using the variables diabetes education, physical activity, feet check, eye exam, and blood glucose check as proxy measurements for quantifying diabetes management did not fully account for other factors that also contribute to good diabetes management and health behaviors. There was potential residual confounding in our Poisson model results due to other self-care behaviors that we did not assess (e.g. type of diabetes, comorbidities, diet, medication, etc.).

*Public Health Implications*

Our study results can be used to help inform primary and secondary preventative measures for diabetes that are promoted by healthcare professionals. It can also be used to help develop interventions that are better catered toward elderly adults that will help them overcome any social barriers that may hinder their ability to participate in good diabetes management. The implementation of these measures and interventions will eventually help lead to a reduction in the prevalence and economic burden of diabetes that is reported annually in the U.S.

**Conclusion**

We found that race, marital status, education level, having a healthcare provider, and general health status were all associated with diabetes management. Our results indicated that healthcare access positively influenced diabetes management. Increasing public health awareness by developing interventions aimed at educating diabetics and removing barriers to good diabetes management might provide a means for improving health outcomes. Therefore, future studies should further explore how increased access to healthcare resources influences diabetes management and thus self-care behaviors in different elderly racial groups.

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| **Table 1. Descriptive Statistics for Number of Self-Care Behaviors** | | |
| Variable Name | Mean | Standard Error |
| Number of Self-Care Behaviors | | |
| None | 0.001 | 0 |
| One | 0.024 | 0.003 |
| Two | 0.09 | 0.005 |
| Three | 0.251 | 0.007 |
| Four | 0.371 | 0.008 |
| Five | 0.264 | 0.007 |
| Self-Care Behaviors | | |
| Diabetes education | 0.537 | 0.008 |
| Physical activity | 0.563 | 0.008 |
| Feet check | 0.81 | 0.007 |
| Eye exam | 0.986 | 0.001 |
| Blood glucose use | 0.862 | 0.005 |

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| **Table 2. Demographic and Socioeconomic Characteristics of the Study Population** | | |
| Variable Name | Mean | Standard Error |
| Race |  |  |
| Non-Hispanic White | 0.739 | 0.008 |
| Non-Hispanic Black | 0.129 | 0.006 |
| Hispanic | 0.09 | 0.007 |
| Other | 0.042 | 0.003 |
| Gender |  |  |
| Female | 0.475 | 0.009 |
| Male | 0.525 | 0.009 |
| Age |  |  |
| 65-69yr | 0.338 | 0.008 |
| 70-74yr | 0.286 | 0.008 |
| 75-79yr | 0.199 | 0.007 |
| >79yr | 0.176 | 0.007 |
| Marital status |  |  |
| Married | 0.529 | 0.009 |
| Divorced/Widowed/Separated | 0.429 | 0.009 |
| Never Married | 0.043 | 0.004 |
| Education |  |  |
| Less than High School | 0.175 | 0.008 |
| High School Graduate | 0.325 | 0.008 |
| Some College | 0.287 | 0.007 |
| College Graduate | 0.212 | 0.007 |
| Income |  |  |
| Less than 15000 | 0.128 | 0.006 |
| 15000 to 25000 | 0.247 | 0.008 |
| 25000 to 35000 | 0.156 | 0.007 |
| 35000 to 50000 | 0.156 | 0.006 |
| More than 50000 | 0.312 | 0.008 |
| Body weight index |  |  |
| Under/Normal Weight | 0.155 | 0.006 |
| Overweight | 0.361 | 0.008 |
| Obese | 0.483 | 0.009 |
| Insurance: Yes | 0.98 | 0.004 |
| Provider: Yes | 0.965 | 0.003 |
| Health status |  |  |
| Fair Poor | 0.411 | 0.009 |
| Good | 0.372 | 0.008 |
| Excellent/Very good | 0.217 | 0.007 |
| Insulin: Yes | 0.323 | 0.008 |
| Smoking: Yes | 0.084 | 0.004 |
| Coronary heart disease: Yes | 0.194 | 0.007 |
| Chronic kidney disease: Yes | 0.123 | 0.005 |
| Chronic heart attack: Yes | 0.173 | 0.006 |
| High cholesterol level: Yes | 0.653 | 0.008 |
| Hypertension: Yes | 0.793 | 0.007 |

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| **Table 3. Poisson Regression Estimates of Predictors for the Mean Number of Diabetes Self-Care Behaviors** | | | |
| Variable Name | IRR | 95% Confidence Interval | |
| (Intercept) | **3.193** | 2.942 | 3.466 |
| Race (reference: Non-Hispanic White) | | | |
| Non-Hispanic Black | **1.051** | 1.027 | 1.075 |
| Hispanic | 0.97 | 0.921 | 1.022 |
| Other | 0.972 | 0.931 | 1.014 |
| Gender: Male | 0.982 | 0.965 | 1.000 |
| Age (reference: 65-69 yr) | | | |
| 70-74 yr | 0.998 | 0.978 | 1.018 |
| 75-79 yr | **0.953** | 0.928 | 0.979 |
| 80 yr and older | **0.936** | 0.913 | 0.959 |
| Marital status (reference: Married) | | | |
| Divorced/Widowed/Separated | **0.978** | 0.958 | 0.999 |
| Never Married | 0.976 | 0.947 | 1.005 |
| Education (reference: Less than High School) | | | |
| High School Graduate | **1.047** | 1.014 | 1.080 |
| Some College | **1.075** | 1.041 | 1.110 |
| College Graduate | **1.084** | 1.047 | 1.122 |
| Income level (reference: Less than $15000) | | | |
| $15000 to $25000 | **1.043** | 1.008 | 1.078 |
| $25000 to $35000 | 1.037 | 0.995 | 1.080 |
| $35000 to $50000 | **1.045** | 1.006 | 1.086 |
| More than $50000 | **1.043** | 1.004 | 1.083 |
| BMI (reference: Under/Normal Weight) | | | |
| Overweight | 1.013 | 0.985 | 1.042 |
| Obese | 1.004 | 0.977 | 1.032 |
| Insurance: Yes | 0.98 | 0.928 | 1.035 |
| provider: Yes | **1.077** | 1.014 | 1.143 |
| Health status (reference: Fair Poor) | | | |
| Good | **1.045** | 1.025 | 1.066 |
| Excellent/Very good | 1.024 | 0.999 | 1.050 |
| Insulin: Yes | **1.119** | 1.099 | 1.139 |
| Smoking: Yes | **0.972** | 0.947 | 0.999 |
| Coronary heart disease: Yes | 1.013 | 0.990 | 1.036 |
| Chronic kidney disease: Yes | **1.027** | 1.004 | 1.050 |
| Chronic heart attack: Yes | 1.002 | 0.979 | 1.025 |
| High cholesterol level: Yes | 1.010 | 0.992 | 1.028 |
| Hypertension: Yes | 0.997 | 0.977 | 1.017 |

Note: Bolded IRR values are statistically significant at p < 0.05.

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