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Relationships of Sociodemographic Characteristics with Glycemic Control and Dietary Adherence in Adults with Type 2 Diabetes

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ABSTRACT

Background: Previous studies supported that sociodemographic characteristics are significantly associated with dietary adherence and glycemic control in adults with type 2 diabetes. The American Diabetes Association recommends that individually designed nutritional plans consider the sociodemographic characteristics of the patients. Few studies were specifically conducted to address the association of sociodemographic characteristics with adherence to dietary guidelines and glycemic control in adults with type 2 diabetes employing data from a US national dataset. ***Purpose***: The study aimed to examine the relationships of sociodemographic characteristics with adherence to the American Diabetes Association dietary guidelines and glycated hemoglobin in adults with type 2 diabetes. ***Methods***: A secondary analysis study used data for 1,401 adults that were extracted from the National Health and Nutrition Examination Survey conducted between 2007 and 2012. Logistic regression was employed to calculate the unadjusted odds ratios to determine the odds of non-adherence with dietary guidelines for each sociodemographic characteristic. ***Results***: A large percentage of the sample was non-Hispanic White (66.1%) and female (52.7%). Sex, race/ethnicity, marital status, education, and income were significantly related to glycemic control. Race/ethnicity and marital status were significantly related to adherence to dietary guidelines. Single participants were at greater risk of being non-adherent compared to married participants. Furthermore, non-Hispanic Whites had much lower odds of non-adherence to dietary guidelines compared to Hispanics. ***Conclusion***: Individualizing patients' nutritional plans based on sociodemographic characteristics is crucial for improving glycemic control and health outcomes in patients with type 2 diabetes. ***Implications for Nursing***: Clinicians should pay attention to the dietary behaviors among people of different ethnic/racial backgrounds. Assessment sheets should be revised accordingly and health caregivers should be aware of how to design and modify dietary plans for their clients based on clients' food preferences and cultures.

Keywords: Type 2 diabetes, Sociodemographic characteristics, Glycemic control, Dietary adherence.

What does this paper add?

1. Racial/ethnic background greatly affects the dietary adherence of persons with type 2 diabetes (T2D).
2. Sex, marital status, and socioeconomic status are significantly predicting glycemic control among persons with T2D.
3. Dietary plans for persons with T2D should be tailored to fit their sociodemographic backgrounds.
4. Individualized dietary plans are expected to improve glycemic control and prevent T2D-related complications.

Introduction

Approximately 34.2 million adults in the United States had diabetes; the largest percentage was 65 years of age or older (21.4 million adults) followed by those between 45 and 64 years of age (13.8 million adults) (Centers for Disease Control and Prevention [CDC], 2020). According to the CDC (2020), about 11.0 million male adults and 9.5 million female adults have diabetes. T2D is often associated with serious complications. African American and Hispanic adults with T2D are more adversely affected by diabetes-related complications in comparison with other ethnic and racial groups (CDC, 2020; Lopez et al., 2014).

Diabetes-related complications are often preventable by adhering to diabetes treatment regimens and implementing the necessary self-management behaviors (CDC, 2020). Self-management is the cornerstone of diabetes control (Gomersall et al., 2011). The goal of self-management for persons diagnosed with diabetes is often to modify their behaviors and prevent diabetes-related complications (Haas et al., 2014). Self-management strategies for patients diagnosed with diabetes are directed toward improving physical activity, nutrition and medication adherence (American Diabetes Association [ADA], 2016).

Previous research has supported that sociodemographic characteristics (e.g. age, sex, race/ethnicity, marital status, education and income) have been significantly associated with dietary adherence and glycemic control in adults with T2D (Ahn et al., 2012; Chiu & Wray, 2010; Demoz et al., 2019; Duarte et al., 2019). Different age groups had various needs and perceptions of dietary management plans, with older adults being the most disadvantaged group (Stark Casagrande et al., 2013; Kirkman et al., 2012). Sex differences were also prominent, especially if they were discussed within the context of marital status and spousal support (Beverly et al., 2014; Duarte et al., 2019). Race/ethnicity also affected dietary management and glycemic control among adults with T2D (Chlebowy et al., 2016; Kollannoor-Samuel et al., 2011; Spanakis & Golden, 2013).

Dietary adherence aims to improve glycemic control and prevent diabetes-related complications in adults with T2D. The ADA recommends that nutritional plans for patients with T2D be individually designed by the healthcare team (ADA, 2018). According to the ADA, the major goal of medical nutrition therapy (MNT) is to promote healthy eating patterns to maintain body weight goals and improve glycemic control (ADA, 2018). MNT recommendations include: (1) encouraging moderate weight loss; (2) reducing calorie intake from fats and carbohydrates; (3) increasing intake of carbohydrates from vegetables and fruits; and (4) avoiding sugar-sweetened beverages and foods with added sugars (ADA, 2018). The ADA recommends that individually designed nutritional plans consider the sociodemographic characteristics of the patients which may affect their ability to adhere to these plans (ADA, 2018).

Age is an important characteristic that contributes to dietary adherence. For example, poor adherence to the diabetes diet has been found in adolescents diagnosed with T2D and race/ethnicity is an added factor that contributes to poorer glycemic control in this age group (Ahia et al., 2014; Ahmad et al., 2014). Young and middle-aged Hispanics have poorer glycemic control than older adults (ADA, 2016; Kollannoor-Samuel et al., 2011). Dietary non-adherence is of concern in the older adult population. Hispanics, especially older adults, have poorer glycemic control when compared to non-Hispanic Whites (Lopez et al., 2014; Weinstock et al., 2011). Thus, personal preferences and goals as well as culture should be taken into consideration when individualizing older adults' nutrition plans (Dorner, 2010; Stanley, 2014).

Older and middle-aged adults are the most disadvantaged age groups among those diagnosed with T2D (Ahn et al., 2012; Bradley & Hsueh, 2016). However, middle-aged adults are slightly different from older adults regarding the factors that predict glycemic control (Chiu & Wray, 2010). Sociodemographic characteristics are the strongest predictors of glycemic control for middle-aged adults; treatment modality (e.g.

diet only, medication or insulin) is the most significant predictor of glycemic control in older adults (Ahmad et al., 2014; Chiu & Wray, 2010).

Sex differences have a profound impact on dietary adherence in patients diagnosed with T2D (De Melo et al., 2013). In a large survey data, women were more adherent to their therapeutic regimen; however, they had higher rates of diabetes-related complications than men (De Melo et al., 2013). Spousal support influences the dietary adherence of persons with T2D (Beverly et al., 2014; Albanese et al., 2019). Women were more likely to engage in dietary self-management activities than men (Albanese et al., 2019; Beverly et al, 2014). On the other hand, men were positively supported by their wives (Stephens et al., 2013).

Ethnic backgrounds were associated with dietary adherence in persons with T2D (Nowlin et al., 2016). Patients from different ethnic backgrounds differ in their perceptions of the difficulty of self-management practices, acceptance of the disease and glycemic control (Nowlin et al., 2016). Hispanic participants felt restricted by diabetes dietary regimens more than any other ethnic group (Misra & Lager, 2009). Furthermore, African Americans reported fear and uncertainty in following therapeutic guidelines; they consider their families the main source of support for T2D self-management, followed by their friends and churches (Bhattacharya, 2012). In addition, African Americans' abilities to adhere to their regimens differed by the sources of support (Ahia et al., 2014).

Dietary non-adherence is one of the most challenging problems confronting persons with T2D (Halali et al., 2016; Marcy et al., 2011). Health-promoting behaviors including dietary adherence are influenced by the background characteristics, such as biological makeup and other environmental factors, such as a person's cultural background (Ordovas et al., 2018). A person's sex, age, ethnicity/race and culture will impact his/her ability to adhere to the dietary regimen (Kollannoor-Samuel et al., 2011; Spanakis, & Golden, 2013); this impact could be positive (facilitating adherence) or negative (hindering adherence) (Brown et al., 2023; Milenkovic et al., 2021). In the review of the existing literature, few studies have been conducted to examine the associations of sociodemographic characteristics with adherence to the ADA dietary guidelines and glycemic control in adults with T2D (ADA, 2016; Chiu & Wray 2011; Weinstock et al., 2011). In addition, more analysis of these associations should be conducted employing big data to build a solid knowledge base. Thus, this study was conducted to explore these associations using data extracted from a large US national dataset.

Methods

Design and Sample

A secondary analysis of existing de-identified cross-sectional data from the 2007-2012 National Health and Nutrition Examination Survey (NHANES) was conducted. NHANES is one of a series of health-related surveys conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) (CDC, 2016). A unique feature of this survey is the collection of health examination data for a nationally representative sample of the resident civilian non-institutionalized United States population. The survey used a stratified, multistage probability cluster design. The primary sampling units were selected from the individual counties for the first stage (screening), followed by personal interview (2^{nd} stage) and examination (3^{rd} stage). For NHANES 2007-2010, the Hispanic population and adolescents were oversampled to ensure sample sizes for these populations. The Asian population was oversampled to ensure sample sizes for this population for the NHANES 2011-2014 cycle (CDC, 2016). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Vandenbroucke et al., 2007) were used to report the findings of this study.

Measures

The NHANES consists of questionnaires administered in the home followed by a standardized health examination in specially equipped mobile examination centers. Sociodemographic characteristics (independent variable) were extracted from the demographic questionnaires collected during the personal interview and provided information regarding age, sex, race/ ethnicity, marital status, education and household income (CDC, 2016). Data was obtained for adults who were 17 years old or older at the time of the interview and had been diagnosed with T2D. Age at diagnosis was obtained from the NHANES Diabetes Questionnaire (CDC, 2016). For this study, race/ethnicity was regrouped into the Hispanic category that included Mexican Americans and other Hispanics,

non-Hispanic Whites, non-Hispanic Blacks and Others that included other races and multi-racial groups.

The NHANES Weight History section of the Sample Person Questionnaire provides personal interview data on several topics related to body weight, including self-perception of weight, attempted weight loss during the past 12 months and methods used to try to lose weight (CDC, 2016). Nine questions in the Weight History section were selected to determine dietary adherence with ADA guidelines (dependent variable) in patients diagnosed with T2D. The first question was*: During the past 12 months, {have you/has SP} tried to lose weight?* Subsequent questions asked the respondents to identify how they tried to lose weight by choosing one or more of the 20 options. For this study, nine options that include ADA dietary guidelines were selected: (1) *ate less to lose weight;* (2) s*witched to foods with lower calories;* (3) *ate less fat to lose weight;* (4) *ate diet foods or products;* (5) *followed a special diet;* (6) *ate fewer carbohydrates;* (7) *ate more fruits, vegetables and salads*; (8) *changed eating habits;* and (9) *ate less sugar, candy and sweets*.

Internal consistency reliability was tested in this study for the nine questions (Cronbach's α was 0.79) measuring adherence with the ADA dietary guidelines. A total score was created for adherence to ADA dietary guidelines. The total score was created for participants who tried to lose weight a year before the questionnaire was administered and at least tried one of the methods to lose weight as suggested by the Weight History Questionnaire. The total score was created by summing the scores of the responses to the selected nine questions. The scores ranged between 1 and 9 and the distribution of the scores appeared to be bimodal; thus, the median was used as a cut-off point to categorize the respondents into adherent and non-adherent to the ADA dietary guidelines; the median was found to be 4.

Following a standardized protocol, a trained professional drew a blood sample (dependent variable) from each participant's antecubital vein. A1C, a diabetes test that reflects plasma glucose for the previous 120 days has been used to monitor diabetes for many years (Bohanny et al., 2013). In recent years, new clinical recommendations included applying hemoglobin A1C to the diagnoses of diabetes (6.5% [48 mmol/mol] or greater) and pre-diabetes (5.7%-6.4% [39 mmol/mol-46 mmol/mol]). A1C measurements were performed on the A1c G7 HPLC Glycohemoglobin Analyzer (Tosoh Medics, Inc., 347 Oyster Pt. Blvd., Suite 201, So. San Francisco, Ca 94080) (CDC, 2016).

Statistical Analyses

Sample weights for the time cohort were used for all data analysis. Data was weighted according to NHANES weighting procedures and guidelines (Johnson et al., 2013); three cycles were combined and the sample weight for interview data was constructed by adding the three-cycle sample weights and dividing them by three (Johnson, 2013). The weighting process was carried out in three folds to compensate for differential probability, missing data and differences between the final sample and population data as obtained by the US Bureau of Census (Mirel et al., 2013). First, descriptive statistics were used to describe the study sample using frequencies and percentages for all categorical variables and means and standard deviations for all continuous variables. For the "Age" variable, the category > 80 was excluded from the analysis, because the extracted dataset did not include any data for this group. The distribution of adults with T2D who tried to lose weight in the past year with ADA guidelines was calculated. Second, bivariate analyses were conducted to determine associations of sociodemographic characteristics with A1C and adherence to ADA dietary guidelines. χ^2 test was employed to determine differences between participants in adherence to ADA dietary guidelines based on their sociodemographic characteristics. Third, unadjusted odds ratios and their respective 95% confidence intervals were calculated to determine the odds of non-adherence with ADA dietary guidelines for each characteristic. Fourth, independent t-tests and one-way ANOVA (for variables with more than two categories) were employed to evaluate potential differences between participants' A1C based on each sociodemographic variable. All data was analyzed using SPSS, version 22 (Armonk, NC) and p-values <0.05 were regarded as statistically significant.

To determine the sociodemographic characteristics associated with non-adherence to the ADA dietary guidelines, a logistic regression model was developed to model the probability of non-adherence to the ADA dietary guidelines. Unadjusted and adjusted odds ratios were calculated. Characteristics with a p-value less than 0.05 for the $\chi 2$ test were initially included in the model. A simultaneous method was used and the -2 Log-

Likelihood goodness-of-fit test was conducted to determine the goodness of fit for the model. All models were compared using the likelihood ratio test.

Multiple regression was performed to identify sociodemographic characteristics' (age, age at diagnosis of T2D, sex, race/ethnicity, marital status, education and income level) associations with A1C. Before conducting multiple regression, the linearity and normality of the dependent variable for each level of the independent variables and homoscedasticity assumptions were all verified. Multicollinearity statistics were obtained and assessed. Then, all the variables were entered simultaneously into the multiple regression model.

Ethical Approval

The data for this secondary analysis is publicly available; thus, this study did not require institutional review board approval. Informed consent was obtained from all participants by the CDC. In addition, participants were informed that their blood specimens and interview data may be used in future research (CDC, 2016).

Results

A total of 1,401 individuals diagnosed with T2D responded to the NHANES between 2007 and 2012 (Figure 1). The majority of them were females (52.7 %), married or in a relationship (61.5%) and non-Hispanic Whites (66.1%). Approximately 27% had a college degree or higher. Approximately 32% of participants reported that they tried to lose weight in the past 12 months; of those, 59% were adherent to the ADA dietary guidelines (Table 1). The most common method used in an attempt to lose weight was eating less food (11.3%), followed by eating less fat (7.1%) and eating lower-calorie food (6.6%).

Table 1. Descriptive characteristics of adults with T2D (> 17 years of age) obtained from NHANES (2007-2012) survey data (N =17.14× 10^6)*

	M(SE)	Confidence Interval
Age	45.14 (0.004)	45.13-45.14
Age at diagnosis	49.27 (0.004)	49.26-29.28
A1c	5.64 (0.0003)	5.63-5.64
		Weighted count, estimated frequency (%)
Sex		
Male		9.11×10^6 (47.3)
Female		8.03×10^6 (52.7)
Race		
Hispanic		2.40×10^6 (14.0)
Non-Hispanic White		11.3×10^6 (66.1)
Non-Hispanic Black		2.00×10^6 (11.7)
Other Race		1.40×10^6 (8.2)
Marital Status		
Married /In Relationship		9.93×10^6 (61.5)
Divorced/Separated		2.26×10^6 (14.0)
Widowed		9.2×10^5 (5.7)
Single		3.05×10^6 (18.9)
Education		
< High School		3.02×10^6 (18.7)
High School		3.55×10^6 (21.4)
Some College		5.22×10^6 (32.3)
College or Higher		4.46×10^6 (27.6)

Income	
≤ $25,000	3.73×10^6 (22.6)
> $25,000	12.79×10^6 (77.4)
Did you try to lose weight in the past year?	
Yes	3.0×10^6(31.9)
No	6.5×10^6(68.1)
Adherence with ADA dietary guidelines	
Yes	1.59×10^6 (59.0)
No	1.1×10^6 (41.0)

**Note*: The number of valid cases for analysis is varied across the variables.

Adherence to the ADA guidelines was significantly associated with sex, race/ethnicity, marital status, education and income (Table 2). Participants who were adherent were more likely to be males, non-Hispanic Whites and married compared to their counterparts.

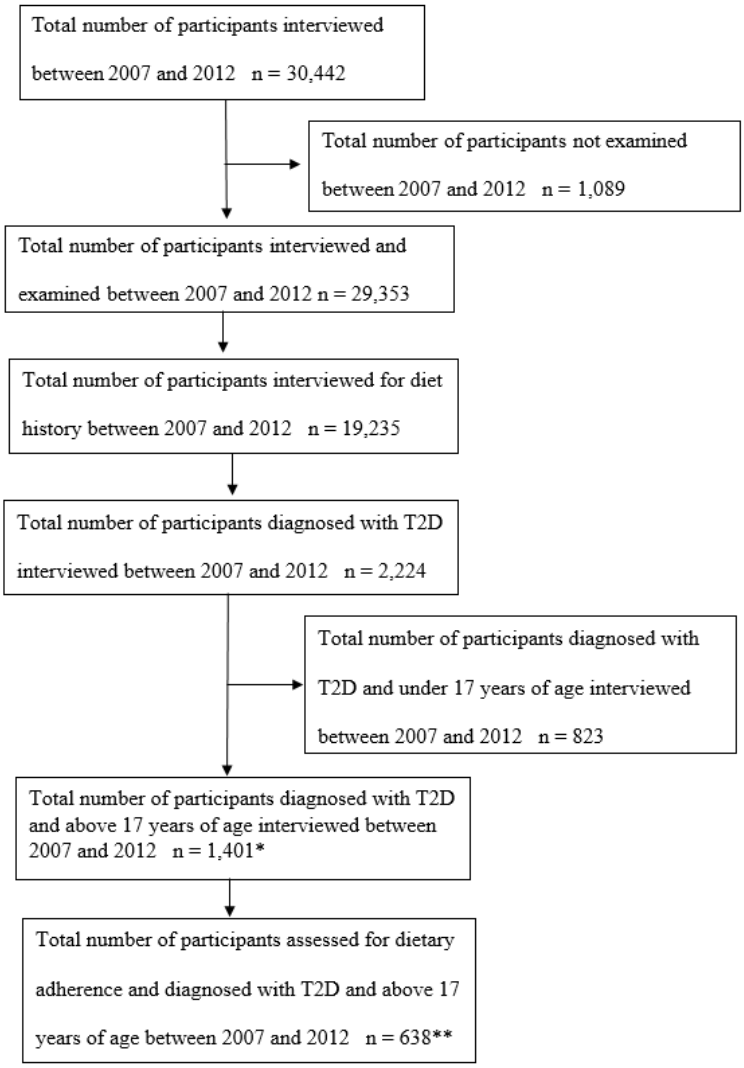

Figure 1: Participants' flowchart

Modified from Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (46)

Note: * The total number of participants assessed for the analysis of the relationships between sociodemographic characteristics and glycemic control

** The total number of participants assessed for dietary adherence with ADA guidelines analysis

Table 2. Associations between demographic characteristics and dietary adherence among those who tried to lose weight in the past year obtained from NHANES (2007-2012) survey data (N =2.69×10^6)*

	Adherence to wtoADA Dietary Guidelines			
	Yes N (%)	**No N (%)**	**X^2**	***p***
Sex				
Male	8.1×10^5 (51.2)	3.8×10^5(34.5)	7.3×10^4	<0.0001
Female	7.7×10^5 (48.8)	7.2×10^5(65.5)		
Race				
Hispanic	2.4×10^5 (14.9)	2.1×10^5 (19.1)	8.1×10^4	<0.0001
Non-Hispanic White	1.0×10^6 (65.3)	5.6×10^5 (50.4)		
Non-Hispanic Black	2.0×10^5 (12.6)	1.6×10^5 (14.3)		
Other Race	1.1×10^5 (7.2)	1.8×10^5 (16.2)		
Marital Status				
Married/In Relationship	1.0×10^6 (67.9)	6.8×10^5 (67.2)	4.6×10^4	<0.0001
Divorced/Separated	1.2×10^5 (8.3)	8.0×10^4 (7.9)		
Widowed	1.7×10^5 (11.6)	5.5×10^4 (5.4)		
Single	1.8×10^5 (12.2)	1.9×10^5 (19.5)		
Education				
<High School	3.8×10^5 (25.4)	1.9×10^5 (18.7)	7.9×10^4	<0.0001
High School	2.9×10^5 (19.3)	2.1×10^5 (20.8)		
Some College	3.6×10^5 (24.2)	4.0×10^5 (39.1)		
College Degree or Higher	4.6×10^5 (31.1)	2.3×10^5 (21.3)		
Income Level				
≤ $25,000	4.7×10^5 (30.9)	2.8×10^5 (26.5)	6.0×10^3	<0.0001
> $25,000	1.0×10^6 (69.1)	7.8×10^5 (73.5)		

* *Note*: The number of valid cases for analysis is varied across the variables.

Although effect sizes were small (Cohen's *d* ranged between 0.0002 and 0.2*)*, sex, race/ethnicity, marital status, education, income, trying to lose weight in the past 12 months and adherence to the ADA dietary guidelines were significantly ($p < 0.0001$) related to A1C. Females, non-Hispanic Blacks, widowed and those with less than a high-school education had higher A1C than their counterparts (Table 3).

Table 3. T-test and one-way ANOVA results applied to the A1C related to sex, race, education, marital status, income and dietary adherence obtained from NHANES (2007-2012) survey data (N =17.14× 106)*

Variable	Mean (95% Confidence Interval [CI])	DF**	F/t-test results	P-value	Cohen's *d*
Sex		10.58×10^6	-107.272	<0.0001	0.07
Male	5.60 (5.60-5.60)				
Female	5.67 (5.67-5.67)				
Race		(3,10.86×10^6)	13061.30	<0.0001	0.004
Hispanic	5.68 (5.67-5.68)				
Non-Hispanic White	5.60 (5.60-5.60)				
Non-Hispanic Black	5.79 (5.78-5.79)				
Other Race	5.61 (5.61-5.61)				

Marital Status		(3,10.26×10^6)	801.45	<0.0001	0.0002
Married/In Relationship	5.64 (5.64-5.64)				
Divorced/Separated	5.61 (5.61-5.61)				
Widowed	5.68 (5.68-6.69)				
Single	5.62 (5.61-5.62)				
Education		(3,10.26×10^6)	19041.12	<0.0001	0.006
< High School	5.76 (5.76-5.77)				
High School	5.52 (5.52-5.52)				
Some College	5.63 (5.62-5.63)				
College or Higher	5.65 (5.65-5.66)				
Income		3.8×10^6	106.11	<0.0001	0.11
≤ $25,000	5.70 (5.70-5.70)				
> $25,000	5.61 (5.61-5.61)				
Did you try to lose weight in the past year?		8.8×10^6	32.6	<0.0001	0.02
Yes	5.66 (5.65-5.66)				
No	5.63 (5.63-5.63)				
Dietary adherence to ADA guidelines		2.32×10^6	178.1	<0.0001	0.23
Yes	5.78 (5.78-5.79)				
No	5.55 (5.55-5.55)				

* The number of valid cases for analysis is varied across the variables.

** DF: Degrees of Freedom.

The results of the logistic regression modeling the odds of being non-adherent to the ADA dietary guidelines showed the following: after controlling for the other variables in the model, non-Hispanic Whites had much lower odds of reporting non-adherence to the ADA dietary guidelines compared to Hispanics (odds ratio (OR) = 0.46; 95% confidence interval (CI) = 0.45-0.46). Single individuals had 1.35 times (95% CI = 1.34-1.36) the odds of reporting non-adherence to the ADA dietary guidelines compared to those who were married, controlling for all the other variables in the model. Compared to males, females had much higher odds of reporting non-adherence to the ADA dietary guidelines (OR = 1.90; CI = 1.89-1.99), after controlling for all the other variables in the model.

Table 4. A multiple linear regression model of the A1C obtained from NHANES (2007-2012) survey data (N =17.14×106)*

	Unstandardized Coefficients		Standardized Coefficients		
Model	**B**	**Std. Error**	**Beta**	***t***	***p***
(Constant)	5.8	0.002		2341.9	<0.0001
Age at diagnosis (per one-year increase)	7.8×$^{10-5}$	0	-0.006	-19.8	<0.0001
Age (per one-year increase)	-0.001	0.0001	-0.01	-24.9	<0.0001
Sex					
Male	0.041	0.001	0.02	60.1	<0.0001
Female	-----	-----	-----	-----	-----

Race					
Non-Hispanic White	-----	-----	-----	-----	-----
Hispanic	0.08	0.001	0.02	69.5	<0.0001
Non-Hispanic Black	0.17	0.001	0.05	149.1	<0.0001
Other Race	-0.03	0.001	-0.009	-26.1	<0.0001
Marital Status					
Married/In Relationship	-----	-----	-----	-----	-----
Divorced/Separated	-0.037	0.001	-0.012	-35.7	<0.0001
Widowed	0.02	0.002	0.005	15.0	<0.0001
Single	-0.02	.001	.008	-23.3	<0.0001
Education					
< High School	-----	-----	-----	-----	-----
High School	-0.22	.001	.09	-201.5	<0.0001
Some College	0-.13	0.001	-0.06	-118.8	<0.0001
College or Higher	-0.06	0.001	-0.03	-55.714	<0.0001
Income					
≤ $25,000	-0.07	0.001	-0.03	-78.2	<0.0001
> $25,000	-----	-----	-----	-----	-----
f-test for the whole model			**8.3×10^4**		
Significance level (overall)			**<0.0001**		
Adjusted R^2			**0.11**		

* The number of valid cases for analysis is varied across the variables.

As shown in Table 4, age, age at diagnosis, sex, race/ethnicity, marital status, education and income explained a significant amount of the variance in A1C values [F (13, 9.8×10^6) = 8.3×10^4, $p < 0.0001$, $R^2_{Adjusted}$ = 0.11]. Educational level significantly predicted A1C values. For example, those with a high-school education had a decrease of 0.22 standard deviation below the mean of the A1C when compared to their counterparts with less than a high-school education (β = -0.22, t (9.8×10^6) = -201.5, $p < 0.0001$).

Discussion

In the current study, sex, race/ethnicity, marital status, education and income were all significantly associated with adherence to the ADA dietary guidelines. Non-Hispanic Whites had a reduced risk of reporting non-adherence to the ADA dietary guidelines compared to Hispanics. This minority group was greatly prone to negative consequences of poor dietary adherence due to its higher risk of obesity secondary to genetics and cultural food preferences (Aguayo-Mazzucato et al., 2019). Those who were single were more likely to report non-adherence to ADA guidelines compared to those who were married or in a relationship. These findings are similar to the findings of other studies in which race/ethnicity (Bohanny et al., 2013; Stephens et al., 2010; Nowlin et al., 2016) and marital status (Wiebe et al., 2016) were among the sociodemographic characteristics that influenced T2D self-management and dietary adherence. For example, Brown et al. (2023) found that Hispanic women had poor dietary adherence, lower food quality and lower ability to make healthy food choices when compared with men.

This study was unique in that many self-report indicators were used to measure adherence to ADA dietary guidelines, specifically losing weight, reducing the intake of fats and carbohydrates and increasing the intake of fruits and vegetables. In addition, the sociodemographic characteristics predicted the glycemic control among the various age groups, aligning with Chiu and Wray's (2010) research in which sociodemographic characteristics (age, sex, marital status and education) were among the strongest predictors of glycemic control among middle-aged adults. Interestingly, while adherence to ADA dietary guidelines was significantly associated with A1C, it was not a significant predictor in the regression model. Additional exploration of the role of dietary adherence

to ADA guidelines in predicting A1C is warranted, since dietary adherence has been directly associated with A1C (Cosansu & Erdogan, 2014). Future studies are recommended to explore how different dietary behaviors and food quality across cultures would influence glycemic control. For example, the Mediterranean diet is recommended to improve glycemic control among persons with T2D (Milenkovic et al., 2021). Furthermore, future studies are recommended to explore the predictive value of additional self-management behaviors, such as physical exercise, blood glucose monitoring and coping skills.

Implications for Clinical Practice and Research

The relationships of sociodemographic characteristics with dietary adherence and glycemic control will help in individualizing diabetes education. Diabetes educators and other clinical practitioners should assess the patients' personal needs and characteristics before designing a patients' education plan (ADA, 2018). The assessment process should take into consideration a patient's sociodemographic characteristics, such as age, race/ethnicity, cultural background, educational level and economic status. Furthermore, clinicians should pay attention to the dietary behaviors among people of different ethnic/racial backgrounds. Assessment sheets should be revised accordingly and health caregivers should be aware of how to design and modify dietary plans for their clients based on clients' food preferences and cultures.

Given the associations of sociodemographic characteristics with ADA dietary adherence and A1C levels, the assessment and subsequent treatment planning process for individuals with T2D should consider the age, race/ethnicity, cultural background, education level and economic status of the individuals. The National Standards for Diabetes Self-management Education and Support (Haas et al., 2013) recommend individualizing patient education for persons with diabetes. For example, knowing that single patients are less adherent to their diet requires the educator to focus on the cultural appropriateness of the educational materials and methods. In addition, minorities, such as Hispanics, may require more attention in designing dietary plans. For example, moderately low carbohydrate and vegetarian diets could be tailored for the person taking into consideration personal preferences and cultural differences to aid in managing diabetes and preventing diabetes-related complications (Ley et al., 2014). Dietary management of diabetes is also greatly affected by economic status; for example, persons with low economic status are often not able to adhere to dietary management plans due to the costs of healthy food (Weaver et al., 2014). In addition, more spousal support and a higher level of education are associated with better dietary management and diabetes control (Formosa & Muscat, 2016; Weaver et al., 2014).

Limitations

This study was limited due to the fact it was a secondary analysis of self-report data and used a cross-sectional design. Although sex, age, race/ethnicity and marital status have been associated with glycemic control in previous studies (Ahn et al., 2012; Nowlin et al., 2016; Wiebe et al., 2016), the effect sizes of these associations were very small. In addition, in this study, the use of A1C was the sole indicator of glycemic control. Using another indicator indicative of glycemic control, such as fasting blood glucose or body mass index may improve the predictive ability of the model and thus explain the variations in glycemic control. For future studies, the addition of more self-management variables (e.g. the caloric intake of diverse food types, exercise, medication use and coping) to the model may improve its ability to predict glycemic control. Dietary adherence could also be explored as a mediating variable between sociodemographic characteristics and glycemic control to improve the understanding of the relationship between sociodemographic characteristics and glycemic control. Health literacy is also thought to have a mediating effect on the relationship between self-management and glycemic control (Lee et al., 2016) and is recommended to be examined in future studies.

Conclusion

This study supported that specific sociodemographic characteristics predicted glycemic control in adults with T2D. Race/ethnicity and marital status were determinant factors in predicting adherence to the ADA dietary guidelines. This information is helpful for healthcare providers and clinical practitioners to select the best interventions that help patients of diverse ethnic and racial backgrounds to gain control over their diabetes.

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Conflict of Interest

All authors declare no conflict of interest.

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