2-25-2011

Medical Advice, Diabetes Self-Management, and Health Outcomes of a Multi-Ethnic Population from the National Health and Nutrition Examination Survey 2007-2008

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MEDICAL ADVICE, DIABETES SELF-MANAGEMENT, AND HEALTH OUTCOMES OF A MULTI-ETHNIC POPULATION FROM THE NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY 2007-2008

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

DIETETICS AND NUTRITION

by

Joan Anne Vaccaro

2011

To: Interim Dean Michele Ciccazzo
R.Stempel College of Public Health and Social Work

This dissertation, written by Joan Anne Vaccaro, and entitled Medical Advice, Diabetes Self-Management, and Health Outcomes of a Multi-Ethnic Population from the National Health and Nutrition Examination Survey 2007-2008, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

I dedicate this dissertation to my husband, Drew Friedland, for his tolerance, nurturance and support that motivated and enabled me to complete my doctoral studies.

MEMORANDUM

This dissertation is in memory of my father, John Robert Agugliaro, Senior (1926-1968) who guided me in my formative years; inspired me to value education; taught me that cooperation is the key word; inspired a love of nature; and, helped me to think outside of the box.

ACKNOWLEDGMENTS

I thank the Department of Dietetics and Nutrition for their Assistantships throughout my doctoral studies. The Graduate Student Association's travel expense reimbursement enabled me to present my preliminary studies at conferences. My sincere appreciation is extended to my committee members: Drs. Baum, Feaster, Lobar and Magnus for their unshakable belief in my abilities, their expertise, guidance, and social support through my triumphs and tribulations. I am particularly grateful to Dr. Baum for insisting that reported health behavior must be verified with biomarkers, Dr. Magnus and Dr. Lobar for steering the focus toward public health implications and Dr. Feaster for his patience and belief in my statistical abilities, despite my early blunders. I thank Sheila and Ram for their support as colleagues. I am grateful to Dr. Huffman for allowing me to be a part of a research team and my team members, Gustavo, Joel, Shyrin, Lamya, Gagandeep and Deva for creating an environment of intellectual synergy, inspiration and social support. A heartfelt recognition goes to Dr. Huffman for believing in my ability to grow socially, spiritually, intellectually and emotionally and her tremendous part in making it all possible. I thank my daughter, Andrea Vaccaro for her honest appraisals which helped me grow and her father, John Andrew Vaccaro, for his enduring friendship that has and continues to enrich my life. My love extends to my parents who gave me an appreciation of learning and the resources to begin pursuing my dreams and to my brothers, grandparents, aunts and uncles for their love, support and inspirational approaches to and discussions of life during a time of social revolution. I thank the life-force for guiding me to turn setbacks into accomplishments.

ABSTRACT OF THE DISSERTATION

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Diabetes self-management, an essential component of diabetes care, includes weight control practices and requires guidance from providers. Minorities are likely to have less access to quality health care than White non-Hispanics (WNH) (American College of Physicians-American Society of Internal Medicine, 2000). Medical advice received and understood may differ by race/ethnicity as a consequence of the patient-provider communication process; and, may affect diabetes self-management.

This study examined the relationships among participants' report of: 1) medical advice given; 2) diabetes self-management, and; 3) health outcomes for Mexican-Americans (MA) and Black non-Hispanics (BNH) as compared to WNH (reference group) using data available through the National Health and Nutrition Examination Survey (NHANES) for the years 2007-2008. This study was a secondary, single point analysis. Approximately 30 datasets were merged; and, the quality and integrity was assured by analysis of frequency, range and quartiles. The subjects were extracted based on the following inclusion criteria: belonging to either the MA, BNH or WNH categories; 21

years or older; responded yes to being diagnosed with diabetes. A final sample size of 654 adults [MA (131); BNH (223); WNH (300)] was used for the analyses.

The findings revealed significant statistical differences in medical advice reported given. BNH [OR = 1.83 (1.16, 2.88), $p = 0.013$] were more likely than WNH to report being told to reduce fat or calories. Similarly, BNH [OR = 2.84 (1.45, 5.59), $p = 0.005$] were more likely than WNH to report that they were told to increase their physical activity. Mexican-Americans were less likely to self-monitor their blood glucose than WNH [OR = 2.70 (1.66, 4.38), $p<0.001$]. There were differences among ethnicities for reporting receiving recent diabetes education. Black, non-Hispanics were twice as likely to report receiving diabetes education than WNH [OR = 2.29 (1.36, 3.85), $p = 0.004$]. Medical advice reported given and ethnicity/race, together, predicted several health outcomes. Having recent diabetes education increased the likelihood of performing several diabetes self-management behaviors, independent of race.

These findings indicate a need for patient-provider communication and care to be assessed for effectiveness and, the importance of ongoing diabetes education for persons with diabetes.

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LIST OF ACRONYMS	
A1C	Hemoglobin A1C
ADA	American Diabetes Association
AHRQ	Agency for Healthcare Research and Quality
BMI	Body mass index
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
DEFF	Design effect (for complex sampling)
DSM	Diabetes self-management
HDL	High-density lipoprotein cholesterol
LDL	Low-density lipoprotein cholesterol
MEC	Mobile examination center
NDSS	National Diabetes Surveillance System
NHANES	National Health and Nutrition Examination Surveys
NHLBI	National Heart, Lung, and Blood Institute
NIDDK	National Institute of Diabetes and Digestive Kidney Diseases
OR	Odds ratio
PA	Physical activity
PSU	Primary sampling units
RSE	Relative standard error
SMBG	Self-monitoring blood glucose
WC	Waist circumference

CHAPTER I

INTRODUCTION

Statement of the problem

Diabetes leads to complications such as heart disease and stroke, high blood pressure, blindness, kidney disease and nervous system disease; the risk of death for persons with diabetes is twice that of persons without diabetes (Center for Disease Control and Prevention (CDC), 2007). Type 2 diabetes, the most common form (90-95% of all cases) has increased among the general population (National Institute of Diabetes and Digestive Kidney Diseases (NIDDK), 2008) and disproportionately among minorities (particularly African-Americans and Hispanics) (National Diabetes Surveillance System (NDSS), 2005). Mexican-Americans have the highest rate of diabetes among Hispanics and are 1.7 times as likely to have diabetes as White non-Hispanics (CDC, 2007). African-Americans are 2.1 times more likely to be diagnosed with diabetes than White non-Hispanics (CDC, 2007).

Minorities tend to have less access to and receive a lower quality of health care, even when controlling for insurance status and income (American College of Physicians - American Society of Internal Medicine (ACP), 2000). Even after adjusting for socioeconomic status, the effects of race and/or ethnicity predict poor health outcomes (such as micro- and macro-vascular complications) due to a lack of cultural competency and appropriate communications skills by health providers (ACP, 2000). It is essential for persons with diabetes to acquire and practice adequate diabetes self-management skills in order to reduce the risk factors that lead to morbidity and mortality associated with diabetes-related complications.

An operational definition of high quality health care for persons with diabetes would include guidance on risk factor control for all of the following: 1) dietary intake and weight management; 2) glycemic and lipid control; and 3) foot and eye care. Given the available national data, the objective of this study was to compare health care disparities regarding reported medical advice received from health care providers, diabetes self-management and risk factors associated with diabetes complications for two minority groups at high risk for diabetes complications: Black non-Hispanics (BNH) and Mexican-Americans (MA) as compared to White non-Hispanic (WNH).

Specific aims and hypotheses

Aim 1

To determine the differences in reported medical advice received for persons with diabetes by Black non-Hispanics (BNH) and Mexican-Americans (MA) as compared to White non-Hispanics (WNH).

Hypothesis 1.a.

Black non-Hispanics and MA with diabetes will be less likely as compared to White non-Hispanics to report being told by a medical professional any or all of the following within the past year: 1) 'to reduce fats or calories in their diet'; 2) 'to increase physical activity or exercise'; and, 3) 'to control or reduce body weight'.

Hypothesis 1.b.

Black non-Hispanics and MA with diabetes will be more likely as compared to White non-Hispanics to report their provider did not specify a treatment goal for any or all of the following: 1) hemoglobin A1C (A1C); 2) "bad cholesterol that clogs your arteries - LDL"; 3) systolic blood pressure (SBP); 4) diastolic blood pressure (DBP).

Hypothesis 1.c.

Black non-Hispanics and MA with diabetes will be less likely to receive diabetes education than WNH.

Aim 2

To ascertain the level of diabetes self-management behavior (DSM) of persons with diabetes by race comparing DSM behavior of BNH and MA to DSM behavior of WNH.

Hypothesis 2.

All or any of the following diabetes self-management skills will be less likely to be reported for BNH and MA than for WNH: 1) frequency of self-monitoring blood glucose (SMBG); 2) reducing fats and calories in the diet; 3) increase physical activity or exercise; 4) control weight; 5) checking feet for sores.

Aim 3

To determine clinical indicators of DSM of persons with diabetes by race when comparing BNH and MA with WNH.

Hypothesis 3.a.

Mean Hemoglobin A1C will be at least 1% higher for Black non-Hispanics and Mexican-Americans as compared to White non-Hispanics.

Hypothesis 3.b **.**

High LDL levels (>100 mg/dl) will be more likely for Black-non Hispanics and Mexican-Americans than White non-Hispanics.

Hypothesis 3.c.

Black non-Hispanics and Mexican-Americans will be more likely to be in the obese category (BMI $\geq$ 30 kg/m^2) than White non-Hispanics.

Aim 4

To determine the association between level of medical advice and level of DSM by race for all study participants (BNH, MA and WNH with diabetes). To establish whether or not ethnicity/race is a modifier for medical advice and DSM.

Hypothesis 4.a.

"Pattern A" level of medical advice*: 'reported being told'* (instruction items to reduce fat or calories, control or reduce weight and increase physical activity or exercise and level of DSM skills/behaviors) will be associated with the corresponding behavior and be modified by race.

Hypothesis 4.b.

There will be a positive association of "Pattern B" medical advice: *'reporting being given a goal'* (instruction items A1C, LDL, SBP, DBP) and level of DSM, as measured by clinical outcomes, independent of race.

Hypothesis 4.c.

There will be positive associations between medical advice received ('Pattern A") and each of the corresponding clinical indicators of DSM independent of race.

Significance of the present study

There have been discrepancies in the quality of health care received by race and ethnicity. Moreover, participants' report of medical advice given may differ by race and ethnicity as a consequence of the communication process. The relationships among medical advice, diabetes self-management, health outcomes by ethnicity and race have not been adequately reported in the literature. Understandings of diabetes as a disease and diabetes self-management are influenced by health beliefs (Anderson & Christison-

Lagay, 2008). In turn, health beliefs and practices vary by cultural differences, ethnicity and race (Anderson & Christison-Lagay, 2008). It is therefore imperative to uncover the interrelationships of patient- provider communication; ethnicity and race; and diabetes self-management beliefs and practices.

CHAPTER II

REVIEW OF LITERATURE

Overview

This chapter begins with a clarification of the terms: *minority*, *ethnicity* and *race* and a subsequent review of diabetes prevalence and complications with respect to race and ethnicity in the United States. Next, the role of diabetes self-management and its relationship to secondary prevention is discussed within the context of overall diabetes medical treatment. Since diabetes self-management is a component of diabetes care, the relationship between the patient-provider communication process and diabetes outcomes is reviewed in the subsequent section. Then, literature regarding the associations among the quality of health care, race, diabetes self-management and diabetes outcomes are elucidated. Since, on average, minorities in the United States have poorer health outcomes than White non-Hispanics, the patient-provider relationship is reviewed in the context of health disparities. Specifically, the quality of health care and health outcomes of Black non-Hispanics and Mexican-Americans with diabetes was reviewed since they are members of the largest minority groups sampled for health behavior and have a higher prevalence of diabetes than White non-Hispanics.

Although the term, *minority*, refers to a political/social status of less societal representation and power than the majority (not necessarily a numerical minority) (Wikapedia.org) there are a number of inconstancies in the literature regarding *race* and/or *ethnic* classification. Persons of Spanish origin may be referred to as Hispanic or Latino. In the past, the distinction was based having a direct lineage to the Spanish mainland (Hispanic) or ancestry from the Caribbean (Latino). Furthermore, classification may be by the investigator rather than by self-report. Race may be classified as Black or White; albeit, these terms do not differentiate ethnicity. Blacks may be of direct African ancestry (African-American) or may be from the Caribbean (Jamaican, Haitian, Dominican Republic, Puerto Rican, Cuban, etc.). For the purposes of this review, classifications given by the investigators and/or authors representing government institutions will be used; however, it is advised by this investigator for future studies to include self-identification of race and ethnicity by participants. It may be considered a strength of NHANES data that a distinction is made between Mexican-Americans and other Hispanics; however, the identification of non-Hispanic Black mixes non-Latino Caribbean Blacks with African-Americans.

The purpose of this review was to develop the framework of the model and to generate hypotheses to be tested. Finally the national databases suitable for this study are reviewed and justification of the selection is made.

Prevalence of diabetes and complications in the United States

Diabetes is classified into four clinical classes: type 1, which is insulin-dependent due to β cell destruction; type 2, which is due to progressive insulin resistance; gestational (GDM) which occurs during pregnancy; and diabetes due to genetic or environmental causes such as diseases of the exocrine pancreas, drugs or organ replacement (American Diabetes Association (ADA), 2010). Type 2 Diabetes is a national epidemic; constituting 90-95% of all diabetes cases (Kenny, Aubert and Geiss, 1995: NIDDK, 2008) and is becoming increasingly more common in the United States. From 1980 through 2004, the reported number of Americans with diabetes (20 years and older) more than doubled (5.8 to 14.7 million) (CDC, 2007). According to 2007 prevalence data, 24 million people in the United States have diabetes and an additional 57 million are estimated to have pre-diabetes (CDC, 2008).

Government reported statistics may underreport actual cases since they do not take into account those people with limited access to health care, and who have not been diagnosed and treated (Cohen, Martinez &Free, 2008). Type 2 diabetes constitutes a significant risk factor for cardiovascular diseases (CVD); the prevalence, incidence and mortality from all forms of CVD is 2-8 times higher in persons with diabetes than those without diabetes (CDC, 2007; Howard et al, 2002; Wingard & Barrett-Connor, 1995). More specifically, the risk of death from coronary heart disease (CHD) in patients with type 2 diabetes is 2 to 4 times higher in comparison to persons without diabetes (CDC, 2007; Stammler, Vaccaro, Neaton & Wentworth, 1993; Wingard & Barrett-Connor, 1995).

The National Center for Chronic Disease Prevention and Health Promotion (CDC) age adjusted data showed that minority populations are disproportionately affected by diabetes (CDC, 2008). Prevalence of diabetes among people 20 years or older in the United States in 2007 was 1.5 times higher for Black non-Hispanics (14.7%) as it is for White non-Hispanics (9.8%) (CDC, 2007). Black non-Hispanics had 1.8 times and Hispanics 1.6 times higher age adjusted rate of diabetes than White non-Hispanics (CDC, 2007).

Based on NHANES I and its 4 follow-up surveys, adults with diabetes had a substantially higher risk of death, lower survival, and lower quality of life compared to adults without diabetes (Gu, Cowie and Harris, 1998). Most of these deaths were due to diabetes itself or its complications. The four leading causes of death among persons with diabetes were: 1) CVD (~50%), 2) diabetes itself (13%), 3) malignant neoplasm (13%), and, 4) stroke (10%) (Harris et al, 1995). The majority of CVD deaths from participants in the NHANES studies was due to CHD; and these accounted for about 40% of the total deaths among persons with diabetes (Geiss, Herman & Smith, 1995; Wingard & Barrett-Connor, 1995). Although mean A1C levels of individuals diagnosed with diabetes improved in the United States, from 1999-2004 (Hoerger Segel, Gregg & Saaddine, 2008) less than half of the people (~ 45%) with type 2 diabetes have adequate glycemic control (A1C levels of < 7% which is the goal for persons with diabetes) (NIDDK, 2008).

Diabetes-related end-stage renal disease (ESRD) was more likely to be found in African-Americans (odds ratio (OR) of 1.9) followed by Hispanics (OR = 1.4) than White non-Hispanics (adjusting for access to health care, microvascular disease, CVD and subsequent death frequencies) (Young Maynard & Boyko, 2003). A recent Behavioral Risk Factor Surveillance Survey (BRFSS) study by the CDC (2007) on regional and racial differences and prevalence of stroke in the United States reported that the percent of stroke cases was the highest among the 10 southeastern states and Blacks when compared to Whites. The CDC indicates that risk factors such as diabetes, high blood pressure, smoking and not having health-care coverage might account for most of the differences in stroke prevalence by region and race (CDC, 2007).

Due to the many health consequences of diabetes and the nature of the disease, diabetes care is vital to quality of life and survival. Interestingly, diabetes is a disease that can be managed by the individual with appropriate guidance. Nwasuruba, Khan & Egede (2007) reported few patients are engaged in diabetes self-care at the recommended level, regardless of race/ethnicity using a US representative sample (from the Behavioral

Risk Factor Surveillance Survey (BRFSS). Furthermore, fewer than 60% of all adults age 40 and over with diagnosed diabetes have their blood glucose, cholesterol, or blood pressure within the recommended levels for adequate control (Agency for Healthcare Research and Quality (AHRQ), 2008).

Goals of diabetes care and diabetes self-management

According to the American Diabetes Association's (ADA) *Standards of Medical Care,* (2010) diabetes care and prevention of diabetes complications involves the following components: a comprehensive diabetes evaluation including a psychosocial assessment; medical care collaboration from a physician-coordinated team; an individually formulated management plan formed in collaboration with the patient, the patient's family and the medical team; diabetes self-management education (DSME); assessment of glycemic control; medical nutrition therapy (MNT); recommendations for regular physical activity; hypertension, blood pressure and lipid control; coronary heart disease (CHD), nephropathy, retinopathy and neuropathy screening and treatment; and foot care.

Evidenced-based guidelines from the American Diabetes Association include the provision of ongoing DSME that addresses problem solving skills and coping mechanism (ADA, 2010). These guidelines are in accordance with National Standards for DSME since DSME has been beneficial in helping patients achieve optimal metabolic control, prevent and manage diabetes-related complications and maximize their quality of life (ADA, 2010). Monitoring and assessing blood glucose level is one of the essential skills of DSM (ADA, 2010). For persons using insulin, self-monitoring of blood glucose (SMBG) may be recommended three or more times a day; whereas for persons on noninsulin therapy, the plan may be less frequent (ADA, 2010). The specific goals of glycemic control include the following: restoring blood glucose to near normal levels with a target A1C level of < 7.0% and FPG < 125 mg/dl (ADA, 2010). Compliance with prescribed laboratory testing of FBG and quarterly or bi-annually A1C testing are essential practices for glycemic control (ADA, 2010).

The diabetes care management plan should also require behavior changes in diet, exercise, foot and eye care (ADA, 2010). Behavior change required for DSM may be measured by the degree to which the patient complies with their medical plan (in terms of MNT, medication administration, physical activity and SMBG) and indirectly by clinical outcomes such as A1C, FBG lipid profile and BMI. According to the *Standard of Care* for diabetes by the American Diabetes Association, dietary modification, weight management and incorporation of physical activity into the lifestyle of persons with diabetes are essential components of DSM (ADA, 2010). Individualized MNT, recommended for all persons with diabetes, should have a component for weight loss for overweight or obese persons (ADA, 2010). Dietary saturated fat intake should be < 7% of total calories and trans-fats should be minimized for persons with diabetes (ADA, 2010). Carbohydrate monitoring is considered a key strategy in glycemic control and the use of the glycemic index and glycemic load may be of additional benefit (ADA, 2010). Physical activity, recommended for persons with diabetes, includes at least 150 min/wk of aerobic activity at 50-70% of maximum heart rate and resistance training three times per week in the absence of contraindications (ADA, 2010).

Although diabetes care is largely the responsibility of the individual, health care providers play a vital role in the patient's skill development. In fact, health care providers are the link between the patient and their disease self-management. The communication process between the provider and patient can determine whether or not the patient is informed, motivated and confident enough to make the behavioral changes necessary for diabetes care.

Patient-provider communication

Health provider definitions vary throughout the literature and for this investigation. In many instances, the generic terms ranging from the broadest: 'provider,' (which could be support staff) and with various distinctions: 'healthcare provider,' which indicates health-related staff (such as x-ray and medical technicians), and 'healthcare professional,' where education in an unspecified health discipline is indicated. Wherever possible, distinctions will be made as to the type of healthcare provider in the literature, as well as for this study.

Patient adherence has been positively associated with effective provider communication throughout the literature since the late 1960's (McCann & Blossom, 1990). Patients' characteristics and behaviors were thought to be responsible for adherence, until around the mid -1980's; from the 1980's onward, the majority of investigations focused on provider behavior (McCann & Blossom, 1990). In fact, McCann and Blossom (1990) framed a system of guidelines for providers to increase the likelihood of patient compliance with an adult learning model. They applied the constructs of the theory toward a model "ADULT" based on a review of the literature and an educational process. Their findings of positive patient-provider communication strategies, briefly and sequentially outlined, were the following: 1) *active involvement:* establish rapport by active listening; 2) *discuss concerns*: assessing needs by identifying the patient's concerns, strengths and limitations; 3) develop a plan by promoting an *understanding of the issues*: involve the patient in the decision-making process concerning treatment and lifestyle changes; 4) *learn new behaviors*: implement the plan through instruction of an interdisciplinary health team; 5) *track the patient's progress*: evaluate the plan by monitoring patient's understanding of the plan and progress.

Despite the importance of quality health care needed to impart DSM skills and behaviors, most clinical trials measure quality indirectly. Degree of quality for diabetes care has usually been assessed by measurements such as the patient's self-reported health behavior and its association with diabetes-related complications. Another variable associated with quality health care and health outcomes is race/ethnicity. These aspects of diabetes care and patient-provider communication will be discussed in the next paragraphs.

Quality of health care, ethnicity, and diabetes self-management

Federal agencies and the literature concur that access to quality health care and education for diabetes self-management are essential to the prevention of diabetes complications. Quality health care can be assessed by the degree to which diabetes complications are prevented or reduced as a result of patient's lifestyle behavioral changes. Medical advice associated with diabetes self-management and clinical health outcomes can serve as measures of risk for diabetes complications for a cross-sectional sample. The association among provider support for diabetes self-management, patient self-care and health outcomes is presumed, yet understudied (Greene & Yedidia, 2005).

Heisler, Cole, Weir, Kerr and Hayward (2007a) using two validated scales to access medical advice found that when providers communicated information and allowed patient involvement in decisions, diabetes self-management practices (medication adherence, diet, exercise, blood glucose monitoring and foot care) and hemoglobin A1C values improved for a national cross-sectional survey of 1588 older adults (Blacks and Latinos were oversampled) with diabetes. Improvement in diet and A1C was associated with a continuity of care score (number of visits to health care providers and the number of providers seen) for a prospective study of 256 adults ages 18 and older with type 2 diabetes (Parchman, Pugh, Noel & Larme, 2002). A longitudinal study of four age groups of urban African-Americans with type 2 diabetes at a primary health care clinic (N = 2539) reported a significant improvement of A1C in all age groups ($p < 0.001$); however, patients with less frequent visits were associated with higher A1C levels (El-Kebbi et al, 2003).

Heisler et al (2007b), using a large nationally representative sample (N = 1901) found no ethnic differences in A1C when comparing individuals not taking antihyperglycemic medications; however, there were significant differences in A1C among Blacks (8.07%), Latinos (8.14%) and Whites (7.22%) taking antihyperglycemic medications. The authors concluded that medication adherence, poorer for Blacks and Latinos in their study, was a significant predictor of glycemic control. Similar results were found for an underserved, population with diabetes of San Diego County, where A1C was higher for Latinos (7.8%) and Blacks (8.0%) as compared to Whites (7.6%); additionally, A1C was lowest for Asians (7.1%) (Benoit, Fleming, Philis-Tsimikas & Ji, 2005). A 12-month study of Canadian adults (ethnicity not mentioned) with diabetes (n = 1029) found a positive association between frequency of testing blood glucose and improved A1C for persons with type 2 diabetes who were taking oral hypoglycemic agents (Jones et al, 2003);

furthermore, access to self-monitoring supplies (provision of testing strips) was related to frequency of glucose self monitoring and improved A1C (Jones et al, 2003).

Data from the 2000 Behavioral Risk Factor Surveillance System revealed that Hispanics were less likely to report daily monitoring of blood glucose than non-Hispanic Whites [OR = 0.3 (95% CI = 0.2, 0.4)] (Nelson, Chapko, Reiber & Boyko, 2005). Around the same time, Harris (1999) found that Mexican-Americans were less likely to check their blood glucose than the rest of the population. Uninsured persons with diabetes were more likely to be African-Americans or Hispanic, under 65 years of age with lower education levels and incomes and were less-likely to perform glucose monitoring (Nelson et al, 2005). There were minimal differences in types and frequency of services between persons with Medicare versus private insurance (Nelson et al, 2005).

More recently, Heisler, et al (2007) using data from the National Institute of Aging longitudinal study; the Health and Retirement Study (HRS) (N = 1233) of Americans $\geq$ 55 years of age with self-reported diabetes, compared A1C and diabetes self-management differences among African-Americans, Latinos and White non-Hispanics. Among the approximate 83% of participants who took antihyperglycemic medications, there were significant differences in A1C among races (Heisler, et al, 2007b). The authors found that Latino and African-American participants had poorer glycemic control than White non-Hispanics and medication adherence was a significant predictor of A1C levels (Heisler, et al, 2007b). Their results concur with Benoit, et al (2005), who found that patients prescribed insulin or multiple oral hypoglycemic agents had higher A1C values than those not prescribed diabetes medication.

The above studies substantiate the need for studies which compare race/ and or ethnicity with respect to the interrelations of health care, health behavior and health outcomes. Due to the race/ethnic composition of the United States, NHANES has classified persons based on self-reported race/ethnicity into four groups: White, non-Hispanics (WNH); Black, non-Hispanics (BNH); Mexican-Americans (MA); and "Other Hispanics". As a means of assessing health disparities, studies compare racial/ethnic minorities to either the overall population or to WNH. Although Native Americans and certain Asian- and Hispanic-American groups are at higher risk for diabetes mortality than the general United States population, NHANES data does not provide sufficient numbers of these groups to determine differences in the study variables. Therefore, the proposed study will compare Black non-Hispanics and Mexican-Americans to White non-Hispanics in accordance with the availability of NHANES data and for the assessment of health disparities for persons with diabetes.

Health care and health outcomes of Blacks, and Mexican-Americans with diabetes

Egede and Michel (2006) studied a phenomena they termed 'medical distrust of the health care system'. The authors investigated a sample they classified as 216 indigent adults with type 2 diabetes (40% White and 60% Black) (Egede & Michel, 2006). Egede and Michel (2006) measured trust with a 15-item (four-point, Likert Scale) validated, Medical Mistrust Index (MMI) where higher scores indicated a higher level of mistrust. The MMI, developed by LaVeist, Nickerson and Bowie (2000), included three sub-scales: patient satisfaction, racism and medical mistrust; and, the test of interreliability yielded alpha coefficients of 0.93, 0.76 and 0.74, respectively. For their study, Egede & Michel (2006) achieved an 80% power at an alpha of 0.05 to detect a 3-point difference in mean scores between Blacks and Whites using a two-tailed t-test. When mean MMI average scores were compared between Blacks and Whites there were significant difference between groups (Egede & Michel, 2006). For both Black and White participants there was a negative relationship between MMI score and perceived control of diabetes; MMI was also negatively associated with reports of physical and mental health (Egede & Michel, 2006). The investigators suggested that there may be racial/ethnic differences when considering the interrelationships among trust of specific health care providers, diabetes self-management and health outcomes.

Instead of seeking race and ethnic differences as a means of improving DSM outcomes, the focus of several studies has been to elicit population-based preferences and recommendations for the development of effective DSM health outcomes and programs. Hill-Briggs, Yeh, Gary, Batts-Turner, D'Zurilla and Brancati (2007) compared a 30-item Diabetes Problem-Solving Scale (DPSS) developed from an African-American focus group in an earlier study with DSM factors such as glycemic control, medication adherence and depressive symptoms for 64 African-American with type 2 diabetes. Their results indicated that a higher DPSS score on the positive problem- solving subscales was significantly associated with decreased A1C and increased likelihood of SMBG (Hill-Briggs et al, 2007). Conversely, they reported that higher scores on the ineffective problem-solving subscales were significantly related to lower likelihood of SMBG, depressive symptoms and increased A1C (Hill-Briggs et al, 2007).

Another culturally-specific study aimed at improving DSM was conducted with four focus groups (N = 40) comprised of Mexican-Americans with type 2 diabetes and their family caregivers (Vincent, Clark, Zimmer &Sanchez, 2006). The major themes included the following: the need for a telephone hotline to answer questions and DSM; modification of traditional recipes with cooking demonstration; activities that reduced stress; the need for family members to be educated about the necessary lifestyle changes for DSM; and DSM education programs to be lead by an expert and translated by a community lay worker (Vincent et al, 2006).

A two-arm, randomized control trial (6-month, culturally specific intervention versus a usual-care control group) was conducted to determine effectiveness of community lay workers (promotoras) on DSM of Mexican-Americans (N = 150) with type 2 diabetes. The sample was predominately female and low-income (Lujan, Ostwald & Ortiz, 2007). The usual-care group received individual diabetes education and DSM pamphlets; whereas the culturally specific group was educated by "promotoras" (following the principal investigator's curriculum) and received faith-based health behavior change postcards (Lujan et al, 2007). The intervention group improved glycemic control (lower A1C levels) and mean knowledge scores significantly more than the control group (Lujan et al, 2007). On the contrary, both groups had a decrease in mean health belief scores at 3 and 6 months. The authors suggested the results may be indicative of the participants' religious belief in divine fatalism (Lujan et al, 2007).

On the other hand, Brown et al (2007) reported an improvement in health belief scores (subscales for benefits, barriers, control, impact of job and social support) for two culturally-competent DSM interventions conducted by local bilingual (Spanish/English) nurses, dietitians and community workers. The investigators compared 52 contact hours versus 22 contact program hours of one-year duration for Mexican-Americans with type 2 diabetes. In their study, control of diabetes, one of the 5 subscales health beliefs (having control over diabetes), accounted for 13.1% ($p < 0.001$) of the variation in A1C and that high control was associated with low A1C (better glycemic control) (Brown et al, 2007).

A pilot study comparing two culturally sensitive interventions: group DSME and individual DSME for African-Americans with type 2 diabetes showed statistical trends for improved goal attainment for those participants who attended group DSME (Utz, et al, 2008). The authors' premise was that social dynamics of an expert functioning within a group of peers would enhance the learning process for individuals beyond that of the expert and the individual (Utz et al, 2008).

Health disparities, diabetes, and NHANES 2007-2008

In order to understand the relationship between health disparities and diabetes, the term "health disparities" needs to be clarified. The first official definition for health disparities was created to the National Institutes of Health (NIH) in 2000 and was defined as 'differences in disease and health conditions among specific populations in the United States' (NIH, 2000). That year, the *Minority Health and Health Disparities Research and Education Act of 2000* was initiated to amend the Public Health Service Act to improve the health of minority individuals. This United States Public Law (106-525) authorized the National Center for Minority Health and Health Disparities to support research and projects aimed at eliminating health disparities. Since its initiation in 2000, the National Center for Minority Health and Health Disparities has become an institute of the National Health Institutes in 2010 (now the Institute on Minority Health and Health Disparities: NIMDH) (NIH, 2010).

Several issues have arisen regarding determining health disparities include but are not limited to: 1) determining the reference group: measuring a subgroup against the entire

United States population versus White non-Hispanics may yield contrary results; 2) the protocol for selecting measures to assess health inequalities; 3) whether or not to use social weights to define relative need for scheduling/ and or funding allocation; 4) should positive or negative outcomes be measured; 5) whether to use an absolute or relative comparison (Carter-Pokras & Baquet, 2002). For purposes of this study, the reference group will be White non-Hispanics and the comparisons will be relative and without social weights.

National health databases provide information that can be analyzed for the relationships of health care diabetes and health disparities. The survey questions, added to the NHANES 2007-2008 regarding medical advice for persons with diabetes, provide a unique opportunity to study the relationships among patient-provider communication; ethnicity and race; and, DSM behaviors and health outcomes. These questions may be used as a tool for the assessment of medical guidance perceived by participants. The questions covered areas such as: blood glucose and lipid monitoring and control; weight management; and, physical activity.

Response differences among ethnicities/races with diabetes can be compared to DSM behaviors (SMBG; weight management; physical activity) and clinical outcomes (glycemic and lipid control, BMI). In addition, there may be unique trends by ethnicity/race and gender. Standard diabetes care instructions are generally administered to all patients regardless of their ethnicity or race; yet, there may be barriers to accessing the health message for certain groups. In addition, the delivery of medical advice may not be gender- or culture- appropriate.

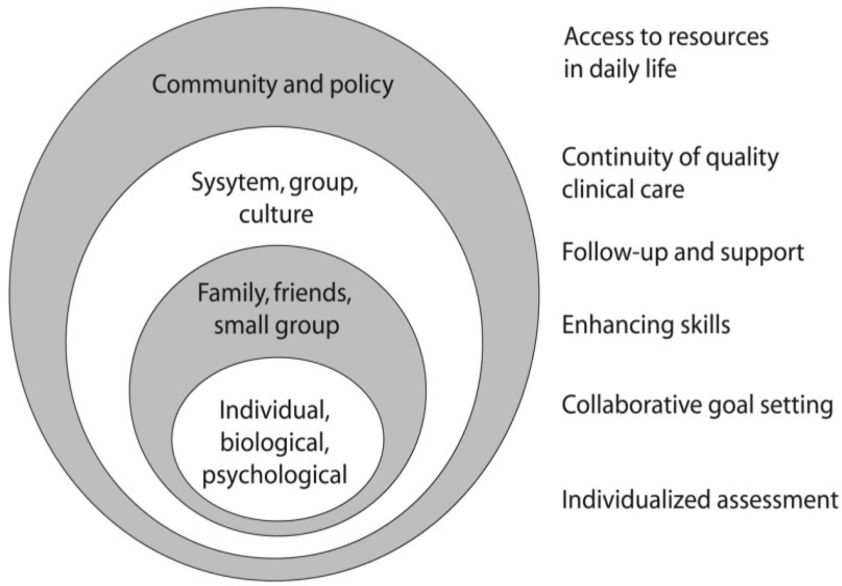
Despite the availability of these data, interpretation has several limitations. Relationships between medical advice and health outcomes are not causal for the following reasons: the study represents a single time point; there are other environmental, social influences that combined with individual characteristics in determining behavior; and, medical advice is self-reported. Although the first two reasons are evident and have been discussed extensively in the literature, the last reason needs clarification. There is no absolute way of determining the level of medical advice that was actually given. For instance, medical advice may have been given and there could have been problems with communication or recall. In some cases, the medical advice was given and the patient did not remember receiving it at the time of the survey (lack of recall). In other cases the patient received the advice but did not process it (ineffective communication on the part of the physician or healthcare provider).

Of the several national health surveys, NHANES 2007-2008, is the most comprehensive. The new questions concerning health care in the NHANES 2007-2008 dataset present a unique opportunity to analyze disparities in health care quality for a sub-group of persons with diabetes in terms of health behavior and health outcomes. This combination of data is not available in NHANES of previous years. The Behavioral Risk Factor Surveillance System (BRFSS) tracks health conditions and health risk; however, it lacks information on medical advice and clinical markers. The National Health Interview Survey (NHIS) contains questions regarding medical advice; however, there were no laboratory measures (height and weight are self-reported). As such, NHANES 2007-2008 provides the data needed to address the gap in the literature concerning the associations between medical advice received and DSM by ethnicity/race.

Ecological model of health behavior and public health

Conceptual framework

The ecological model was used for the conceptual framework for this study In the ecological model, Fisher, Brownson, O'Toole, Shetty, Anwuri, and Glasgow (2005) describe self-management in the context of the community, larger cultural group, smaller family/friend group and individual, biological, and psychological characteristics as it influences their support systems. The model was chosen since DSM behaviors are the product of multiple levels of influences. The general ecological model encompasses concentric, multiple layers of political and social influence on the individual's biological and psychological constitution (Fisher, Walker, Bostrom, Fischhoff, Haire-Joshu & Johnson, 2002). The model was augmented to include aspects of self management referred to as resources and supports for self-management (RSSM) needed by individuals **(Figure 1)** (Fisher et al, 2005). The categorization of resources/supports has been developed by the authors, based on a review of diabetes interventions. Fisher and colleagues (2005) claimed the ecological approach combines the individual's knowledge, motivation and skills with the services and supports from the social and physical environment. In turn, the medical supports/resources are influenced by the same levels of influence affecting the individual. They further assert that ecological layers do not necessarily correspond to any one service or resource, but rather there is a complementary nature of individual and social processes (Fisher et al, 2005).



Correspondence of ecological levels of influence with resources and supports for self management In: Fisher, E.B., Brownson, C.A., O'Toole, M.L., Shetty, G., Anwuri, R.R. & Glasgow, R.E. (2005). Ecological approaches to self-management: The case of diabetes. *American Journal of Public Health*, 95(9), 1523-1535. Used by permission from Sheridan Press.

Figure 1. Conceptual framework: Ecological approach to self-management

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The ecological model (also referred to as the socio-ecological paradigm) has been applied extensively in the development of public health programs. The ecological model advocates that health indicators need to be assessed within a global framework. The model is based on the belief that key changes (positive or negative) in the social and physical environment will promote corresponding changes in individuals and that these changes correspond to the support of their group culture, small group (interpersonal: family and friends) as well as the biological and psychological components (attitudes, motivation, knowledge and skills) necessary for health behavior change.

Historically, the ecological approaches to health behavior have been credited to the field of behavioral psychology (Skinnerian theory,1953); where the environment was thought to cause the individual's actions and public health theories such as social cognitive theory (attributed to Albert Bandura; 1986); whereby the individual's personality interacts with social and environmental influences (Glanz, Rimer &Lewis, 2002, pp. 464-465). Rudolph Moos (1980) developed a rudimentary social cognitive model with four categories: physical settings (natural and built environment); organizational (worksites, schools, churches); human aggregate (cultural and demographic factors) and social climate (individual's perceptions of their social environment) (Glanz et al, 2002, p 465).

The social-ecological paradigm emphasizes the dynamic interrelationship between personal attributes and the cumulative impact of multiple environmental conditions on the person's physical, social and emotional well-being (Stokols, 1996). As such, practical guidelines ensuring quality health care can be developed and measured using the ecological framework.

Relationship of the ecological model to health outcomes

Kreps, O'Hair and Hart (1994; p.5) affirmed that "The time has come to advance research that illuminates the important relationships between communication and health outcomes." Diabetes is a public health problem requiring a multilevel systems approach for prevention and treatment (Glasgow, Wagner, Kaplan, Vinicor & Norman, 1999). The population-based approach advocated by Glasgow et al (1999) includes personal, family, health care team, and community influences that impact on the promotion or inhibition of diabetes self-management and lifestyle changes (Glasgow et al, 1999). A key factor, interwoven through each system, is communication.

Investigations concerning the relationship between patient-provider communication and health behavior were conducted in the late 1960's (Davis, 1968). There have been detailed protocols for medical advice, which included collaborative goal setting, in the field of nursing since the 1960's.

Although medical professionals have established guidelines for effective communication, the complex dynamics of interpersonal relationship makes desired outcomes and assessment of the patient- provider communication challenging. For example, the treatment plan for a patient with type 2 diabetes includes an interview that has a standard protocol. Even if how to deliver the message was defined as 'culturally sensitive and collaborative,' determining if the communication was received in the manner it was intended by the provider has been assessed through health behavior and outcomes as opposed to direct feedback by the majority of the research.

In the field of public health, key resources and supports for self-management (RSSM) have been developed regarding the interrelationships among patient-health care provider communication, DSM behavior and health outcomes based upon research conducted over the past 15 years (Fisher, Brownson, O-Toole, Shetty, Anwuri & Glasgow, 2005). The ecological model provides the framework for the levels of influence of the RSSM. The RSSM needed by individuals were identified as follows: individualized assessment; collaborative goal setting; skills enhancement; follow-up and support; access to resources in daily life; and continuity of quality clinical care (Fisher et al, 2005). Although it may be tempting to match influences with a particular domain of the ecological model, all elements from public policy through systems and groups affect individuals' health beliefs, behaviors and health outcomes (Fisher et al, 2005).

Health outcomes may be categorized as 1) *cognitive*: adjustment of health knowledge and beliefs; self-efficacy; commitment to improving health; and change in level of trust, expectations, fears and anxieties; 2) *behavioral*: degree of compliance with regiment; and level of motivation in adoption of health-promoting behaviors, which are by observation or self-report; or 3) *physiological:* disease prevention measurement which can be considered objective endpoints (for example serum levels of A1C or HDL or BMI as an obesity indicator) (Kreps et al, 1994).

The following concepts from the Ecological model by Fischer and colleagues (2005): access to resources in daily life; continuity of quality clinical care; enhancing skills; collaborative goal setting; and, individual assessment have been linked to operational measures. Medical advice is associated with collaborative goal setting; receiving diabetes education corresponds to enhancing skills; health outcomes are a measure of the continuity and quality of care; and, the individual with their culture/ ethnicity corresponds to their access to resources (healthcare) and their individual assessment. In turn, individual assessment is influenced by the culture/ethnicity of the patient-provider dyad.

Patient-provider communication precedes the operational constructs as an influence. The effectiveness of medical advice and diabetes education may be contingent upon factors of patient-provider communication. The entire interchange of the patient and healthcare provider affects the behavior of the patient. How medical advice influences the patient is dependent upon patient-provider communication. It is imperative for there to be an effective patient-provider interchange for collaborative goal setting to occur. Indirectly, medical advice and collaborative goal setting happened; albeit, better health outcomes may be attributed to better collaborative goal setting. Health behavior may be an indirect measure of patient-provider communication and collaborative goal setting.

Patient-provider communication is confounded by the health beliefs and values of the dyad. The manner in which the organization and healthcare provider approaches the patient depends on individual and organizational cultural competency. According to Cross, Bazron, Dennis & Isaacs (1989), cultural competency is an evolving process of awareness and skills that incorporate values, principles, behaviors, attitudes and policies of working effectively cross-culturally. As such, measurement of cultural competency is complex and is a factor of variance among the study population. In order for a system to become more culturally competent, Cross et al (1989) identifies the following five elements: value diversity; cultural self-assessment; consciousness of the dynamics of cultural knowledge; and, development of adaptations to diversity. Cross et al (1989) further stated that attitudes, policies and practices are areas that need to be targeted in the movement toward cultural competency.

Even though the working model does not measure cultural competency, this concept is present and indicated, throughout the literature, as a component of medical advice and/or diabetes education. Cultural competency has also been referred to as cultural sensitivity. Cultural linguistic competency, a narrower type of cultural competency, specifies only the ability to communicate in the client's language either by being bilingual or having a certified interpreter participate in the communication process. The Office of Minority Health has developed 14 national standards on culturally and linguistically appropriate services (CLAS) that are mandated for government agencies at the federal, state and county levels and suggested for use in all health care organizations (OMH, 2007). Even though these standards are specifications for an operational definition of *cultural and linguistically cultural competency*, definition of the term varies among health care organizations. As applied to the patient- provider relationship, cultural competency is a subjective indicator of the degree to which the provider can interact successfully irrespective of race and/or ethnicity of the pair. While cultural sensitive might be considered the intention of the provider, cultural competence is the measureable outcomes of patients' satisfaction and their rating of the effectiveness of the advice or education given.

Specifically, the linguistic competency of the provider may influence whether or not the patient receives the intended message. Goode & Jones (2009) developed and revised a definition for linguistic competency that has been widely used in health care and other human service delivery systems. Communication is considered to be linguistically competent if it is delivered effectively to meet the needs of the populations served and is easily understood by such persons (Goode & Jones, 2009). The major constructs of the ecological model applied to the variables of this study that form the working theory are shown in **Figure 2**., and the relationship between the conceptual framework and the working theory is shown in **Figure 3**.

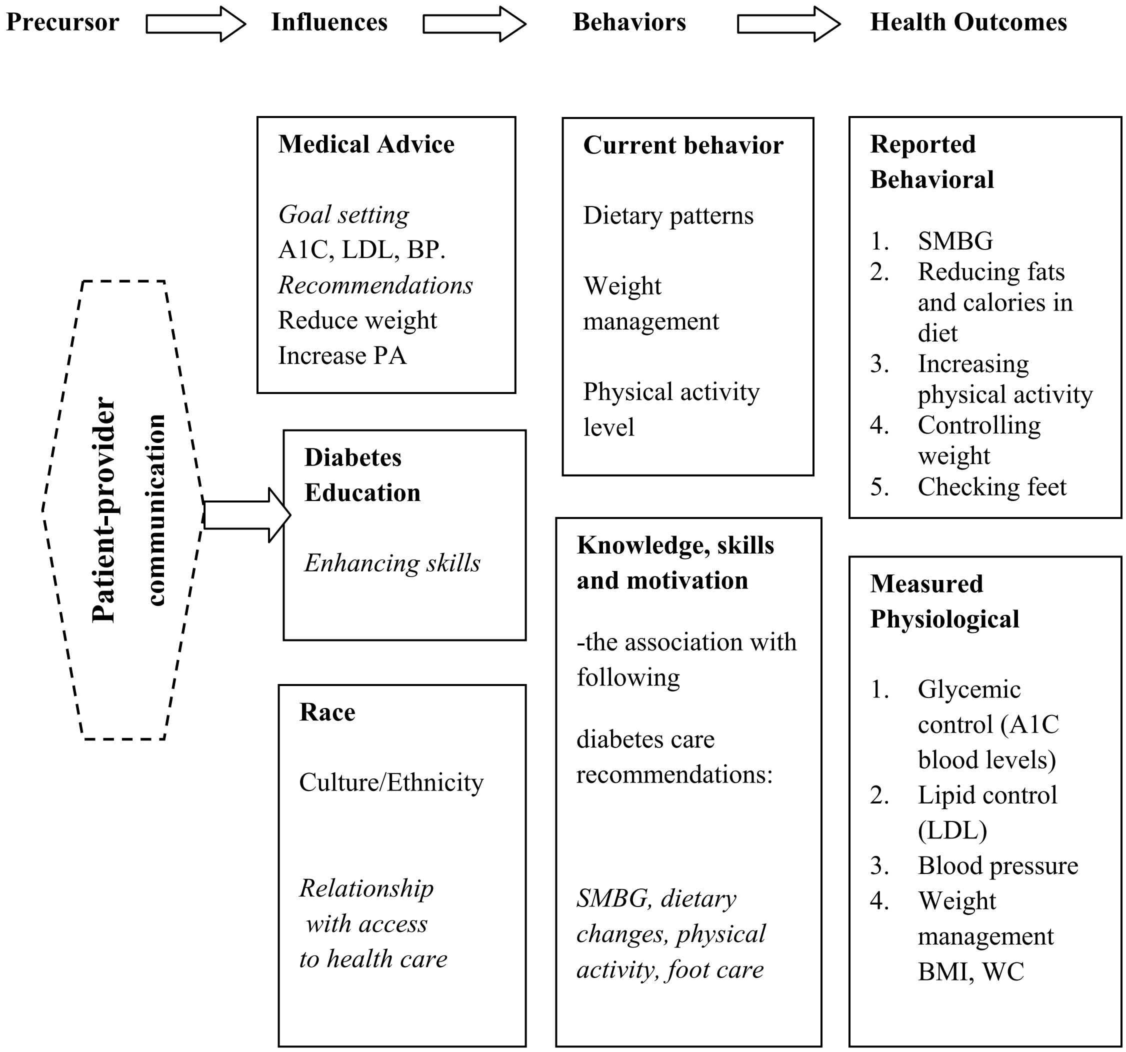

Figure 2. Ecological model applied to health care, DSM, and health outcomes

Adapted from the NHLBI workshop on predictors of obesity, weight gain, diet, and physical activity; August 4-5, 2004; Bethesda, MD, and from the Ecological approaches to self-management: The case of diabetes (Fisher et al, 2005).

Abbreviations: A1C = hemoglobin A1C; BMI = body mass index; BP = blood pressure; LDL = low-density lipoprotein cholesterol; SMBG = self-monitoring blood glucose; WC = waist circumference.

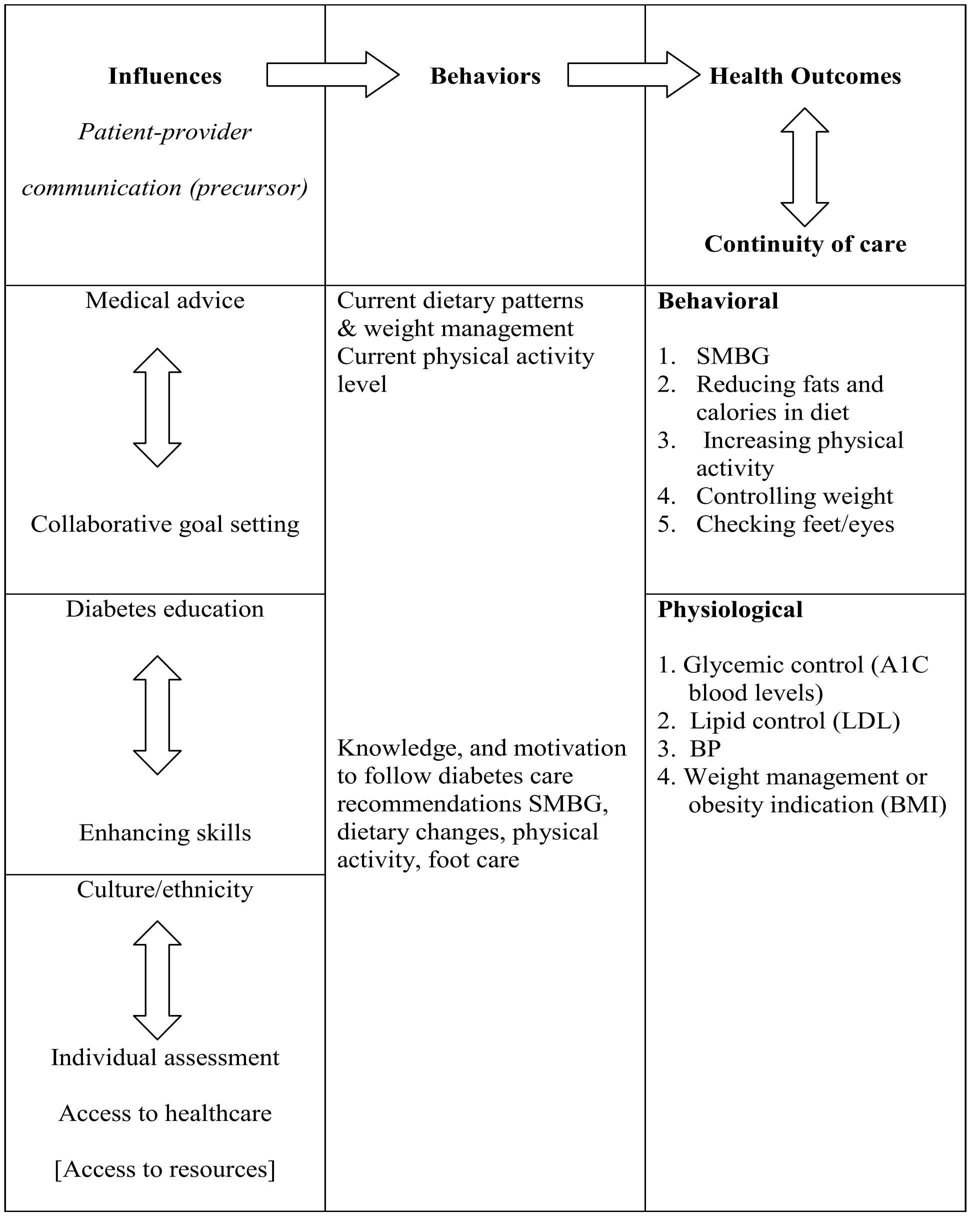

Figure 3. Connection of conceptual framework and working theory

Abbreviations: A1C = hemoglobin A1C; BMI = body mass index; BP = blood pressure; SMBG = self-monitoring blood glucose.

Clarification of working model terms

The influences: medical advice, diabetes education, patient- provider communication, access to healthcare, and cultural competency are defined within the context of this study as follows: 1) medical advice was reported given by their *doctor* or *health professional*; 2) diabetes education was reported given by a *diabetes nurse educator*, *dietitian*, or *nutritionist* for their diabetes and they were told not to include doctors or other health professionals in their response; 3) patient-provider communication and cultural competency were not specified; and, 4) access to healthcare was reporting having a healthcare plan within the past 12 months. Knowledge and motivation of diabetes care and eye care were not measured for this study. They were included in the working model, since they are a part of diabetes care. Operational definitions for influences, behaviors and health outcomes are described in methodology and the pertinent assessment questions are given in **Appendix 1**.

Although there are numerous definitions of culture, ethnicity and race, for the purposes of this investigation the following interpretations will be applied: 1) *culture* refers to the beliefs, social practices and characteristic of a racial, religious or social group; 2) *ethnicity* reflects a belonging to a group of people that share common and generally distinct cultural, racial, national or religious heritage; and, *race* is a social term or social construct. For this study, race will be used to define the social groups: MA, WNH and BNH; even though, MA refers to ethnicity, while BNH and WNH refer to race.

CHAPTER III

METHODOLOGY

Design overview

Secondary analysis was conducted using the National Health and Nutrition Examination Survey (NHANES) 2007-2008 database comparing ethnicity, reported medical advice, diabetes self-management skills and diabetes-related health outcomes.

Sample population

Male and female adults age's ≥ 21 years with diabetes were selected from NHANES 2007-2008 database for whom detailed interviews and examinations were available and met the following conditions:

Inclusion criteria

Adults' ≥ 21 years and reporting a diagnosis of diabetes and of the following ethnicities:

1. Black Non-Hispanic
2. Mexican-American
3. White Non-Hispanic

Exclusion criteria

1. Hispanics who are not Mexican (categorized as "other").
2. Persons under 21 years of age.
3. Persons without a diagnosis of diabetes

Of the total sample size for the 2007-2008 participants that were examined, there were 2,064 MA, 1,147 other Hispanics, 2,141 BNH, 3969 WNH, and 441 persons classified as "other". From the combined sample, there were 777 persons (7.7%) of the 9372 valid cases who responded to the screening question for diabetes (age when first told you had diabetes). The categories for “other Hispanics” and “other races” were 10.8% and 2.7%, respectively, and did not constitute a sufficient sample size for comparative analyses and were not included in this study. In addition, 18 minors were excluded (< 21 years). The final sample size was *N* = 654 [MA (130); BNH (224); WNH (300)]. List-wise deletion was used for analyses where information was missing.

Sample size estimation

Since the main outcome variables, medical advice received and treatment behaviors have not been tested by NHANES, the power analysis was based on several clinically important outcomes: fasted blood glucose (FBG), SBP, DBP, triglycerides (TG), and LDL, and a review of the literature. Since these outcomes are paired by ethnicity and continuous, sample size calculation was based on the t test. Furthermore, our power analysis is based on a two-tailed alpha of 0.05 (95% confidence) and beta of 0.20 (80% power) for each variable. Meta-analyses of short-term dietary interventions by the American Diabetes Association (2007) reported reductions of 15-25 mg of LDL-C and considers this reduction range to be a clinical target for lifestyle interventions. Applying this target (15-25 mg range) for a power analysis, a modest standardized effect size of 0.45 yielded a sample size of 80 in each group (Hulley & Cummings, 1988).

Next, a power analysis using FBG was performed. A desired effect of 1mmol/L or 9 mg/dL was chosen, based on the outcome evaluation of the CANOE trial (Zinman et al, 2006). A standard deviation of FBG for persons with diabetes was found to be 66 with a mean of 146 from an analysis of data collected in our laboratory from Cuban-American subjects. Back calculation of a standard effect size of 0.45 yielded an estimated SD of 20 and a sample size of 80 (Hulley & Cummings, 1988). A clinical change of 5 mg/dL in FPG would correspond to a standardized effect size of 0.40 and would require 98 participants per group. Three ethnic groups were compared, so approximately 300 participants would be required to achieve statistical power considering a design effect of 1.0.

The design effect (DEFF) is an estimate of the variance of a complex sample with respect to that of a simple random sample (DEFF = variance estimate (cluster)/variance estimate (simple random sampling). The design effect represents the factor of change needed to produce estimates comparable to a simple random sample (Dattalo, 2008). A DEFF of two would require twice as many participants than a simple random sample to determine a difference between groups (Dattalo, 2008). According to the National Center for Health Statistics (NCHS, 2010) it is difficult to set a single minimum sample size for analysis since DEFF are generally greater than 1.0 for NHANES and differ for each variable, race/ethnicity and age group. It was determined that groups of 100 were necessary to achieve power and the full sample of Mexican-Americans was 120. This implies that a DEFF > than 1.5 would create a situation with insufficient power. Therefore, a cut-off for the design effect was set at DEFF < 1.5.

It was recommended to consider the sampling error of the statistic to determine adequate sample size (NCHS, 2010). For continuous outcome variables, such as serum lipids or blood pressure, a cutoff point of ≤ 30% relative standard error (RSE) was recommended for adequate sample size (NCHS, 2010). Interpretations of sufficient sample size for binary variables is less clear; however, Hosmer and Lemeshow (2000) suggest treating the data as a simple sample to obtain model fit and then as a complex sample to estimate parameters. Thus, the adequacy of sample size can be estimated by the diagnostic statistic available in simple sample methods. Furthermore, model fit estimates for complex designs available in packages like STATA and SUDAAN have been criticized for overstating *p*-values (Sukasih, Jang, Xu, 2007). Adequate goodness of fit testing procedures have not been developed for large-scale survey data such as NHANES and the National Health Interview Survey applicable to logistic regression models (Archer, Lemeshow, Hosmer, 2007).

As such, for this study, a number of strategies were applied to determine the adequacy of sample size for each analysis. For general linear models, the RSE was used as a guide for sample size sufficiency in accordance with the suggestions of the NCHS. Logistic regression models were conducted first by the simple sample technique (without sample weights) and the following conditions were required for sample size adequacy: 1) Model classification of at least 60 %. 2) Category frequencies of at least 30. 3) Odds ratio of at least 1.5. The later cut-off for the odds ratio was chosen, based on preliminary investigation of the design effect range for race explaining medical advice (DEFF ≤ 1.5).

Data collection

Raw data were extracted from datasets collected from the National Health and Nutrition Examination Survey, 2007-2008 (NHANES 2007-2008)[1] available for public use (p. 119). For more details on their data collection, visit the NHANES website available at http://www.cdc.gov/nchs/nhanes/nhanes2007-2008/generaldoc_e.htm. The next several paragraphs, a summary of NNANES 2007-2008 sampling pertinent to this investigation has been presented.

This survey contains data for 10,149 individuals of all ages. Data were collected between January 2007 and December 2008. Each year, for a sub-set of the survey, a more detailed household interview and examination is conducted by trained interviewers on approximately 5,000 individuals. A limited data set from the survey interview and examination is available to the public with the corresponding codebooks.

All NHANES research is generated under the auspices of The National Center for Health Statistics (NCHS), Division of Health and Nutrition Examination Surveys (DHNES), part of the Centers for Disease Control and Prevention (CDC). Since the early 1960's, NHANES were conducted and starting from 1971 to 1994, the surveys were periodically administered. Starting in 1999 the survey has been conducted continuously. Questions from the NHANES 2007-2008 were taken from previous versions of NHANES with additional questions added based on public feedback.

The NHANES survey design is a stratified, multistage probability sample of the civilian non-institutionalized U.S. population. The stages of sample selection are as follows: 1) *Primary Sampling Units* (PSUs), which are counties or small groups of contiguous counties; 2) *Segments* within PSUs (a block or group of blocks containing a cluster of households); 3) *Households* within segments; and, 4) one or more participants within households. A total of 15 PSUs were visited during a 12-month period.

From the 2007 survey and continuing to the 2008-2009 survey, several changes were made to the domains being oversampled. Starting in 1988, oversampling of the Mexican-American (MA) population began. The current survey (2007-2008) oversamples the entire Hispanic population as opposed to only MA. Sufficient numbers of MAs were retained in the sample design so that trends in the health of MAs can continue to be monitored. Persons 60 and older, Blacks and the low income persons were also oversampled. In addition, for each of the race/ethnicity domains, the 12-15 and 16-19 year age domains were combined and the 40-59 year age minority domains were split into 10 year age domains 40-49 and 50-59. This has led to an increase in the number of participants aged 40+ and a decrease in 12-19 year olds from previous cycles. The oversample of pregnant women and adolescents in the survey from 1999-2006 was discontinued to allow for the oversampling of the Hispanic population.

The procedure for the household interviews and health examinations are briefly described in the next several paragraphs. First a letter was sent to all selected households to inform respondents that a trained interviewer will visit their home. When the interviewer arrived at the home, identification was shown and the objectives of the survey were explained. For the household interview, participants were those who understood, agreed to and signed an Interview Consent for the household interview portion of the survey. In addition, respondents 16-17 years of age could participate only if both conditions were met: a parent or guardian consented and the child gave his or her assent.

After the household interview was completed, all interviewed persons were asked to complete the health examination component. Those who agreed to participate were asked to sign additional consent forms for the NHANES health examination component. The interviewer telephoned the NHANES field office from the participant's home to schedule an appointment for the examination and informed the participants that they will receive remuneration as well as reimbursement for transportation and childcare expenses, if necessary. The health examinations were conducted in mobile examination centers

(MECs); the MECs provide a standardized environment for the collection of high quality data.

Data acquisition and quality control

Of the datasets available, approximately 30 datasets were merged to form the final working dataset for this analysis. The procedure for merging was by sequence number through the data-merge function of SPSS. The quality and integrity of the merged dataset was assured by following the procedure and tested by analysis of frequency, range and quartiles. The subjects were extracted based on the inclusion criteria. The final dataset, entitled 'REVISED FINAL NHANES', was saved on jump drive SPSS and a backup version on the hard drive of this investigators' laptop. All final analyses were saved on the SPSS thumb drive and hard copies were provided in a bound binder labeled by hypothesis or extra analyses. The results were reviewed and audited by the appropriate committee members. More details are provided in the data analysis section.

Data analysis

In order to understand the data analysis approach, a brief recapitulation of NHANES 2007-2008 sampling technique is first discussed. The sampling technique was a multi-staged design with post-stratification adjustments. Sample weights were constructed and included in the data sets to account for complex sample design and achieve unbiased national estimates. To achieve their target population, NHANES 2007-2008 oversampled, Mexican-Americans, all Hispanics, Black non-Hispanics, persons 60 years or older and all persons of lower income. Over-sampling of specific groups forms a reserve sample from which participants can be substituted or replaced to reduce non-sample bias by use of statistical techniques to form sample weights (Yansaneh, 2003).

The principle need for sample weights in complex designs is to compensate for unequal probabilities of selection, account for non-response, and make sample weights conform to a known population distribution. The base sample weights for interview and MEC are the probability of selection at each stage. The choice of sample weight needs to be based on data file with the smallest sample size (NCHS, 2006). For the majority of the analysis in this study, the choice of sample weight was the MEC sample weight: WTMEC2YR. This is because hypotheses for full models included variables with laboratory or anthropometrics. These measurements were taken for a smaller number of participants. The choice of sample weight was based on the data file with the smallest sample size as recommended by the NHANES guidelines afore mentioned. For additional analyses that included dietary intake, the appropriate dietary sample weight replaced the MEC sample weight.

In addition to the base sample weight, the design information for the complex sampling plan included mask variances incorporated into strata (sdmvstra) and primary sampling units (sdmvupsu). Together, the design accounted for unequal probability of selection and reduced the chance of type 1 error (NCHS, 2006; Stiller & Tompkins, 2005). The statistical program used Taylor series linearization for estimating population characteristics (Siller & Tompkin, 2005). The sample plan handled the multistage design as a single stage design with replacement.

These estimators are used for complex samples, since there are no exact formulas to calculate sample errors (variance of estimates), which are necessary for the determination of statistical reliability. However, two approximations of sample error have been applied to data from national surveys for complex samples: the Jackknife method and the Taylor

Series Linearization. The later is the current variance estimation procedure used by the continuous NHANES, including NHANES 2007-2008 (NHANES, 2010). The major software packages: SAS, STATA, SPSS and SUDAAN use the Taylor Series Linearization to calculate estimated sample error. Variables for stratum (sdmvstra) and primary sampling unit (sdmvpsu), used in conjunction with the sample weight, contain the variance estimation as a masked variance unit (MVU) to protect the identity of the participants.

Data analysis program for complex sampling

Suitable software systems available for complex sample design and approved by NHANES for analysis of survey data are: SAS, SPSS, STATA and SUDAAN (Siller & Tompkins, 2005). These software packages were compared with complex sampling modules for data from the National Ambulatory Medical Care Survey (NAMCS) and the National Survey of Family Growth (NSFG) and produced identical results using the Taylor series linearization (Siller & Tompkins, 2005). The investigators were from the NCHS and suggested selection of any of these software packages should be based on preference, cost, convenience and other individual need. In addition, the NHANES website recommends the use of complex sample analysis by either SAS, SPSS, STATA or SUDAAN.

Data analysis was conducted with IBM-SPSS version 18 with a complex sampling add-on, where *Bonferroni corrections were applied to an alpha of 0.05 within sub-hypotheses.* Continuous variables were analyzed for normality by Q-Q plots and when needed, transformed. Continuous variables were tested by residual graphs for skew. Only two variables failed to achieve normality: the diabetes self-management scale constructed by this investigator (more detail is available in the results section for hypothesis 2.b.) and fasted blood glucose.

Participants' characteristics were presented by frequency and percent. Difference of means by ANOVA and chi squared tests of health outcomes (blood glucose, lipid profile, anthropometrics, diet & physical activity) were performed to determine if there are any significant differences between gender and ethnic groups. Logistic regression was used to determine likelihood of health disparities. Ordinal logistic regression and ANOVA models were used to determine the association of level of DSM and medical advice by ethnicity.

Hierarchical logistic regression models were conducted for medical advice by race predicting adequate/inadequate DSM adding variables associated by the literature as covariates. The final models were determined by retaining covariates with $p < 0.2$ as suggested by Hosmer and Lemeshow (2000). Model fit was assessed by performing the *simple analysis*, where significant models were required to classify ≥ 60% of the cases, correctly. Estimates of poor model fit from the *simple* model can be used to cast doubt on the fit for the *complex* model (Archer, Lemeshow & Hosmer, 2007).

Although there is a choice for hypothesis testing, the *Wald F* for logistic regression is more conservative than *Chi-Square* for complex analysis models. *Wald F* constrains the degrees of freedom to a constant value [NHANES 2007-2008, (# PSU -# strata) = 17]. For complex analysis of dichotomous or continuous variables, *Wald F* is the preferred hypothesis test statistic (Forthofer, Lee & Hernandez, 2007). All F-values reported for complex analysis were *Wald F*. **Tables 1-4** summarize the concepts, hypotheses and how they were assessed, statistically.

Table 1. Summary of methodology and outcome measurements: Hypothesis 1.

Model Constructs	**Hypotheses**	**Variables**	**Measures**
	Quality of health care		
Medical Advice System, group and culture	**Hypothesis 1.a.** Black non-Hispanics and Mexican-Americans will be less likely as compared to White non-Hispanics to report being told by a medical professional any or all of the following within the past year: 1) to reduce fats or calories in their diet; 2) to increase physical activity; and, 3) to control body weight. **Hypothesis1.b.** Black-non-Hispanics and Mexican-Americans will be more likely as compared to White non-Hispanics to report their provider did not specify a treatment goal for any or all of the following: 1) A1C; 2) "Bad cholesterol that clogs your arteries - LDL"; and, 3) blood pressure.	Binary *–outcomes = received advice or other* Dietary, wt. management, physical activity, goals for A1C, LDL	Hierarchical Logistic regression models
Diabetes Education System, group culture	**Hypothesis 1.c.** Black non-Hispanics and Mexican-Americans will be less likely to report receiving diabetes counseling than White non-Hispanics.	Binary – *outcome received counseling within the past two years versus other*	Hierarchical logistic regression models

Table 2. Summary of methodology and outcome measurements: Hypothesis 2.

Model Construct	**Hypotheses**	**Variables**	**Measure**
		Diabetes self-management (DSM)	
DSM Skills System, group culture, and individual	Reporting all or any of the following diabetes self-management skills will be less likely for Black non-Hispanics and Mexican-Americans than White non-Hispanic: 1) Frequency of self-monitoring blood glucose (SMBG) 2) Reducing fat or calories in the diet. 3) Increase physical activity or exercise. 4) Control or reduce weight 5) Checking feet for sores.	Binary –outcomes reporting the following: 1) SMBG 2) Reducing fats and calories in their diet 3) Increase physical activity or exercise 4) Control or reduce weight 5) Checking feet for sores	Logistic regression models for likelihood of each skill by ethnicity ANOVA ethnicity for total DSM (continuous variable)

Table 3. Summary of methodology and outcome measurements: Hypothesis 3.

Model Construct	**Hypotheses**	**Variables**	**Measure**
	Diabetes self-management (DSM)		
DSM indicators System, group culture and individual	**Hypothesis 3.a.** Mean Hemoglobin A1C will be at least 1% higher for Black non-Hispanics and Mexican-Americans as compared to White non-Hispanics.	% A1C -outcome - continuous variable with AA, MA, WNH (race) as the independent variable	ANOVA
	Hypothesis 3.b. Inadequate LDL levels (>100 mg/dl) will be more likely for Black non-Hispanics and Mexican-Americans than White non-Hispanics. **Hypothesis 3.c.** Black non-Hispanics and Mexican-Americans will be more likely to be in the obese category (BMI $\geq$ 30 kg/m^2) than White non-Hispanics.	Binary outcomes – likelihood of Inadequate LDL levels (>100 mg/dl); obese category (BMI $\geq$ 30 kg/m^2)	Logistic regression models

Table 4. Summary of methodology and outcome measurements: Hypothesis 4.

Quality of health care and DSM			
Associations among: medical advice, DSM and ethnicity System, group culture and individual	**Hypothesis 4.a.** Reporting being told ("Pattern A" level of medical advice) and level of DSM skills/behaviors will be modified by ethnicity/race. **Hypothesis 4.b.** There will be a positive association of reporting receiving goals ("Pattern B" level of medical advice) and level of DSM, as measured by corresponding, clinical outcomes, independent of ethnicity/race. **Hypothesis 4.c.** There will be positive associations between medical advice received ("Pattern A" and "Pattern B") and each of the corresponding clinical indicators of DSM independent of ethnicity/race.	Categories of level of medical advice and level of DSM prepared as 1) ordinal and 2) continuous mean values for each ethnicity	1) Ordinal logistic regression 2) Hierarchical logistic regression models for medical advice interaction with ethnicity/race predicting adequate/inadequate DSM skills. 3) Predicted probability of DSM by race from logistic model as the dependent variable of GLM with deciles of DSM as the independent variable

Complex versus simple sample analysis

Since survey data collection applies complex sampling procedures as opposed to simple random sampling, a focused discussion of the underlying principles and differences of each method follows. Simple random sampling is the gold standard of population estimation; yet, it would be time and cost prohibitive for national surveys. Instead, complex sampling, introducing and then removing standard errors has been used by NHANES. Clustering by a multistage selection of primary sampling units (PSU) underestimates the true population variance because there are greater similarities among members of the PSU than of the total population. For example, homes in the same neighborhood of a PSU may share several characteristics such as number of bedrooms, floor levels, proximity to stores and would be more homogeneous than homes of the same value in the general population (Gilbert, 2004). Hence, the result of clustering is the estimation of a smaller standard error than would be obtained by a simple random sampling procedure.

The next element of complex sampling design, stratification, can introduce a similar underestimation true population variance for similar reasons. Additionally, among the stratification techniques used by NHANES 2007-2008 was over-sampling of certain group: Mexican-Americans, all Hispanics, Black non-Hispanics, persons 60 years or older and all persons of lower income. In order for complex sampling techniques to lead to unbiased estimates of the population, post-survey sampling weights must be applied to compensate for stratification, clustering and unequal representation of sub-populations. This investigator has questioned the application of sample weights toward variables where a known population distribution has not been determined. For example, new variables introduced by NHANES for medical advice may have been piloted; yet, they have not been assessed on the population longitudinally, to determine an adequately established population reference to this investigator's knowledge. On the other hand, variables calculated from clinical measurements, such as BMI, have known population distributions; and, sample weights could be constructed to adjust the sampling design so that the estimators and variance approach the precision obtained by simple random sampling. According to the National Center for Health Statistics (NCHS, 2006), NHANES guidelines are not standards; instead, the investigator is responsible for justifying the statistical analyses and interpretation of the results. For variables where the outcome is not known, sample weights adjusting for non-response may increase variance (Little & Vartivarian, 2004); the authors suggest using sample weights if the difference between the means square error (MSE) with sample weights is substantially different from the MSE without sample weights.

Still, another consideration for use of sample weights is the possibility that the key variables of interest (such as reported medical advice) could have been answered differently by participant as compared to non-respondents; moreover, these differences in responses may vary in magnitude and direction by ethnic or racial group. In such cases where there is no established comparison, the use of paradata (measures about the process of data) from other surveys where information is available from the non-respondents of the present survey to form sample weights has been suggested (Maitland, Casas-Cordero, Kreuter, 2009). The investigators indicated that paradata can measure respondent reluctance to answer certain types of questions and the factors associated with cooperation; in turn, these factors can be used to weight the sample for the survey of interest.

The question remains, can NHANES be used without sample weights to compare homogeneous groups by ethnicity/race? As such, the participants selected for secondary analysis would be considered volunteers. Persons willingly participating in at the mobile examinations centers (MEC) for in-depth interviews and laboratory measures have certain shared psychosocial characteristics and these attributes may not be generalized to their sociodemographic counterparts. One of the key factors in the construction of sample weights is the adjustment of age, gender and race to match a known population distribution (Yansaneh, 2003). Medical advice and health behavior questions, asked for the first time by NHANES, were the impetus for choosing the volunteer method for this study. Even though NHANES may have piloted the new medical advice/behavior questions, a known population distribution has not been established for these questions. Because of these potential differences in standard errors generated by application of complex sampling techniques this investigator has provided analyses and discussion of the primary hypotheses with and without sample weights. Analyses conducted without sample weights were also used to assess the model fit parameters (as discussed, earlier, in the sample size section under methods).

Clinical significance of the covariates

Race was considered an explanatory factor for medical advice and health behaviors. Full models were constructed with the possible clinically significant covariates since there were differences in age, health insurance and diabetes education by race. In order to assess the contribution of race to health variables, models with race alone were compared to models with contributing covariates (final models). By this method, differences across race were presented while covariates served as control variables and were held constant.

Role of the preliminary study

Prior to embarking on data acquisition and analysis for the main study, a preliminary study was conducted to ascertain whether the social phenomena, “race” could be an explanatory factor of diabetes self-management behavior and clinical outcomes. The preliminary study was designed within the conceptual framework of the ecological model applied to public health. The working model for the preliminary study contained the same broad categories: influences; behaviors; and, health outcomes as were applied to this investigation with several changes: 1) social support replaced medical advice as an influence; 2) diabetes self-management beliefs were measured as health outcomes.

Data for the preliminary study, *Diabetes self-management, family social support, and glycemic control in a tri-ethnic population with type 2 diabetes*, were acquired from two raw datasets provided by [2]F.G. Huffman. The components of the preliminary study: background; objectives; hypotheses; statistical analyses; results; and discussion contributed to the methodology of the current study. The major sections are designated with 'Preliminary' to denote preliminary study, and the manuscript is found in the **Appendix 2**.

CHAPTER IV

RESULTS

General characteristics of the study population

The general characteristics of the study participants by *simple* (no sample weights) and *complex* (sample weights) *analyses* are provided in **Tables 5** and **6**, respectively. The final sample size was N = 654 (130 MA, 224 BNH and 300 WNH). No significant differences for years with diabetes were found among races by both methods of analyses There were significant differences among race for age and education by both methods (*simple/complex analysis*). White non-Hispanics were approximately 4 years older than BNH and MA; additionally, simple analyses mean ages were 4 years higher than complex analysis mean ages across races. Income was different across race by *simple* but not *complex analysis*. Mexican-Americans were more likely not to have health care than WNH; however, there was no significant difference in reporting having health coverage between BNH and WNH (by both methods). Even though no significant differences were found for reported frequency of doctor visits by race, 60 % of MA reported not remembering the number of visits than WNH; whereas, approximately half of BNH and WNH reported they did not recall the number of doctor's visits over the past year. Of those who reported number of doctor visits, there were no significant differences among participants by race; however, those reporting specific frequencies may not be representative of their group. As such, access to health care may differ between participants, in particular, MA and WNH (data for doctor's visits not shown).

Table 5. General characteristics of the study participants *simple analysis* (*N* = 654)[a]

Variable[b]	MA	BNH	WNH	P MA/WNH	P BNH/WNH	P Total
Age (years)	60.8 ± 12.9	61.7 ± 12.2	64.0 ± 13.8	0.066	0.134	0.033
Gender				-	-	0.031
Male	58 (44.3)	99 (44.4)	164 (54.7)	-	-	
Female	73 (55.7)	124 (55.6)	138 (45.1)	-	-	
Years with Diabetes	10.4 ± 10.6	12.6 ± 12.6	12.1 ± 12.2	0.300	1.00	0.246
Education						< 0.001
≤ 8th grade	61 (46.9)	27 (12.1)	37 (12.3)	-	-	-
>8th <HS	32 (24.6)	66 (29.5)	61(20.3)	-	-	-
HS/ GED	13 (10.0)	50 (22.3)	92 (30.7)	-	-	-
Some college	24 (18.5)	81 (36.2)	110 (36.7)	-	-	-
Income						0.002
<15,000	23 (18.4)	50 (23.7)	52 (18.7)	-	-	-
15 to 34,999	32 (25.6)	64 (30.3)	115 (41.4)	-	-	-
35 to 54,999	27 (21.6)	34 (16.1)	43 (15.5)	-	-	-
55 to 74,999	9 (7.2)	26 (12.3)	21 (7.6)	-	-	-
≥75,000	21 (16.8)	30 (14.2)	41 (14.7)	-	-	-
Refused	5 (4.0)	2 (0.9)	4 (1.4)	-	-	-
Don't know	8 (6.4)	5 (2.4)	2 (0.7)	-		
Health insurance[c] *None within the past 12 months*	41 (45.6)	23 (25.6)	26 (28.9)	< 0.001	0.523	< 0.001

Abbreviations: MA = Mexican-American; BNH = Black non-Hispanic; WNH = White non-Hispanic (comparison group)

[a] MA n = 131; BNH n = 223; WNH n = 300. There were missing responses of income (n = 614), education (n = 653), years with diabetes (n = 644).

[b] Continuous variables are given as (mean ±SD) were tested by one-way ANOVA and categorical variables are given as *N* (%) and were tested by Pearson's chi-square.

[c] The *p*-values are for the log-likelihood χ^2 of the unadjusted odds ratios. The OR $_{MA/WNH}$ = 3.80 (2.00, 7.21), $p < 0.001$; OR $_{BNH/WNH}$ = 1.20 (0.64, 2.26), $p = 0.574$, (controlling for age and education).

Table 6. General characteristics of the study participants by *complex analysis* (N = 654)[a]

Variable[b]	MA	BNH	WNH	$P_{MA/WNH}$	$P_{BNH/WNH}$	P_{Total}
Age (years)	56.2 ± 1.95	57.6 ± 0.89	60.7 ± 0.65	0.019	0.012	0.002
Gender				-	-	0.127
Male	54 (48.1)	96 (398)	160 (50.2)	-	-	
Female	67 (51.9)	117 (60.2)	128 (49.8)	-	-	
Years with diabetes	9.68 ± 0.85	11.6 ± 0.67	11.6 ± 0.68	0.127	0.989	0.242
Education						< 0.001
≤ 8th grade	56 (41.5)	25 (9.2)	37 (10.1)	-	-	-
>8th < HS	29 (25.7)	60 (28.2)	59 (15.0)	-	-	-
HS/ GED	12 (11.8)	50 (24.1)	89 (31.0)	-	-	-
Some college	23 (21.0)	78 (38.6)	103 (43.7)	-	-	-
Income						0.132
< 15,000	21 (17.0)	47 (21.3)	49 (12.0)	-	-	-
15 to 34,999	29 (26.5)	62 (30.9)	111(34.2)	-	-	-
35 to 54,999	26(24.0)	33(15.8)	41(16.4)	-	-	-
55 to 74,999	9 (7.1)	24 (12.3)	21 (12.7)	-	-	-
≥ 75,000	20 (15.3)	28 (16.1)	38 (22.4)	-	-	-
Refused	5 (3.4)	2 (0.6)	4 (2.2)	-	-	-
Don't know	6 (3.9)	5 (2.9)	2 (0.6)	-		
Health insurance[c] *none in the past 12 months*	38.0 (6.7)	14.8 (3.3)	6.9 (1.2)	< 0.001	0.055	<0.001

Abbreviations: MA = Mexican-American; BNH = Black non-Hispanic; WNH = White non-Hispanic (comparison group)
[a]unweighted cases: MA (n = 131); BNH (n = 223); WNH (n = 300). There were missing responses for income (n = 614), education (n = 583), years with diabetes (n = 644). Gender and health insurance was weighted for N = 622 cases based on MEC (mobile examination center) participants.
[b] Continuous variables are given as (mean ± *SE*) were tested by one-way ANOVA and categorical variables are given as N (%) and were tested by Pearson's chi-square.
[c] The values are percent (*SE*) for the *unadjusted* odds ratios. The *adjusted* odds ratios are as follows; $OR_{MA/WNH}$ = 5.73 (2.17, 15.1), $p < 0.001$; $OR_{BNH/WNH}$ = 1.90 (0.77, 4.70), $p = 0.151$, (controlling for age and education).

Hypothesis 1. Medical advice reported by race

Final models of medical advice by race for hypothesis 1.a. and 1.b., conducted with *simple* and *complex* analyses, are presented in **Table 7**. The requirements for adequate classification of cases (≥ 60%) and DEFF < 1.5 were met for all models.

Table 7. Medical advice and diabetes education reported by race: Hypothesis 1.

Dependent Variable[a]	**Independent Variables**[b]	**OR(CI)** *Simple Analysis*		**OR(CI)** *Complex Analysis*	
"Pattern A" Medical Advice		**MA/WNH**	**BNH/WNH**	**MA/WNH**	**BNH/WNH**
Told fat/cal	-Race -Obesity (≥30kg/m$^{2)}$	2.11* (1.27, 3.51) $p = 0.004$	1.58 (1.05, 2.38) $p = 0.028$	2.15 (1.03, 4.46) $p = 0.042$	1.83* (1.16, 2.88) $p = 0.013$
Told PA	-Race -Obesity (≥ 30kg/m^2) Education	3.03* (1.73, 5.31) $p < 0.001$	2.15* (1.41, 3.29) $p < 0.001$	2.45 (1.08, 5.57) $p = 0.034$	2.84* (1.45, 5.58) $p = 0.005$
Told Wt	-Race -Education -Obesity (≥ 30kg/m^2)	2.13 (1.23, 3.69) $p = 0.007$	1.18 (0.78, 1.80) $p = 0.431$	1.86 (0.72, 4.85) $p = 0.187$	1.29 (0.88, 1.89) $p = 0.169$
Dependent Variable[a]		**Independent Variables**[b]	**OR(CI)** *Simple Analysis*	**OR(CI)** *Complex Analysis*	**Dependent Variable**[a]
"Pattern B" Medical Advice		**MA/WNH**	**BNH/WNH**	**MA/WNH**	**BNH/WNH**
Given goal A1C (yes)	None	0.99 (0.64, 1.52) $p = 0.947$	0.953 (0.66, 1.37) $p = 0.796$	1.00 (0.68, 1.48) $p = 0.981$	0.82 (0.47, 1.42) $p = 0.444$
Given goal LDL (yes)	None	Model not significant: χ^2 (2)= 7.05; $p = 0.028$		2.14* (1.37,3.35) $p = 0.011$	0.99 (0.64,1.54) $p = 0.972$
Given goal LDL (yes)	Education	1.84 (1.18, 2.87) $p = 0.007$	1.21 (0.81, 1.80) $p = 0.350$	1.78 (1.21, 2.63) $p = 0.002$	0.96 (0.64, 1.46) $p = 0.972$
Diabetes Education[c] (yes)	Age(yrs)	0.92 (0.60,1.41) $p = 0.688$	2.29* (1.60, 3.26) $p < 0.001$	0.75 (0.40, 1.44) $p = 0.366$	2.29* (1.36, 3.85) $p = 0.004$

Abbreviations: Told fat/cal = reported yes to being told by healthcare provider to reduce fat or calories; Told PA = reported yes to being told by healthcare provider to increase physical activity or exercise; Told wt = reported yes to being told by a healthcare provider to control or lose weight; Goal A1C =What does your doctor or other health professional say your "A one C" level should be? Goal LDL = What does your doctor or other health professional say your LDL cholesterol should be?

[a]See appendix for English phrasing of key questions.
[b]Control variables for the final models.
[c]Represents frequency reporting being given recent diabetes education (within two years).

Hypothesis 1.a. "Pattern A" medical advice

Characterization of model fit

Each component of "Pattern A" medical advice was performed by separate logistic regression for the unadjusted OR and then with clinically significant covariates. The best model considered covariates with p-values < 0.2 in either the *simple* or *complex analysis* and then used as control variables for both models. Bonferroni correction for multiple comparisons was applied since "Pattern A" medical advice allows three opportunities for the hypothesis to be correct; significance was adjusted at $p = 0.017$ ($p < 0.05/3$) for the model. Since race has 2 df, a p-value of 0.017 for overall race was necessary for significance and, each race may or may not meet the condition for significance ($p < 0.017$).

1.a.1 Told to reduce fat or calories

Model fit. Final models were significant; however, the *complex* model without covariate was no longer significant applying the correction for multiple comparisons [χ^2 (2, $N = 652$) = 10.2, $p = 0.006$, *simple analysis*, no covariates; χ^2 (3, $N = 652$) = 68.1, $p < 0.001$, *simple analysis*, with covariates; F (2, 15) = 4.81, $p = 0.024$ *complex analysis*, no covariates; F (3, 14) = 11.2, $p = 0.001$, *complex analysis* with covariates].

Hypothesis test. The 2-df tests were statistically significant by *simple analysis* [χ^2 (2, $N = 652$) = 10.1, $p = 0.006$, no covariates; χ^2 (2, $N = 652$) = 10.4, $p = 0.005$, with covariates] and by *complex analysis* [F (2, 15) = 4.81, $p = 0.024$, no covariates; F (2, 5) = 6.66, $p = 0.009$, with covariates]. Mexican-Americans were more likely than White non-Hispanics to report being 'told to reduce fat or calories', controlling for obesity by *simple analysis*; whereas, BNH were more likely to report being 'told to reduce fat or calories', (controlling for obesity) by *complex* analysis. The hypothesis was not supported, since it was predicted that MA and BNH would be less likely to report being 'told to reduce fat or calories' as compared to WNH. Unadjusted OR by *simple* and *complex analysis* followed a similar pattern to the adjusted OR: *simple analysis* [$^{unadj}OR_{MA}$ = 1.83 (1.16, 2.39), $p = 0.009$; $^{unadj}OR_{BNH}$ = 1.62 (1.12, 2.36), $p = 0.011$] and *complex analysis* [$^{unadj}OR_{MA}$ = 1.65 (0.93, 2 .94), p =0 .081; $^{unadj}OR_{BNH =}$ 1.68 (1.08, 3.62), $p = 0.023$]. The adjusted OR's are shown in **Table 7**, p. 53.

Effects of covariates. The following covariates were considered: age, gender, obesity, health insurance and education. Final models included obesity.

1.a.2. Told to increase physical activity or exercise

Model fit. Final models were significant; however, the *complex* model, without covariates was not significant after correcting for multiple comparisons [χ^2 (2, N = 653) = 21.2, $p < 0.001$, *simple analysis* no covariates; χ^2 (6, N = 599) = 80.0, $p < 0.001$, *simple analysis* with covariates; F = (2, 15) 3.87, $p = 0.044$, *complex analysis* no covariates; F (6, 11) = 16.4, $p < 0.001$, *complex analysis* with covariates].

Hypothesis test. The 2-df tests were statistically significant by *simple analysis* [χ^2 (2, N = 653) = 24.7, $p < 0.001$, no covariates; χ^2 (2, N = 599) = 21.4, p<0.001, with covariates]. The 2-df test was not significant by *complex analysis* without covariates after the Bonferroni correction [F (2, 15) = 3.87, $p = 0.044$]; but was significant with covariates [F (2, 15) = 5.42, $p = 0.017$]. There were differences in race reporting having been given the advice 'to increase physical activity or exercise' (*complex analysis*). The unadjusted odds ratios were as follows: *simple analysis* [$^{unadj}OR_{MA}$ = 1.82 (1.16, 2.85), p = 0.009; $^{unadj}OR_{BNH}$ = 2.01 (1.37, 2.93), $p < 0.001$] and *complex analysis* [$^{unadj}OR_{MA}$ =

1.60 (0.87, 2.93), $p = 0.119$; ${}^{unadj}OR_{BNH} = 2.32$ (1.25, 4.33), $p = 0.011$]. The adjusted OR's are presented in **Table 7**. BNH were 2.84 (1.45, 5.58) times more likely to report being 'told to increase physical activity or exercise', as compared to WNH ($p_{BNH/WNH} = 0.009$, $p_{race} = 0.017$). The hypothesis was not supported, since WNH were predicted to be more likely to report being given this advice.

Effects of covariates. The following covariates were tested: age, gender, obesity, education, diabetes education and health insurance. The final models included obesity and education.

1.a.3 Told to control weight

Model Fit. The models with race only were not significant [χ^2 (2, $N = 653$) = 1.77, $p = 0.412$ *simple analysis*; F (2, 15) = 0.668, $p = 0.527$; *complex analysis*]. The models became significant with the addition of covariates; however, race was not significant [χ^2 (6, $N = 599$) = 133.0, $p <0.001$, *simple analysis*; F (6, 11) =9.94, $p = 0.001$, *complex analysis*]

Hypothesis test. The 2-df tests were not significant by *simple analysis* [χ^2 (2, $N = 653$) = 1.77, $p = 0.413$, no covariates; χ^2 (2, $N = 599$) = 7.24, $p = 0.027$, with covariates] and by *complex analysis* [F (2, 15) = 0.668, $p = 0.527$ no covariates; F (2, 15) = 1.63, $p = 0.229$, with covariates]. The hypothesis was not supported since race was not associated with reporting being given advice to 'control weight' after the Bonferroni correction ($p_{race}<0.017$).

Effects of covariates. The following covariates were considered: age, gender, obesity, health insurance and education. The final models included obesity and education. Individuals with obesity were more likely to report being given advice to 'control weight'

[OR = 7.41 (5.10, 10.9), $p < 0.001$ *simple analysis*; OR = 6.80 (4.26, 10.9), $p < 0.001$ *complex analysis*].

Summary of results for Hypothesis 1.a.

Significant OR's (adjusted for multiple comparisons) are denoted by (*) in **Table 7** (p. 53). There were several differences between *simple* and *complex analysis*: 1) 'told to reduce fat or calories' was more likely for MA by *simple* and BNH by *complex analysis* (controlling for obesity); 2) 'told to increase physical activity or exercise' was significant for race controlling for obesity by *simple analysis*, only; and 3) race was significant (BNH were more likely to report 'told to reduce fat or calories', controlling for obesity and education) by *complex analysis*. All models for 'told to control weight' were not significant for race by *simple* or *complex analysis*.

Hypothesis 1.b. "Pattern B" medical advice

Another aspect of medical advice examined in this study was race as an independent variable and reporting having been given goals for A1C, LDL, systolic and diastolic blood pressure. The categories for being given a goal were 'yes', 'no', and 'not sure.' No and not sure were collapsed since there were no significant differences between them. The characteristics of individuals who reported being given goals may help identify who are more likely to have had effective medical communications with their physician/provider.

Characterization of model fit

The procedure for determining model fit for "Pattern B" was the same as for "Pattern A" medical advice. Separate logistic regressions were performed for each goal. Since four opportunities were available for reporting being given a goal, alpha was adjusted for multiple comparisons by the Bonferroni method at $p < 0.0125$ ($p < 0.05/4$). The final models considered covariates with p-values < 0.2 in either the *simple* or *complex analysis* and then used as control variables for both models. Race (2df) was considered significant at $p = 0.0125$. The requirements for adequate classification of cases (≥ 60%) and design effect (DEFF < 1.5) were met for all models.

1.b.1. Goal for A1C

Model fit. The final models of 'goal for A1C' by s*imple* and *complex* analysis are presented in **Table 7**. The *simple analysis* models and the *complex* model without covariates were not significant [*simple analysis* χ^2 (2, N = 653) = 0.068, p = 0.967, no covariates; χ^2 (3, N = 653) = 8.26, p = 0.041, with covariates; *complex analysis* F (2, 15) = 0.221, p = 0.805, no covariates]. *Complex analysis* with covariates was significant [F (4, 13) = 8.82, p = 0.001].

Hypothesis test. The 2-df tests for race were not significant since no models were significant by *simple analysis* [χ^2 (2, N = 653) = 0.068, p = 0.967, no covariates; χ^2 (2, N = 653) = 0.28, p = 0.870] or by *complex analysis* [F (2, 15) = 0.22, p = 0.805, no covariates; F (2, 15) = 0.47, p = 0.663, with covariates]. The hypothesis was not supported since reporting being 'given a goal for A1C' did not differ by race.

Effect of covariates. The following covariates were considered as covariates: age, gender, diabetes education and health insurance. The final model by *simple analysis* contained age. As noted above in the model fit section, the models with covariates by *simple analysis* were not significant. The final model by *complex analysis* contained age and gender. Reporting receiving a goal for A1C was less likely for older participants by *complex analysis* [OR = 0.98 (0.96, 0.99), p = 0.007].

1.b.2 Goal for LDL

Model fit. The final model was not significant for *simple analysis* without covariates [χ^2 (2, N = 654) = 7.05, p = 0.029]. Final models were significant *for complex analysis* without covariates [F (2, 15) = 6.20, p = 0.011] and for *simple* and *complex* with covariates [χ^2 (5, N = 599) = 20.3, p = 0.001, *simple analysis*; F (5, 15) = 5.75, p = 0.006, *complex analysis*].

Hypothesis test. The 2-df tests for race were significant for the *complex* model, only. Race was not a significant predictor for the binary outcome, being given a goal for LDL versus the 'no/not sure' category *by simple analysis* [χ^2 (2, N = 654) = 7.18, p = 0.028, no covariates; χ^2 (2, N = 599) = 1.86, p = 0.394, with covariates] whereas for *complex analysis* race was significant without covariates, only [F (2, 15) = 6.20, p = 0.011, no covariates; F (2, 15) = 4.62, p = 0.027, with covariates]. Mexican-Americans were more likely to report being given a goal for LDL than WNH. The *unadjusted* and *adjusted* OR's are presented in **Table 7**. The hypothesis was not supported since WNH were not more likely to be given a goal for LDL than MA or BNH.

Effect of covariates. The following covariates were tested: age, gender, education, obesity, diabetes education and health insurance. The final models contained education. The addition of education caused race to no longer be significant (Bonferroni correction) *by complex analysis* (p_{race} = 0.027).

1.b.3. Goal for blood pressure: SBP

Model fit. The model fit was not significant without covariates by *simple analysis* [χ^2 (2, N = 653) = 7.00, p = 0.030] and by *complex analysis* [F (2, 15) = 5.53, p = 0.016].

The models with covariates were significant by *simple analysis* [χ^2 (8, N = 599) = 57.9, p < 0.001] and by *complex analysis* [F (8, 9) = 11.7, p = 0.001].

Hypothesis test. The 2-df tests for race were not statistically significant by *simple analysis* [χ^2 (2, N = 653) = 6.49, p = 0.039, no covariates; χ^2 (2, N = 599) = 0.59, p = 0.745, with covariates] nor by *complex analysis* [F (2, 15) = 5.53, p = 0.016, no covariates; F (2, 15) = 2.08, p = 0.159, with covariates]. The hypothesis was not supported, since it was not significant after the Bonferroni correction (p < 0.0125).

Effect of covariates. Age, gender, education, diabetes education and health insurance were considered. The final models contained all covariates except gender. Persons with health insurance [OR = 3.68 (1.98, 6.83), p < 0.001] and recent diabetes education [OR = 1.57 (1.06, 2.34), p = 0.027] were more likely to report receiving a goal for systolic blood pressure by *complex analysis*; the results were parallel by *simple analysis*.

1.b.4. Goal for blood pressure: DBP

Model fit. The model fit was not significant without covariates by *simple analysis* [χ^2 (2, N = 653) = 6.10, p = 0.047] and by *complex analysis* [F (2, 15) = 4.62, p = 0.027]. The models with covariates were significant [χ^2 (8, N = 599) = 60.9, p < 0.001, *simple analysis*; F (8, 9) = 10.6, p = 0.001, *complex analysis*].

Hypothesis test. The 2-df tests for race were not statistically significant by *simple analysis* [χ^2 (2, N = 653) = 5.67, p = 0.059, no covariates; χ^2 (2, N = 599) = 0.32, p = 0.854, with covariates] nor by *complex analysis* [F (2, 15) = 4.62, p = 0.027, no covariates; F (2, 5) = 1.49, p = 0.257, with covariates]. The hypothesis was not supported, since it was not significant after the Bonferroni correction (p < 0.0125).

Effect of covariates. The following covariates were considered: age, gender, education, diabetes education and health insurance. Final models included all covariates except gender. Education level was associated with 'goal for SBP' [F (3, 14) = 3.60, p = 0.004, *complex analysis*]. Individuals having current health insurance were more likely to report being given a goal for diastolic blood pressure [OR = 3.58 (1.92, 6.69), p = 0.001, *complex analysis*] as compared to those without health insurance. The results for covariates were paralleled by the *simple* model.

Hypothesis 1.c. Diabetes education

Diabetes education and race were analyzed by hierarchical logistic regression models where the dependent variable was the likelihood of receiving diabetes education (by a nurse diabetes educator, dietitian or nutritionist) in the past 2 years versus over 2 years or not at all.

Characterization of model fit. Diabetes education constituted a 'stand-alone' hypothesis and no adjustments were made to alpha for multiple comparisons of the dependent variable.

Model fit. All models were significant: without covariates [χ^2 (2, N = 654) = 25.2, p< 0.001, *simple analysis*; F (2, 15) = 8.24, p = 0.004, *complex analysis*] and with covariates [χ^2 (3, N = 654) = 33.1, p < 0.001, *simple analysis*; F (3, 12) = 7.23, p=0.004, *complex analysis*].

Hypothesis test. The 2-df tests for race were significant by *simple analysis* [χ^2 (2, N = 654) = 24.8, p < 0.001, no covariates; χ^2 (2, N = 654) = 23.8, p < 0.001, with covariates] and by *complex analysis* [F (2, 15) = 8.24, p = 0.004, no covariates, F (2, 15) = 8.75, p = 0.003, with covariates]. Race was an explanatory factor for reporting 'receiving diabetes education' by a nurse diabetes educator, dietitian or nutritionist. The hypothesis was not supported, since WNH were *less likely* than BNH to report having received diabetes education within the past two years. BNH were twice as likely to report receiving diabetes education (within the past two years) than WNH [OR = 2.39 (1.43, 3.99), p = 0.002 (no covariates); OR = 2.29 (1.36, 3.85), p = 0.004, (controlling for age), *complex analysis*]. The results were paralleled by *simple analysis* (**Table 7,** p. 53).

Effects of covariates. The following covariates were tested by two models: 1) demographics (age, gender, education and health insurance) and 2) clinical (obesity, A1C, LDL). Age was the only significant covariate for the final models. Older individuals were less likely to report having received diabetes education (within the past two years) than younger individuals by both *simple* and *complex analysis*.

Hypothesis 2. Diabetes self-management behaviors by race

Five diabetes self-management behaviors were tested individually by hypothesis 2.a: 1) self-monitoring blood glucose (SMBG); 2) reducing fats or calories; 3) increasing physical activity or exercise; 4) controlling or reducing weight; and, 5) checking feet for sores. The final models are presented in **Tables 8**. The requirements for adequate classification of cases ($\geq$ 60 %) and design effect (DEFF < 1.5) were met for all models.

Characterization of model fit

Since this hypothesis tested race for 5 behaviors, the Bonferroni correction for multiple comparisons was applied to alpha and adjusted at $p < 0.01$ ($p < 0.05/5$) to reduce the chance of false positives. The p-value for race (2df) will be considered significant at $p < 0.01$. Independent variables were chosen for the full models based on clinical significance.

Table 8. Diabetes self-management behaviors by race: Hypothesis 2.

Dependent Variable[a]	**Controls**[b]	**OR(CI)** *Simple analysis*		**OR(CI)** *Complex analysis*	
Behavior		MA/WNH	BNH/WNH	MA/WNH	BNH/WNH
SMBG no	-none	2.56* (1.51, 4.35) *p* = 0.001	1.22 (0.73, 2.05) *p* = 0.453	3.82* (2.16, 6.76) *p* <0 .001	1.63 (0.81, 3.29) *p* = 0.156
SMBG no	-gender -yrs with diabetes	2.41* (1.41, 4.18) *p* = 0.002	1.29 (0.76, 2.18) *p* = 0.340		
SMBG no	-health insurance -diabetes education			2.70* (1.66,4.38) *p* = 0.001	1.89 (1.02, 3.49) *p* = 0.044
Reduce fat/cal yes	-gender -race*gender -diabetes education obesity	3.35* (1.52, 7.37) *p* = 0.003	1.52 (0.84, 2.74) *p* = 0.171		
Reduce fat/cal yes	-diabetes education -obesity			2.33 (1.05, 5.14) *p* = 0.038	1.28 (0.073, 2.26) *p* = 0.367
Increase PA yes	-age -education -diabetes education obesity	1.63 (0.98, 2.71) *p* = 0.058	1.11 (0.75, 1.64) *p* = 0.607		
Increase PA yes	-age -diabetes education			1.18 (0.62, 2.25) *p* = 0.603	1.1.0 (0.65,1.85) *p* = 0.718
Reduce Wt yes	-education -diabetes education -obesity	1.62 (0.94, 2.78) *p* = 0.083	0.80 (0.53, 1.22) *p* = 0.305	1.41 (0.82, 2.42) *p* = 0.202	0.82 (0.46, 1.46) *p* = 0.474
Check Feet[c]	-gender	0.65 (0.39, 1.09) *p* = 0.100	2.28* (1.27,4.10) *p* < 0.001	0.94 0.60,1.47) *p* = 0.771	2.40* (1.67, 3.45) *p* < 0.001

Abbreviations: Control fat/cal = reported yes to reducing fat or calories; Increase PA = reported yes to increasing physical activity or exercise; obesity =≥ 30 kg/m^2; Lose wt yes = reported yes to controlling or losing weight; SMBG = self-monitoring blood glucose; check feet = reporting checking feet for sores.
Note: OR are significant p < 0.025 applying the Bonferroni correction for race (2 df) *if indicated by (*).*
[a]See appendix for English phrasing of key questions.
[b]Control variables indicated were for the reduced model.
[c]Cumulative OR (ordinal logistic categories: none, < 2 times per month, at least 2 times per month or more) was used for *complex analysis.*

Hypothesis 2.1. Self-monitoring blood glucose

Model fit. All models were significant by *simple analysis*, [χ^2 (2, N = 650) = 12.2, p = 0.002, no covariates; χ^2(4, N = 640) = 20.7, p < 0.001, with covariates] and *complex analysis* [F (2, 15) = 24.3, p < 0.001, no covariates; F (4, 13) = 10.8, p < 0.001, with covariates].

Hypothesis test. The 2-df tests for race were significant by *simpl*e [χ^2 (2, N = 650) = 12.9, p = 0.002, no covariates; χ^2 (2, N = 640) = 10.1, p = 0.007, with covariates] and *complex analysis* [F (2, 15) = 24.3, p < 0.001, no covariates; F (2, 15) = 8.84, p = 0.003, with covariates]. The hypothesis was partially supported, since MA were less likely than WNH to self-monitor their blood glucose. The final covariates: diabetes education and health insurance for the *complex model* reduced the effect of likelihood of *not* SMBG approximately one unit for MA [OR from 3.82 to 2.70] (**Table 8, p. 63**).

Effect of covariates. The following covariates were tested: age, gender, education, diabetes education, health insurance and years with diabetes. The final models with covariates differed between *simple* (gender and years with diabetes) and *complex analysis* (diabetes education and health insurance). Individuals with recent diabetes education (past 2 years as opposed to more than 2 years or not at all) (OR_{yes}= 3.22 (1.44, 6.99), p = 0.007, and health insurance (within the past 12 months) [OR_{yes}= 1.49 (1.12, 6.62), p = 0.044] were *more* likely to self-monitor their blood glucose (*complex analysis*).

Hypothesis 2.2. Reducing fat or calories

Model fit. Models were significant by *simple analysis* [χ^2 (2, N = 654) = 9.95, p= 0.007, no covariates; χ^2 (7, N = 601) = 49.8, p < 0.001, with covariates]. *Complex* models were significant with covariates, only [F (2, 15) = 1.89, p = 0.185, no covariates; F (4, 13) = 6.67, p = 0.004, with covariates].

Hypothesis test. The 2-df tests for race were significant by *simple analysis* [χ^2 (2, N = 654) = 9.86, p = 0.007, no covariates; χ^2 (2, N = 601) = 9.25, p = 0.010, with covariates] and not significant by *complex analysis* [F (2, 15) = 1.89, p = 0.185 no covariates; F (2, 15) = 2.71, p = 0.099, with covariates]. The hypothesis was not supported since MA and BNH were not less likely to reduce fat or calories than WNH. Race was an explanatory variable for reporting 'reducing fat or calories' in the final model by *simple analysis*; but, was not significant by *complex analysis*, whether or not the covariates were included. Mexican-Americans were three times more likely than WNH to report reducing fat or calories [OR_{MA}= 3.35 (1.52, 7.37), p = 0.003, *simple analysis*]. The adjusted OR's for the *simple* and *complex models* are presented in **Table 8** (p. 63).

Effect of covariates. The following covariates were tested: health insurance, diabetes education, obesity, education, age and gender. Covariates for the final *simple* model included: diabetes education, gender, race*gender and obesity. Study participants with BMI $\geq$ 30 [OR = 2.47 (1.68, 3.61), p < 0.001] and who reported being given diabetes education within the past two years [OR = 2.13 (1.43, 3.17), p <0.001] were more likely to report 'reducing fat or calories' than their counterparts. Covariates for *complex analysis* were obesity and diabetes education, only. *Complex analysis* was in accordance with *simple analysis* for the likelihood of recent diabetes education [OR = 2.04 (1.28, 3.20, p = 0.005] and being obese [OR = 2.74 (1.52, 4.95), p = 0.002] as independent variables for 'reporting reducing fat or calories'.

Hypothesis 2.3. Increasing physical activity or exercise

Model fit. The *simple* model, without covariates was not significant [χ^2 (2, N = 654) = 2.52, p = 0.284] but with covariates was significant [χ^2 (6, N = 600) = 55.4, p < 0.001]. The *complex* model, without covariates was not significant [F (2, 15) = 0.593, p = 0.565] and with covariates, was not significant after the Bonferroni correction for multiple comparisons [F (4, 13) = 3.62, p = 0.034].

Hypothesis test. The 2-df tests for race were not significant [χ^2 (2, N = 654) = 2.51, p = 0.285; *simple analysis* no covariates; χ^2 (2, N = 600) = 3.48, p = 0.175, *simple analysis* with covariates; F (2, 15) = 0.593, p = 0.565, *complex analysis* no covariate; F (2, 15) = 0.155, p = 0.858, *complex* analysis with covariates]. The hypothesis was not supported, since BNH and MA were *not less likely* to report increasing physical activity or exercise than WNH. The OR's are shown in **Table 8** (p. 63).

Effect of covariates. Race was not an explanatory factor for reporting increasing physical activity or exercise. The following covariates were considered: age, gender, education, health insurance and obesity. Covariate in the final *simple* model included: age, education, diabetes education, and obesity. Covariates in the *complex* model were age and diabetes education. Factors, associated with reporting increased physical activity or exercise included: having recent diabetes education [OR = 1.77 (1.24, 2.53), p = 0.002]; reporting a higher education, college or more [χ^2 (3, N = 600) = 20.8, p<0.001)]; and, being a younger age [OR = 0.98 (0.96, 0.99), p = 0.001). The likelihoods to increase physical activity for *simple analysis* (recent diabetes education and being younger) were supported by *complex analysis*.

Hypothesis 2.4. Controlling or losing body weight

Model fit. Models without covariates were not significant [χ^2 (2, N = 654) = 0.13, p = 0.937, *simple analysis*; F (2, 15) = 0.045, p = 0.956, *complex analysis*]. Models with covariates were significant by *simple analysis*, only [χ^2 (7, N = 600) = 40.1, p < 0.001, *simple analysis*; F (7, 10) =3.69, p = 0.031 *complex analysis*].

Hypothesis test. The 2-df tests for significance were not significant by *simple* [χ^2 (2, N = 654) = 0.13, p = 0.937 without covariates; χ^2 (2, N = 600) = 5.69, p = 0.058] and *complex analysis* [F (2, 15) = 0.045, p = 0.956, without covariates; F (2, 15) = 3.32, p = 0.64, with covariates].

Effect of covariates. The following covariates were tested: age, gender, education, health insurance, diabetes education and obesity. The final models included diabetes education, education and obesity. For both models, persons with recent diabetes education (within 2 years) and BMI ≥ 30 kg/m^2 were more likely to report controlling or losing weight by *simple analysis* [(χ^2 (7, N = 600) = 40.1, p < 0.001; OR$_{\text{diabetes_education}}$ = 1.59 (1.08, 2.34), p = 0.018); OR$_{\text{obese}}$ = 2.23 (1.54, 3.22), p < 0.001] and *complex analysis* [F (7, 10) = 3.69, p = 0.031; OR$_{\text{diabetes_education}}$ = 1.63 (1.03, 2.58), p = 0.038; OR$_{\text{obese}}$ = 2.53 (1.48, 4.35), p = 0.002]. Persons with less education, compared to individuals reporting ‘college or graduate school’ were less likely to reducing weight by *simple analysis* [χ^2 (3) = 10.6, p = 0.014].

Hypothesis 2.5. Checking feet for sores

Model fit. All models were significant [χ^2 (2, N = 651) = 16.5, p < 0.001; *simple analysis*, no covariates; χ^2 (3, N = 651) = 24.1, p<0.001 *simple analysis*, with covariates;

F (2, 15) =13.7, p< 0.001 *complex analysis*, no covariates; F (3, 14) = 8.79, p =0.002, *complex analysis*, with covariates; and ordinal *complex*: F_{race} (2,15 = 14.6, p <0.001; F_{gender} (1,16) = 6.88, p = 0.018].

Hypothesis Test. The 2-df tests for race were significant by *simple analysis* [χ^2 (2, N = 651) = 14.7, p = 0.001, without covariates; χ^2 (2, N = 651) = 16.8, p < 0.001, with covariates] and *complex analysis* [F (2, 15) = 13.7, p< 0.001, without covariates; F (2, 15) = 8.18; p = 0.004, with covariates; F (2, 15) = 14.6; p< 0.001, ordinal *complex analysis* with covariates]. Race explained the likelihood of checking feet for sores by *complex* and *simple analysis*. The hypothesis test failed since WNH were not more likely to check feet for sores as compared to MA and BNH. The unadjusted OR were as follows: BNH were 2.41 (1.35, 4.31), p = 0.003 more likely to check their feet for sores than WNH (p_{race} = 0.001) (*simple analysis*) and BNH were 2.46 (1.68, 3.61) times more likely to check their feet for sores than WNH by cumulative ordinal OR, *complex analysis* (p < 0.001).

Effect of covariates. The following covariates were tested: age, gender, education diabetes education and health insurance. The final models included gender (**Table 8**). Gender was significant by *simple* [χ^2 (1, N = 651) =7.32, p = 0.007] and the ordinal *complex* models [F (1, 16) = 6.88, p = 0.018].

Summary of results from Hypothesis 2

Mexican-Americans were less likely to self-monitor their blood glucose, but more likely to reduce fat or calories than WNH. Black non-Hispanics were more likely to check their feet for sores than WNH. Race did not explain controlling weight.

Summary of effect of covariates from Hypothesis 2

Having health insurance and higher frequency of doctors' visits was associated with self-monitoring blood glucose (binary) as well as a higher frequency of self-monitoring blood glucose (ordinal). Data were not shown for ordinal SMBG. Recent diabetes education (in the past 2 years) as opposed to more than 2 years or 'none,' was associated with self-monitoring blood glucose, increasing physical activity and reducing weight.

Hypothesis 3. Clinical outcomes by race

Characterization of Model Fit

The clinical outcomes (A1C, LDL and BMI) all passed the assessment for sample size where RSE was < 18%. Since hypothesis 3 specified 3 ways for BNH and MA to have poorer diabetes self-management skills by clinical indicators: A1C, LDL and BMI, the Bonferroni correction for multiple comparisons was applied and significance was considered at $p < 0.0167$ ($p = 0.05/3$).

Hypothesis 3.a. Mean hemoglobin A1C (log-A1C) by race

Model fit. No models were significant [*simple analysis* $F\ (2, 574) = 1.79$, $p = 0.116$, no covariates; $F\ (3, 573) = 3.37$, $p = 0.018$, with covariates; *complex analysis* $F\ (2, 15) = 1.48$, $p = 0.260$, no covariates; $F\ (3, 14) = 1.56$, $p = 0.243$, with covariates].

Hypothesis test. The 2-df tests for race were not significant by *simple analysis* [$F\ (2, 574) = 1.79$, $p = 0.168$, no covariates; $F\ (2, 573) = 1.25$, $p = 0.288$, with covariates] nor by *complex analysis* [$F\ (2, 15) = 1.48$, $p = 0.260$, no covariates; $F\ (2, 15) = 1.06$, $p = 0.372$, with covariates]. Race was not an explanatory factor for A1C; therefore, there was no support for the hypothesis that MA and BNH would have at least 1% higher A1C levels than WNH. The means and (*SD*) were as follows for the *simple analysis*: MA =

7.45 (1.73); BNH = 7.42 (1.87); and, WNH = 7.14 (1.45). The estimated marginal means and standard error for *complex analysis* were as follows: MA = 0.87 (0.0093); BNH = 0.86 (0.0064); and, WHN = 0.85 (0.0065).

Effect of covariates. Age and gender were considered. The final models included age. The models were not significant with covariates. This also implies none of the covariates were significant.

Hypothesis 3.b. High LDL (>100 mg/dl) by race

Low-density lipoprotein cholesterol variation by race examined by forming a binary variable. Although the American Diabetes Association (2010) recommendation for lipid control is < 100 mg/dL, the distribution of participants was more favorable using ≤ 100 mg/dL as the cut-off for adequate and >100 mg/dL for high LDL. For the purpose of this study LDL >100 was designated 'high LDL'. The difference in raising the cut-off was that 6 additional participants out of 469 (22.6%) were classified with 'not high' LDL; whereas, using an LDL level of 99 resulted in 100 out of 475 (21.0%).

Model fit. All models were significant [χ^2 (2, N = 575) = 18.9, p < 0.001 *simple analysis*, no covariates; χ^2 (4, N = 575) = 41.2, p = 0.002, *simple analysis*, with covariates; F (2, 15) = 6.37, p = 0.010 *complex analysis*, without covariates; F (5, 12) = 6.58, p = 0.004, *complex analysis*, with covariates].

Hypothesis test. The 2-df tests for race were significant by *simple analysis* [χ^2 (2, N = 575) = 17.9, p < 0.001 no covariates; χ^2 (2, N = 575) = 15.6, p < 0.001, with covariates] and by *complex analysis* [F (2, 15) = 6.37, p = 0.010, no covariates; F (2, 15) = 8.40, p = 0.004, with covariates].

The hypothesis was supported since MA and BNH were more likely to have 'high LDL' than WNH. The unadjusted and final models are presented in **Table 9.**

Effects of covariates. The following covariates were tested: age, gender, education, diabetes education, health insurance and obesity (BMI ≥ 30 kg/m^2). The final model by *simple analysis* retained age and obesity; whereas, the final model by *complex analysis* retained age, gender and obesity.

Table 9. Odds ratio of high LDL > 100 mg/dL by race

Independent variables	*Simple analysis*		*Complex analysis*	
	$OR_{MA/WNH}$	$OR_{BNH/WNH}$	$OR_{MA/WNH}$	$OR_{BNH/WNH}$
Race	2.76 (1.46, 5.22) *p* < 0.001	2.50 (1.49, 4.18) *p* < 0.001	3.07 (1.44, 6.54) *p* = 0.001	2.40 (1.23, 4.72) *p* = 0.014
Race, age, obesity	2.99 (1.50, 5.97) *p* = 0.002	2.27 (1.34, 3.84) *p* = 0.002		
Race, age, gender, obesity			3.87 (1.93,7.81) *p* = 0.001	2.10 (1.13, 3.92) *p* = 0.022

Hypothesis 3.c. Obesity by race

To determine obesity by race, hierarchical logistic regressions were performed by *simple* and *complex analysis,* with BMI ≥ 30 kg/m^2 as the outcome variable in accordance with the World Health Organization's definition of obesity (WHO, 2010).

Model fit. The models without covariates were not significant and models with covariates were significant [χ^2 (2, *N* = 654) = 1.18, *p* =0.554; *simple analysis*, no covariate; χ^2 (5, *N* = 601) = 26.8, *p* = 0.001, *simple analysis,* with covariates; *F* (2, 15) = 0.930, *p* = 0.416; *complex analysis*, no covariates; *F* (5, 12) = 6.37, *p* = 0.004, *complex analysis*, with covariates].

Hypothesis test. The 2-df tests for race were not significant by *simple analysis* [χ^2 (2, N = 654) = 1.18, p = 0.555, no covariates; χ^2 (2, N = 601) = 1.20, p = 0.550, with covariates] nor by *complex analysis* [F (2, 15) = 0.930, p = 0.416, no covariates; F (2, 15) = 0.675, p =0.538, with covariates]. The hypothesis was not supported since race was not an explanatory factor of obesity with or without covariates.

Effects of covariates. The following covariates were tested: age, gender, education, diabetes education and health insurance. The final *simple* model included age, gender and diabetes education; however, it was estimated that less than 10% of the variance was explained by the model (Nagelkerke pseudo R-squared = 0.069) and race was not significant (p = 0.550). The final *complex* model included age, gender and health insurance. Female [OR = 2.23 (1.53, 3.26), p < 0.001] and younger [OR = 1.03 (1.10, 1.05), p = 0.012] individuals were more likely to be obese. Less than 10% of the variance (Nagelkerke Pseudo R-square = 0.086) was explained by the *complex analysis*, indicating factors beyond the variables may account for obesity.

Hypothesis 4. Interaction of race by medical advice on DSM and clinical outcomes

Hypothesis 4.a. Race by "Pattern A" medical advice

Characterization of model fit

Simple and *complex analyses* were conducted to assess medical advice on health behavior. The goal of these analyses was to establish whether or not race was a modifier of medical advice predicting health behavior. To assess the research hypothesis for "Pattern A" medical advice (being told to reduce fat or calories, increase physical activity or exercise and control or lose weight) explaining the corresponding behaviors, a series of hierarchical logistic regression analyses were executed where covariates p < 0.2 were retained. The reduced model was considered a full factorial of race by receiving each medical advice, since an interaction was being tested. The Bonferroni correction was applied to each sub-hypothesis based on the number of tests within the sub-hypothesis. For "Pattern A" medical advice, (*Hypothesis 4.a.*) there were 3 chances so alpha was considered significant at $p < 0.0167$). Control variables were defined as covariates with p-values < 0.2. Reduced models include 'race', the interaction term of race by 'told', and 'told'.

Hypothesis 4.a.1. Effect of reporting 'told to reduce fat or calories' by race on reporting reducing fat or calories

Model fit. All models were significant [χ^2 (5, N = 652) = 141.4, $p < 0.001$, *simple analysis*, no covariates; χ^2 (9, N = 599) =134.7, $p < 0.001$ *simple analysis* with covariates; F (5, 12) = 31.6, $p < 0.001$, *complex analysis,* no covariates; F (9, 8) = 16.5, $p < 0.001$, *complex analysis* with covariates].

Hypothesis test. The 1-df tests for 'told' were significant for final models by *simple* [χ^2 (1, N = 652) = 60.4, p <0.001, no covariates; χ^2 (1, N = 599) = 42.0, $p < 0.001$, with covariates] and *complex* [F (1, 16) = 94.4, $p < 0.001$, no covariates; F (1, 16) = 69.5, $p < 0.001$, with covariates] *analysis*. The 2-df tests for 'told*race' were not significant for any models [χ^2 (2, N =562) = 0.39, $p = 0.823$, *simple* no covariates; χ^2 (2, N = 599) = 0.37, $p = 0.832$, *simple* with covariates; F (2, 15) = 1.15, $p = 0.344$, *complex* no covariates; F (2, 15) = 0.90, $p = 0.428$, *complex* with covariates].

The hypothesis was partially supported since the advice was associated with the corresponding behavior; however the relationship was not modified by race. Participants 'told to reduce fat or calories' were more likely to report 'reducing fat or calories' than those not told [OR = 7.90 (4.49, 13.8), $p < 0.001$, *simple analysis*, with covariates; OR = 6.87 (3.83, 12.3), $p < 0.001$, *complex analysis*, with covariates]. The relationship was independent of race. Race was not significant with or without covariates [$p = 0.428$, *simple*, $p = 0.148$, *complex*] (*p*-values given were for 5-df models). The unadjusted OR's for 'told to reduce fat or calories' predicting the behavior of reducing fat or calories were as follows: [OR = 8.80 (5.08, 15.2), $p < 0.001$, *simple analysis*] and [OR = 8.78 (5.57, 13.8), $p < 0.001$), *complex analysis*].

Effects of covariates. The following covariates were tested: age, gender, obesity, diabetes education, education and health insurance. The final *simple* and *complex* models included age, gender, obesity and diabetes education. The likelihood of reducing fat or calories by the reduced model (race, race*told, told) was only slightly dampened for the adjusted models.

Hypothesis 4.a.2. Effect of reporting 'told to increase physical activity or exercise' by race with reporting increasing PA or exercise

Model fit. All models were significant by *simple analysis*, without covariates [χ^2 (5, N = 653) = 96.0, $p < 0.001$]; *simple analysis* with covariates [χ^2 (11, N = 600) = 126.9, $p < 0.001$)]; *complex analysis w*ithout covariates [F (5, 12) = 21.5, $p < 0.001$]; and *complex analysis* with covariates [F (6, 11) = 15.3, $p = 0.001$)].

Hypothesis test. The 1-df tests for 'told' were significant by *simple analysis* [χ^2 (1, N = 653) = 47.5, $p < 0.001$, no covariates; χ^2 (1, N = 600) = 47.4, $p < 0.001$, with covariates; [F (1, 16) = 86.8, $p < 0.001$, *complex analysis* no covariates; F (1, 16) = 83.8, $p < 0.001$, *complex analysis* with covariates]. The 2-df tests for 'told*race' were not significant for any models [χ^2 (2, N = 653) = 0.24, $p = 0.886$, *simple analysis*, no covariate; χ^2 (2, N = 600) = 1.11, p = 0.573, *simple analysis* with covariates; F (2, 15) = 0.089, p = 0.916, *complex analysis* no covariates; F (2, 15) = 0.07, p = 0.933, *complex analysis* with covariates]

The hypothesis was partially supported since advice predicted behavior; however the relationship was not modified by race. Participants were more likely to increase PA if they were told by *simple analysis* [OR = 6.44 (3.79, 10.9), p < 0.001) no covariate; OR = 7.48 (4.21, 13.3, p < 0.001, with covariates] and by *complex analysis* [OR = 6.53 (3.73, 11.4), p < 0.001 without covariates; OR = 6.34 (3.55, 11.5), p < 0.001 with covariates]. Race and the interaction of race by being told were not significant by *simple* or *complex analysis.*

Effect of covariates. The following covariates were tested: age, gender, obesity, health insurance, diabetes education, and education. The final model for the *simple analysis* contained age, gender, education and obesity. Education was a significant predictor of reporting increasing PA by *simple analysis* [χ^2 (3, N = 600) = 17.5, p = 0.001] but not by *complex analysis* (after the Bonferroni correction for multiple comparisons). The final model by *complex analysis* included age (p = 0.011) as the only covariate.

Hypothesis 4.a.3. Effect of reporting 'told to control weight' by race with reporting controlling weight

Model fit. All models were significant [χ^2 (5, N = 653) = 72.0, p < 0.001, *simple analysis*, no covariates; χ^2 (7, N = 600) = 65.1, p < 0.001 *simple analysis* with covariates; F (5, 12) = 12.3, p < 0.001 *complex analysis*, no covariates; F (6, 11) = 8.80, p = 0.001, *complex analysis* with covariates].

Hypothesis test. The 1-df tests for 'told' were significant [χ^2 (1, N = 653) = 32.2, $p <$ 0.001, *simple analysis,* no covariates; [χ^2 (1, N = 600) = 22.5, $p <$ 0.001 *simple analysis*, with covariates; F (1, 16) = 63.8, $p <$ 0.001, *complex analysis* no covariates; F (1, 16) = 48.6, $p <$ 0.001, *complex analysis* with covariates]. The 2-df test for 'told*race' was not significant [χ^2 (2, N = 653) = 0.81, p = 0.886, *simple analysis*, no covariates; χ^2 (2, N = 600) = 1.15, p = 0.562, *simple analysis*, with covariates; F (2, 15) = 0.051, p = 0.610, *complex analysis* no covariates; F (2, 15) = 0.38, p = 0.688, *complex analysis* with covariates].

The hypothesis was partially supported, since 'told to control weight' predicted performing the behavior (controlling or reducing weight); albeit, the hypothesis did not show race modified the relationship. Race and race by 'control weight' were not significant by *simple* or *complex analysis*. The likelihood of being told and reducing weight was approximately four times more likely than not being told for both the unadjusted and adjusted odds ratios [OR_{unadj}. = 4.72 (2.75, 8.06), $p <$ 0.001, *simple analysis*; $OR_{unadj.}$ = 4.64 (2.32, 9.32), $p <$ 0.001, *complex analysis*; $OR_{adj.}$ = 3.85 (2.20, 6.71), $p <$ 0.001, *simple analysis*; OR_{adj}. = 4.13 (1.98, 8.62), p<0.001, *complex analysis*].

Effect of the covariates. The following covariates were tested: age, gender, health insurance, diabetes education, education, and overweight. The final model by *simple analysis* included diabetes education and overweight; whereas, *complex analysis* retained overweight, only for the final model.

Summary of Hypothesis 4.a. "Pattern A" medical advice (reporting being told) resulted in reporting the respective behaviors, independent of race.

Hypotheses 4.b. Goals by race associated with clinical outcomes

Hypothesis 4.b., "Pattern B" medical advice (receiving goals for A1C, LDL and blood pressure), was tested and reported by *simple* and *complex analysis* by general linear model (GLM) regressing clinical outcomes on the corresponding goal, race, and goal by race. When the GLM fit was not significant, binary outcomes were regressed on goals by logistic regression analysis. For models with no covariates meeting the cut-off criteria ($p < 0.2$), age and gender were used as final models with covariates. The covariates age and gender were used for the 'no covariate' models and designated as the 'reduced models' for SBP and DBP since there were significant differences across races. Final models for SBP and DBP with covariates included obesity. The Bonferroni correction was applied to each sub-hypothesis based on the number of tests within the sub-hypothesis. Since "Pattern B" had four opportunities, significance was set at $p < 0.0125$.

Hypothesis 4.b.1. Effect of reporting given a goal for A1C on A1C level

Model Fit. The models for both the *simple* [F (7, 568) = 1.84, p = 0.084] and *complex analysis* [F (7, 12) = 0.945, p = 0.515] were not significant with log-A1C. Models were conducted with glycemic control (binary ≤ 7) as the outcome variable. Models with glycemic control were not significant by *simple analysis* [χ^2 (5, N = 576) = 7.67, p = 0.175 without covariates; χ^2 (7, N = 576) = 13.2, p = 0.066 with covariate] nor by *complex analysis* [F (5, 12) = 1.57, p = 0.241, no covariates; F (7, 10) = 1.30, p = 0.341, with covariates]. The model fit failed classification criteria (> 60 %) and was 56.4 % without covariates and 56.8 % with covariates.

Hypothesis Test. The lack of overall model fit implies that the hypothesis was not supported. Goal, race and race*goal for A1C were not explanatory factors for log-A1C or glycemic control by the *simple* or *complex* models with or without covariates. Specifically for glycemic control, the 1-df tests for 'goal' were not significant [χ^2 (1, N = 576) = 2.82, p = 0.093, *simple analysis* no covariates; χ^2 (1, N = 576) = 2.15, p =0.142, *simple analysis* with covariates; F (1, 16) = 2.87, p = 0.110, *complex analysis* no covariates; F (1, 16) = 3.51, p = 0.052, *complex analysis* with covariates]. The 2-df tests for 'goal*race' were not significant [χ^2 (2, N = 576) = 4.86, p = 0.088, *simple analysis* no covariates; χ^2 (2, N = 576) = 4.59, p = 0.101; F (2, 15) = 3.54, p = 0.055, *complex analysis* no covariates; F (2, 15) = 3.61, p = 0.052].

Effect of the covariates. As noted, the models with covariates were not significant. This implies the covariates were not significant. The following covariates were tested: obesity, education, diabetes education and health insurance. Final models included age and gender.

Hypothesis 4.b.2. Effect of reporting given a goal for LDL on LDL-cholesterol

Model Fit. Models were significant by *simple analysis* [χ^2 (5, N = 575) = 20.5, p = 0.001, no covariates; χ^2 (7, N = 575) 35.6, p < 0.001, with covariates] and by *complex analysis* [F (5, 12) = 4.34, p = 0.017, no covariates; F (7, 10) = 6.72, p = 0.004, with covariates].

Hypothesis test. The 1-df tests for 'goal' were not significant [χ^2 (1, N = 575) = 0.44, p = 0.508 *simple analysis* no covariates; χ^2 (1, N = 575) = 0.41, p = 0.524, *simple analysis* with covariates; F (1, 16) = 0.18, p = 0.697, *complex analysis* no covariates; F (1, 16) = 0.16, p = 0.697, *complex analysis* with covariates]. The 2-df tests for 'goal*race' were not significant [χ^2 (2, N = 575) = 1.60, p = 0.450 *simple analysis* no covariates; χ^2 (2, N =

575) = 1.36, p = 0.506 *simple analysis* with covariates; F (2, 15) = 0.74, p = 0.495, *complex analysis* no covariates; F (2, 15) = 0.62, p = 0.550, *complex analysis* with covariates].

The hypothesis was not supported since having a LDL goal did not predict LDL cholesterol by *simple analysis* (p = 0.876). The model fit for *complex analysis* was not significant. For the *simple analysis* reporting being given a goal for LDL was not significant (p = 0.876) and was not modified by race in explaining ln-LDL levels ($p_{\text{race*LDL goal}}$ = 0.366). Race was associated with LDL levels by *simple analysis* [χ^2 (2, N = 575) = 16.7, p < 0.001, no covariates; χ^2 (2, N = 575) =12.6, p = 0.002, with covariates]; however, race was no longer significant after the Bonferroni correction by *complex analysis* [F (2, 15) = 4.78, p = 0.025].

Effect of covariates. The following covariates were considered: age, gender, overweight, diabetes education and health insurance. The final models contained age and education. Age was associated with LDL level by *simple analysis* [χ^2 (2, N = 575) = 12.8, p < 0.001] and by *complex analysis* [F (1, 16) = 8.19, p = 0.001]. Gender was not a significant predictors of LDL cholesterol after correcting for multiple comparisons by *complex analysis* [F (1, 16) = 6.50, p = 0.021].

Hypothesis 4.b.3 (i). Effect of reporting given a goal for SBP with measured SBP

Medical advice reported received for systolic blood pressure by race was assessed by the general linear model for the first reading of SBP, natural log transformed for linearity (Ln-SBP). As indicated, the models with ‘no covariates’ contained gender and age and are referred to as the ‘reduced models’, and the final model included obesity.

Model fit. All models were significant [F (7, 568) = 9.55, p < 0.001, *simple analysis* 'reduced model'; F (8, 551) = 9.63, p < 0.001, *simple analysis* final model; F (7, 10) = 8.22, p = 0.002, *complex analysis* 'reduced model'; F (8, 9) = 9.70, p = 0.001, *complex analysis* final model].

Hypothesis test. The 1-df tests for 'goal' were not significant [F (1, 568) = 2.35, p = 0.126, *simple analysis* reduced model; F (1, 551) = 3.81, p = 0.051, *simple analysis* final model; F (1, 16) = 3.33, p = 0.087, *complex analysis* reduced model; F (1, 16) = 6.22 p = 0.024, *complex analysis* final model]. The 2-df tests for 'goal*race' were not significant [F (2, 568) = 0.036, p = 0.965, *simple analysis* reduced model; F (2, 551) = 0.063 p = 0.939, *simple analysis* final model; F (2, 15) = 0.81, p = 0.463 *complex analysis* reduced model; F (2, 15) = 1.56, p = 0.243, *complex analysis* final model]. The hypothesis was not supported since reporting receiving a goal did not predict systolic blood pressure. The interaction of race with having a goal was also not significant.

Effect of the covariates. Age was a significant predictor of SBP [F (1, 568) = 58.4, p < 0.001, *simple analysis* reduced model; F (1, 551) = 53.8, p < 0.001, *simple analysis* final model; F (1, 16) = 64.1, p <0.001, *complex analysis* reduced model; F (1, 16) = 58.4, p <0.001, *complex analysis* final model]. Gender was significant by *simple analysis*, only [F (1, 568) = 4.2, p = 0.034, reduced model; F (1, 551) = 6.17, p = 0.013, final model]. Obesity was associated with SBP by *simple analysis* [F (1, 551) = 7.35, p = 0.007] but not by *complex analysis*. Race did not predict SBP by either model.

Additional analysis. Full factorial models by *simple* and *complex analysis* were conducted to examine the 3-way interaction of race*gender*goal with SBP as the independent variable. The models were significant [F (12, 563) = 6.59, p < 0.001 *simple* *analysis*; *F* (12, 5) = 6.57, *p* = 0.025, *complex analysis*]. The 3-way interaction was significant [*F* (3, 563) = 3.09, *p* = 0.027, *simple analysis*; *F* (2, 15) = 5.38, *p* =0.017, *complex analysis*]. The 3-way interactions were plotted separately by gender for the *simple* model (**Figures 4, 5**).

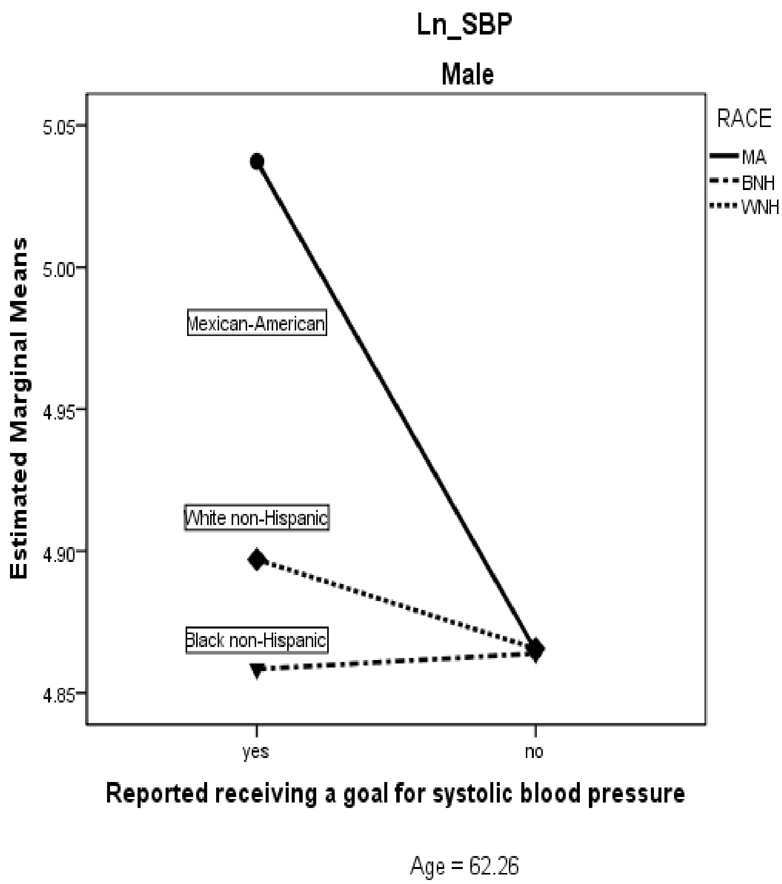

Figure 4. The effect of reporting receiving a goal for systolic blood pressure on systolic blood pressure for males by race

Abbreviations: BNH = Black non-Hispanic; MA = Mexican-American; WNH = White non-Hispanic; Ln_SBP = the natural log transformation of systolic blood pressure.

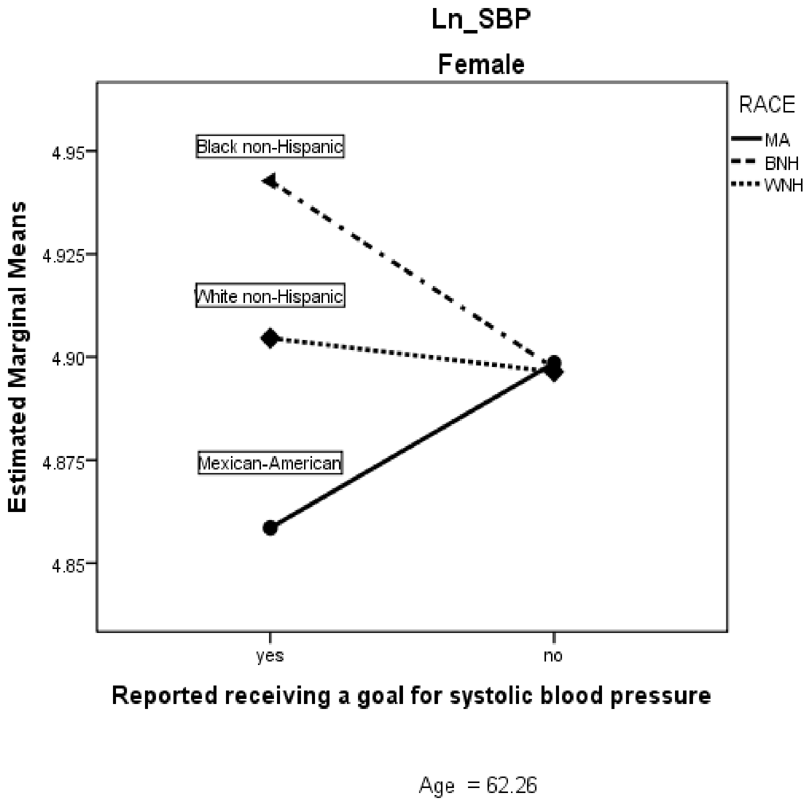

Figure 5. The effect of reporting receiving a goal for systolic blood pressure on systolic blood pressure for females by race

Abbreviations: BNH = Black non-Hispanic; MA = Mexican-American; WNH = White non-Hispanic; Ln_SBP = the natural log transformation of systolic blood pressure.

Hypothesis 4.b.3 (ii). Effect of reporting given a goal for DBP with measured DBP

As indicated for blood pressure, the models with 'no covariates' contained gender and age and are referred to as the 'reduced models', and the final model included obesity.

Model fit. All models were significant [F (7, 568) = 14.5, $p < 0.001$ *simple analysis* reduced model; F (8, 551) = 12.3, $p < 0.001$, *simple analysis* final model; F (7, 10) = 13.2, $p < 0.001$, *complex analysis* reduced model; F (8, 9) = 9.68, $p = 0.001$, *complex analysis* final model].

Hypothesis test. The 1-df tests for 'goal' were not significant [F (1, 568) = 0.049, p = 0.824 *simple analysis* reduced model; F (1, 551) = 0.20, p = 0.655, *simple analysis* final model; F (1, 16) = 0.050, p = 0.826, *complex analysis* reduced model; F (1, 16) = 0.24, p = 0.632 *complex analysis* final model]. The 2-df tests for 'goal *race' were not significant [F (2, 568) = 1.27, p = 0.282 *simple analysis* reduced model; F (2, 551) = 1.37, p = 0.255, *simple analysis* final model; F (2, 15) = 2.50, p = 0.116, *complex analysis* reduced model; F (2, 15) = 2.82, p = 0.091, *complex analysis* final model]. The hypothesis was not supported since having a goal was not a predictor of DBP. The interaction of race with having a goal was also not significant.

Effect of the covariates. The following covariates were significant: **age** [F (1, 568) = 81.3, p < 0.001, *simple analysis* reduced model; F (1, 551) = 81.2, p < 0.001 *simple analysis* final model; F (1, 16)= 45.8, p < 0.001, *complex analysis* reduced model; F = (1, 16) = 43.5, p < 0.001, *complex analysis* final model] and **gender** [F (1, 568) = 11.8, p = 0.001, *simple analysis* reduced model; F (1, 551) = 10.7, p = 0.001, *simple analysis* final model; F (1, 16)= 8.57, p = 0.010, *complex analysis* reduced model; F (1, 16) = 7.28, p = 0.016, *complex analysis* final model]. **Obesity** was not significant.

Hypothesis 4.c. The effect of reported "Pattern A" medical advice on A1C, LDL, SBP, and waist circumference

In order to assess hypothesis 4.c., clinical outcomes were regressed on "Pattern A" medical advice by race. The goal was to determine if reporting being told to perform health behaviors (independent variables: reduce fat or calories, control or lose weight and increase physical activity or exercise) by a health professional would be associated with clinical outcomes: blood glucose, cholesterol and blood pressure (dependent variables).

“Pattern A” medical advice reported for ‘reducing fat or calories’, ‘increasing physical activity or exercise’, and ‘controlling or losing weight’, was interacted with race to predict clinical outcomes as a single model. General linear models (GLM) were performed by *simple* and then *complex* sample *analysis* with each dependent variable: log-A1C, ln-LDL, ln-SBP. “Pattern A” medical advice was run together as the independent variables along with race and its interaction with each component of “Pattern A”. Due to poor model fit parameters for ln-A1C, and ln-SBP, the components of “Pattern A” medical advice were run in separate models; whereas, all of “Pattern A” was run together for the dependent variables LDL cholesterol and waist circumference.

Hypothesis 4.c.1. Hemoglobin A1C and “Pattern A” medical advice

General consideration for model fit. The full model, with all “Pattern A” predictors combined, for log-A1C as the dependent variable was not significant by *simple analysis* [$F(12, 562) = 1.01$, $p = 0.451$) and the “lack of fit tests” was significant [$F (292, 270) = 1.49$, $p = 0.005$], indicating a poor model fit. In addition, the wide difference between R^2 (14.0%) and adj. R^2 (0.2%) suggested multicollinearity was responsible for the poor model fit. These model fit parameters indicated the need to run each component of reported being told as a separate model to test the effect on log-A1C. The Bonferroni correction for multiple comparisons was applied at $p < 0.017$, since there were 3 types of “Pattern A” medical advice.

Hypothesis 4.c.1(i). Effect of reporting told to reduce fat or calories by race on A1C

Model fit. The models were not significant [$F (5, 569) = 1.69$, $p = 0.136$, *simple analysis* without covariates; $F (6, 568) = 2.35$, $p = 0.030$, *simple analysis* with covariates;

F (5, 12) = 1.11, p = 0.407) *complex analysis* without covariates; F (6, 11) = 0.93, p = 0.510 *complex analysis* with covariates].

Hypothesis test. The hypothesis was not supported since the models were not significant.

Effect of the covariates. Age and gender were tested. Age was retained; however, neither age, nor age and gender, as covariates improved the association of told or race by told in predicting hemoglobin A1C.

Hypothesis 4.c.1(ii). Hemoglobin A1C and told to increase physical activity or exercise

Model fit. The models were not significant [F (5, 570) = 1.51, p = 0.183, *simple analysis*, no covariates; F (6, 569) = 2.27, p = 0.036, *simple analysis*, with covariates; F (5, 12) = 1.69, p = 0.201, *complex analysis*, no covariates; F (6, 11) = 1.38, p = 0.304, *complex analysis* with covariates].

Hypothesis test. The hypothesis was not supported since the models were not significant.

Effect of the covariates. Age and gender were tested. Neither age, nor age and gender, as covariates improved the association of told or race by told in predicting hemoglobin A1C.

Hypothesis 4.c.1(iii.) The effect of told to control weight by race on A1C

Model fit. The models were significant [F (5, 570) = 3.29, p = 0.006, *simple analysis,* no covariates; F (6, 569) = 3.84, p = 0.001, *simple analysis*, with covariates; F (5, 12) = 7.73, p = 0.002, *complex analysis,* no covariates; F (6, 11) = 6.74, p = 0.003 *complex analysis* with covariates].

Hypothesis test. The 1-df tests for 'told' were not significant [F (1, 570) = 2.99, p = 0.085, *simple analysis* no covariates; F (1, 569) = 4.14, p = 0.042, *simple analysis* with covariates; F (1, 16) = 2.15, p = 0.162, *complex analysis* no covariates; F (1, 16) = 3.01, p = 0.102, *complex analysis* with covariates]. The 2-df tests for 'told*race' were all significant [F (2, 570) = 6.40, p = 0.002, *simple analysis* no covariates; F (2, 569) = 6.28, p = 0.002, *simple analysis* with covariates; F (2, 15) = 16.0, $p < 0.001$, *complex analysis* no covariates; F (2, 15) = 16.7, $p < 0.001$, *complex analysis* with covariates]. Race interacted with 'told to control weight' in determining A1C. The final models included race, race*told, and age. Mexican-Americans who reported being 'told to control or reduce' their weight in the past year had lower log-A1C values than WNH [*simple analysis* no covariates (B = -0.071 (-0.111, -0.031), p = 0.001); *simple analysis*, with covariates (B = -0.070 (0.110, -0.030, p = 0.001); *complex analysis*, with and without covariates (B = -0.081 (0.125, -0.037), p = 0.001]. The relationship was not significant for BNH (p = 0.708 *simple analysis*; p = 0.897, *complex analysis*). The hypothesis was partially supported since reporting being 'told to control weight' was associated with A1C levels; however, the association was not independent of race.

Effect of covariates. Age and gender were tested and only age remained in the final model. Age had little effect on the coefficient for MA*told by *simple analysis* and no effect by *complex analysis*.

Hypothesis 4.c.2. The effect of "Pattern A" medical advice on low-density lipoprotein-cholesterol

Model fit. The model fit for "Pattern A" medical advice (reported being 'told to reduce fats or calories'; 'increase physical activity or exercise' and 'control or lose weight') was tested by *logistic regression* with LDL as a binary variable (LDL > 100 versus LDL ≤ 100). Only the models by *simple analysis* were significant: [χ^2 (11, N = 573) = 29.4, p = 0.002, *simple analysis*, without covariates; χ^2 (12, N = 573) = 43.2, p < 0.001, *simple analysis* with covariates; whereas, the *complex* models were not significant [F (11, 6) = 2.13, p = 0.182 *complex analysis*, without covariates; F (12, 5) = 1.48, p = 0.351, *complex analysis* with covariates].

Hypothesis test. The 1-df tests for each "Pattern A" medical advice and the two degree tests for race by told were not significant by *simple analysis* with or without covariates. The results of the 1-df tests for *simple analysis* without covariates were as follows: 'told to reduce fat or calories' (χ^2 (1, N = 573) =1.77, p = 0.183); 'told to control weight' (χ^2 (1) = 0.37, p = 0.545); 'told to increase physical activity' (χ^2 (1, N = 573) = 0.24, p = 0.626). The *simple* model with covariates 1-df tests were as follows: 'told to reduce fat or calories' (χ^2 (1, N = 573) = 1.77, p = 0.183); 'told to control weight' (χ^2 (1, N = 573) = 0.37, p = 0.545); 'told to increase physical activity' (χ^2 (1, N = 573) = 0.24, p = 0.626).

The results of the 2-df tests for race by each "Pattern A" by *simple analysis* without covariates were as follows: 'race* told to reduce fat or calories' [χ^2 (2, N = 573) =3.26, p = 0.196]; 'race* told to increase PA or exercise' [χ^2 (2, N = 573) = 0.59, p = 0.744]; and, 'race* told to control weight' [χ^2 (2, N = 573) = 1.89, p = 0.389]. The results of the 2-df tests for race by each "Pattern A" by *simple analysis* with covariates were as follows: race* 'told to reduce fat or calories' [χ^2 (2, N = 573) = 3.26, p = 0.196]; 'race* 'told to increase PA or exercise' [χ^2 (2, N = 573) = 0.59, p = 0.744]; and, race* 'told to control weight' [χ^2 (2, N = 573) = 1.89, p = 0.389]. The tests failed by *complex analysis*, since the models were not significant. The hypothesis was not supported; "Pattern A" medical advice by race was not an explanatory factor of high LDL. Race was a significant predictor of high LDL in the *simple* model [χ^2 (2, N = 573) = 8.86, p = 0.12].

Effect of the covariates. The following covariates were tested: age, gender and overweight. The final model included and age.

Hypothesis 4.c.3(i). Effect of reporting 'told to reduce fat or calories by race on Ln-SBP

Model fit. Models without covariates were not significant [F (5, 568) =0.38, p = 0.861, *simple analysis*; F (5, 12) = 0.62, p = 0.685; *complex analysis*. All models with covariates were significant [F (8, 549) = 9.94, p < 0.001, *simple analysis*; F (8, 9) = 12.2, p = 0.001, *complex analysis*].

Hypothesis test. The hypothesis was inconclusive by *simple and complex analysis* due to insufficient power. The observed power (by *simple analysis*) for the interactive term (race by 'told to reduce fat or calories') was 48.9% indicating there was not sufficient power to test the hypothesis. The *simple analysis* model fit predicted the *complex* model fit would not be suitable (Archer, Lemeshow & Hosmer, 2007). *Complex analysis* (with the interactive term) had a high design effect (DEFF = 3.01) for the 'told to reduce fat or calories' variable. This effect was greater than the cut-off designated for adequate sample size (DEFF < 1.5). Therefore, the hypothesis test was withdrawn for *simple* and *complex analysis* due to insufficient power needed to make a determination of the differences between groups.

Effect of covariates. Age, gender and obesity were considered and remained in the final model.

Hypothesis 4.c.3(ii.). The effect of reporting being 'told to increase physical activity or exercise' on Ln-SBP

Model fit. Models without covariates were not significant [F (5, 569) = 1.92, p = 0.090, *simple analysis*; F (5, 12) = 1.45, p = 0.203, *complex analysis*]. Models with covariates were significant, [F (6, 568) = 12.3, p <0.001, *simple analysis*; F (6, 11) = 18.8, p < 0.001, *complex analysis*].

Hypothesis test. The hypothesis tests were not significant in models without covariates, since model fit was not significant. The 1-df tests were not significant: 'told to increase PA' was not significantly related to ln-SBP by either model *simple* [F (1, 568) = 0.207, p = 0.649] or *complex* [F (1, 16) = 1.36, p = 0.260]. The 2-df tests were significant by *simple* but not by *complex analysis*. The interaction of race with 'told to increase PA' was significantly related to ln-SBP by *simple analysis* [F (2, 568) = 6.74, p = 0.001] but not by *complex analysis* after correction for multiple comparisons [F (2, 15) = 4.24, p = 0.035].

Race was a modifier of ln-SBP when comparing MA and WNH to BNH [MA/BNH: B= -0.98 (-182, - 015), SE = 0.042, p = 0.021 and WNH/BNH: B= -113 (-0.174, -0.51), SE = 0.031, p< 0.001]. The direction of the coefficients indicated that being BNH was more strongly associated with 'told to increase PA' as SBP increased. The hypothesis was not supported since reporting being 'told to increase physical activity or exercise' was not associated with lower systolic blood pressure, and race was associated with both being 'told to increase PA' and ln-SBP (by *simple analysis*).

Effect of covariates. Age, gender and obesity were tested. Age remained in the final models. Age was positively associated with ln-SBP, and estimates for *simple* and *complex analysis* were the same [$B = 0.004$ (0.003, 0005), $SE < 0.001$, $p < 0.001$].

Hypothesis 4.c.3(iii.). The effect of reporting being 'told to control weight on Ln-SBP

Model fit. Models without covariates were not significant [F (5, 569) =0.79, $p = 0.554$, *simple analysis*; F (5, 12) = 0.31, $p = 0.898$, *complex analysis*]. Models with covariates were significant [F (8, 550) = 9.62, $p < 0.001$, *simple analysis*; F (8, 9) 13.7, $p < 0.001$, *complex analysis*].

Hypothesis test. The hypothesis tests were not significant for models without covariates due to model fit. The 1-df tests of 'told' were not significant with covariates [F (1, 550) = 0.64, $p = 0.425$, *simple analysis*; F (1, 16) = 5.51, $p =0.032$, *complex analysis*]. The 2-df tests of race by 'told' were not significant [F (2, 550) =1.44, $p = 0.238$, *simple analysis*; F (2, 15) = 0.91; $p = 0.425$, *complex analysis*]. The hypothesis was not supported since reporting being 'told to control weight' did not predict systolic blood pressure. Race was not associated with ln-SBP by either *simple* or *complex analysis*.

Effects of the covariates. Age, gender and obesity were considered and retained in the final models. Age and obesity were predictors of systolic blood pressure by both *simple* and *complex analysis*. Gender was associated with ln-SBP by *simple analysis* [F (1, 550) = 6.86, $p = 0.004$].

Summary of hypothesis 4.c.3(iii.). Ln-SBP regressed told to control weight. Neither *simple*, nor *complex analysis* support the hypothesis that 'told to control weight' predicts systolic blood pressure.

Summary of findings hypothesis 4.c.3. Blood pressure regressed on "Pattern A" medical advice. The systolic blood pressure was regressed on three different *types of medical advice*: 1) 'told to reduce fat or calories'; 2) 'told to increase physical activity or exercise'; and, 3) 'told to control weight or lose weight' by *simple* and *complex* models. Power was insufficient to determine the hypothesis for 'told to reduce fat or calories'. 'Told to increase physical activity or exercise'; was not significantly related to ln-SBP and the interaction of 'told to increase PA' by race was significant by *simple analysis*, only. 'Told to control weight' was not a predictor of systolic blood pressure.

Hypothesis 4.c.4. The effect of "Pattern A" medical advice with obesity

Since WC and BMI are both obesity indicators, only one was chosen. Waist circumference was chosen since it did not need a transformation for linearity. Since "Pattern A" medical advice has three components, the Bonferroni correction was set at $p < 0.0167$.

Model fit. All models were significant [F (11, 558) =13.1, p <0.001, *simple analysis* no covariates; F (13, 556) = 12.1, p < 0.001, *simple analysis* with covariates; F (11, 6) = 9.01, p = 0.007, *complex analysis* no covariates; F (12, 5) = 6.84, p = 0.023, *complex analysis* with covariates].

Hypothesis test. The results for 1-df tests for each of "Pattern A" by *simple analysis,* without covariates were as follows: significant for reporting yes to 'told to control weight' [F (1, 558) = 52.2, p < 0.001]; not significant for reporting 'told to increase physical activity' [F (1, 558) = 0.24, p = 0.627]; and, not significant for reporting 'told to reduce fat or calories' [F (1, 558) =0.31, p = 0.576]. The results for the 1-df tests for each of "Pattern A" *simple analysis* with covariates were as follows: significant for reporting yes to 'told to control weight' [F (1, 556) = 49.2, p < 0.001; B = 10.4 (5.07, 12.8); SE = 2.59]; not significant for reporting 'told to increase physical activity' [F (1, 556) = 0.545, p = 0.461]; and, not significant for reporting 'told to reduce fat or calories' [F (1, 556) = 0.452, p = 0.505]. The observed power for 'told to control or lose weight' was 96.8 %; however, power for 'told to increase PA' and 'told to reduce fat or calories' was below 85 % (29.9 % and 5.0 %, respectively). The model explained 20.3 % (adj. R^2) of the estimated variance with an overall observed power of 99.9%. The 'Lack of Fit Tests' was not significant indicating the model had a significant fit [F (1, 16) = 0.783, p = 0.974].

The results for the 1-df tests for each of "Pattern A" by *complex analysis* without covariates were as follows: significant for reporting yes to 'told to control weight' [F (1, 16) = 44.6, p < 0.001]; not significant for reporting 'told to increase PA' [F (1, 16) = 0.76, p = 0.396]; and, not significant for reporting 'told to reduce fat or calories' [F (1, 16) = 0.50, p = 0.489]. The results for the 1-df tests for each of "Pattern A" by *complex analysis* with covariates were as follows: significant for reporting yes to 'told to control weight' [F (1, 16) = 37.3, p < 0.001; B = 8.44 (5,25, 11,6), SE = 1.59]; not significant for reporting 'told to increase PA' [F (1, 16) = 0.60, p = 0.449];and, not significant for reporting 'told to reduce fat or calories' [F (1, 16) = 0.926, p = 0.320].

The results for the 2-df tests for race by each of "Pattern A" were not significant by *simple analysis* without covariates [F (2, 558) = 0.59, p =0.557, wt*race; F (2, 558) = 0.83, p = 0.436, pa*race; F (2, 558) = 0.38, p =0.685, fat/calories* race]; nor by *complex analysis* [F (2, 15) 1.50, p = 0.254, wt*race; F (2, 15) = 0.61, p = 0.557, PA*race; F (2, 15) = 0.14, p = 0.869, fat/calories*race]. Race was significant by *simple analysis* [F (2,

558) = 3.98, $p = 0.019$] but not by *complex analysis* [F (2, 15) = 2.82, $p = 0.091$]. The results for the 2-df tests for race by each of "Pattern A" final models were not significant by *simple analysis* with covariates [F (2, 556) = 0.68, $p = 0.508$, wt*race; F (2, 556) = 0.87, $p = 0.421$, PA*race; F (2, 556) = 0.44, $p = 0.643$, fat/calories* race]; nor by *complex analysis* [F (2, 15) = 1.83, $p = 0.191$, wt*race; F (2, 15) = 0.77, $p = 0.481$, PA*race; F (2, 15) = 0.11, $p = 0.901$, fat/calories*race]. Race was significant in the final model by *simple analysis* [F (2, 556) = 4.52, $p = 0.011$] but not by *complex analysis* [F (2, 15) = 3.11, $p = 0.074$].

Effect of the covariates. Age and gender were considered as covariates. The covariates for *simple analysis* were gender [B = 2.93 (0.56, 5.31), $p = 0.016$] and age [B = -0.100 (-0.189, -0.010); SE = 0.046, $p = 0.029$]. Gender was dropped for the most parsimonious model for *complex analysis* since it did not pass the cut-off for a control variable ($p < 0.2$).

Summary of Hypothesis 4.c.4. One part of "Pattern A" medical advice, 'told to control weight' was associated with waist circumference by *simple* and *complex analysis* independent of race. The hypothesis was partially supported. 'told to increase PA or exercise' and 'told to reduce fat or calories' was not associated with WC. Race was significant as a predictor of WC for the *simple* model only. Race was not a modifier of "Pattern A" medical advice.

Summary of hypotheses testing

A summary of the results with respect to the hypotheses are given by **Table 10.**

Table 10. Results of hypothesis testing

Hypotheses	**Results**
Hypothesis 1.a. Black non-Hispanics and MA will be less likely as compared to WNH to report being told by a medical professional any or all of the following within the past year: 1) to reduce calories or fat in their diet; 2) to increase physical activity; and, 3)to control body weight.	MA and BNH were more likely to report being advised to reduce fat or calories and increase physical activity than WNH. MA were more likely than WNH to be told to control body weight. Hypothesis 1.a. was rejected since it was contradicted.
Hypothesis1.b. BNH and MA will be more likely as compared to WNH to report their provider did not specify a treatment goal for any or all of the following: 1) A1C; 2) “Bad cholesterol that clogs your arteries -LDL”; and, 3) blood pressure (SBP and DBP).	Race was not an explanatory factor for reporting receiving a goal for A1C. MA were more likely to report receiving a goal than “no goal” or “don’t know” for LDL than WNH. Hypothesis 1.b. was rejected since it was contradicted.
Hypothesis 1.c. BNH and MA will be less likely to receive diabetes education/ counseling than WNH	BNH were twice as likely to report receiving diabetes education as compared to WNH. Hypothesis 1.c. was rejected since it was contradicted.
Hypothesis 2. All or any of the following diabetes self-management skills will be less likely for BNH and MA than WNH: 1) frequency of self-monitoring blood glucose (SMBG); 2) reducing fat or calories in the diet; 3) increase physical activity; 4) controlling weight; and, 5) checking feet for sores.	BNH were more likely to report reducing fat or calories than WNH. BNH were more likely to check their feet than WNH. There was no significant difference in increasing physical activity or controlling weight among races. Hypothesis 2. was rejected.

Hypotheses	Results
Hypothesis 3.a. Mean Hemoglobin A1C will be at least 1% higher for BNH and MA as compared to WNH. The likelihood of adequate glycemic control :A1C $\leq$ 7 will be higher for WNH than MA or BNH	Race did not explain A1C levels or glycemic control Hypothesis 3.a. was rejected
Hypothesis 3.b. Inadequate LDL levels (>100 mg/dl) will be more likely for BNH and MA than WNH.	BNH and MA were more likely to have high LDL levels. Hypothesis 3.b. was supported
Hypothesis 3.c. BNH and MA will be more likely to be in the obese category (BMI $\geq$ 30 kg/m^2) than WNH.	Profile of an obese participant: female, younger, more doctors visits, and less likely to reduce fat or calories. Hypothesis 3.c .was rejected
Hypothesis 4.a. "Pattern A" level of medical advice (told by a physician/provider) and level of DSM skills/behaviors will be modified by ethnicity/race.	There was a positive relationship between "Pattern A" advice and behavior; however, the relationship was independent of race. Hypothesis 4.a. was partially supported
Hypothesis 4.b. There will be a positive association of "Pattern B" level of medical advice (given goals by a provider) and level of DSM as indicated by corresponding clinical outcomes, independent of ethnicity/race.	Goals reported for A1C, LDL and DBP were independent of race. Goals reported for SBP were modified by race. Hypothesis 4.b.was partially supported.
Hypothesis 4.c. There will be positive associations between "Pattern A" medical advice received and each of the corresponding clinical indicators of DSM independent of ethnicity/race.	'Told to control weight' was positively associated with WC independent of race. The direction was not consistently positive. MA 'told to control weight' had lower A1C than WNH. Hypothesis 4.c. was partially supported.

Abbreviations: A1C = hemoglobin A1C; BMI = body mass index; BNH = Black non-Hispanic; DBP = diastolic blood pressure; DSM = diabetes self-management; LDL = low-density lipoprotein cholesterol; MA = Mexican-American; SBP = systolic blood pressure; WC = waist circumference.

CHAPTER V

DISCUSSION

The intention of this study was to investigate the relationships and processes that may occur among persons with diabetes from two minority groups as compared to WNH with respect to medical advice, diabetes self-management and health outcomes using data from NHANES 2007-2008. Moreover, the goal of this undertaking was to determine the association of reported medical advice with health behaviors and health outcomes by race in an effort to uncover an aspect of health disparities in the patient-provider communication process. In order to achieve this goal, four main hypotheses were tested to address the following research questions: 1) What are the differences in medical advice reported to have been received by BNH, MA as compared to WNH with diabetes? 2) What are the differences of diabetes self-management behavior (DSM) by race of persons with diabetes by comparing DSM behavior of BNH and MA to DSM behavior of WNH? 3) What are the differences in clinical indicators of DSM for persons with diabetes by race when comparing BNH and MA with WNH? 4) What are the associations between level of medical advice and level of DSM by race for all study participants (BNH, MA and WNH with diabetes)? The final goal was to allow the investigator to pursue additional analyses to further elucidate the associations indicated by the initial hypothesis testing and to compare results obtained by *simple* and *complex* sample analyses.

Analysis of the main research questions prompted additional analyses to investigate possible mediators of race and health behaviors. Diabetes education was considered as a mediator for race in reporting receiving medical advice as well as reporting performing the advised behaviors. Furthermore, this investigator's experience with the new NHANES data has lead to suggestions for improvement of the test questions.

Implications of results

Weight reduction and management, an important aspect of DSM, can be achieved by reducing fat or calories and increasing physical activity. Performing these skills is central among the recommendations for persons with type 2 diabetes by the ADA (ADA, 2010). Contrary to hypothesis 1.a., there were differences by race in medical advice reported in these effective means of weight management (calorie or fat reduction and physical activity). Controlling for obesity, MA and BNH with type 2 diabetes were more likely to report being told by their doctor to reduce calories or fat in the past year than WNH and were more likely to report being told to increase their physical activity by a doctor in the past year. These findings are contrary to the study hypothesis which predicted that MA and BNH would be less likely to report being given medical advice than WNH. The original hypothesis was based on two assumptions: 1) there were health disparities with access to quality medical care; and, 2) the health beliefs of Latinos and Blacks might be a factor associated with filtering the provider's advice regarding lifestyle changes. Piette, Schillinger, Potter and Heisler (2003) found that African-Americans and Spanish speaking participants, as well as participants with a lower education, reported better general communication than patients of other races, languages and higher education. However, the investigators found that African Americans reported better diabetes-related communication with their physicians than Hispanics or WNH. On the other hand, Campos (2007) reports that Hispanics resist diabetes care advice due, in part, to cultural issues.

Black non-Hispanics and MA were more likely to report receiving medical advice than WNH for diet and physical activity; however, there were no differences for BNH and MA for weight management as compared to WNH. These results suggest that patients with diabetes are told to reduce weight, regardless of their ethnicity; but, that minority patients may be given guidelines on how to lose weight more often than WNH. Physicians who scored high in engaging their patients were either members of a minority or have had experiences dealing with minority patients' frustrations (Vanderbilt, Wynia, Gadon & Alexander, 2007). The authors suggest these physicians actively engage their patients as an attempt to reduce health disparities (Vanderbilt et al, 2007).

With respect to hypothesis 1.b., there were racial differences for reporting having received goals for blood pressure, only. Black non-Hispanics were more likely to report 'no' or 'not sure' regarding receiving a goal for blood pressure. This anomaly is difficult to explain since hypertension is more prevalent in African-Americans than WNH. Perhaps when patients are taking hypertensive medications, physicians do not see the need to give a blood pressure goal. Reporting receiving a goal for A1C and LDL did not differ by race. Putzer et al (2004) emphasize that when assessing whether patients (33% from a racial/ethnic minority) achieved the ADA treatment goals from charts it is not known whether patients and physicians are aware of the goals. Furthermore, the physician-patient communication may not be effective and could interfere in the patient's interpretation of the goals (Putzer et al, 2004). The same reasoning can be applied to the evaluation of secondary data, in this case, NHANES.

Contrary to hypothesis 1.c., which predicted WNH would be more likely to receive diabetes education than BNH or MA, BNH were twice as likely to report receiving diabetes education in the past two years as WNH. When ethnic or racial groups receive, on average, unequal health care or have an imbalance in access to health care, they are considered to have 'health disparities'. The Office of Minority Health (2005) defines health disparities as significant differences between one population and another. The Department of Health and Human Services launched a series of initiatives to eliminate health disparities through the Minority Health and Health Disparities Research and Education Act of 2000 (Office of Minority Health, 2005). The National Diabetes Education Program (NDEP), a governmental and private public health partnership program, was formed in an effort to eliminate the diabetes epidemic by forming programs specifically for African-Americans, Hispanics, Native Americans, Alaskan natives, Asian Americans and Pacific Islanders (NDEP, 2007). For this study, BNH and WNH had no significant difference in health care coverage. In an effort to comply with governmental programs and cut costs, it is possible that health care providers are selecting more BNH to receive diabetes education than WNH, while maintaining or decreasing the numbers of persons sent for diabetes education per year. It is likely that in an effort to eliminate health disparities, inadvertently, another form of health care inequality was formed for persons having health care coverage since the difference remained controlling for health care insurance type. The differences between MA and WNH for diabetes education cannot be assessed for this study since MA were less likely to be covered by health insurance. For the study participants, there were overlaps with belonging to two insurance types, particularly private and Medicare. Quality of services may not be equal; however, Nelson et al (2005) found private, Medicaid and Medicare patients had little differences in quality services.

Diabetes self-management behavior differed by race; however, hypothesis 2. was contradicted. Participants from the two minority groups (MA and BNH) were more likely to report engaging in healthy DSM skills such as reducing fat or calories. This study's findings that BNH were more likely to report checking their feet for sores than WNH corroborates with Nwasuruba et al (2007)'s findings.

Although BNH and MA were more likely to report being advised to reduce fat or calories and increase physical activity than WNH there were no racial differences in the corresponding behaviors. Instead, being advised to make lifestyle changes was associated with reporting making the change. In direct contrast to our findings, Oster et al (2006) reported Blacks (n = 984) and Hispanics (n = 428) with diabetes were less likely to monitor their diet than Whites (n = 4623) from a national managed care organization. In addition, Blacks were less likely than Whites to exercise (Nwasuruba et al 2007; Oster et al, 2006).

Clinical indicators of diabetes care were hypothesized to vary by race (hypothesis 3.) with minorities expected to have poorer health outcomes as compared to WNH. The findings of numerous studies corroborate with the results of this study regarding a higher likelihood of inadequate LDL levels for minorities than for WNH. This study did not test the association of cholesterol levels and medication; however, throughout the literature access to lipid-lowering medications and compliance with treatment plans have been more likely for WNH than Hispanics or Blacks.

Conversely, our results (hypothesis 3.) of no significant differences in A1C and BMI for MA and BNH as compared to WNH were not in accordance with the literature. Concerning A1C, the target guidelines are based on all patients with diabetes and have been suggested by the American College of Physicians (Qaseem, 2007), but not in accordance with the American Diabetes Association, to have a flexible range depending on the individual's health conditions. While a value of < 6% may be optimal for individuals who can achieve this without hypoglycemia, <7% may be a more feasible goal to target by physician and patient agreement for the majority of patients (Qaseem, 2007). Furthermore, goals of higher than 7% are appropriate for older, frailer patients who are at risk for adverse complications from tight control (Qaseem, 2007).

Considering the guidelines by the American College of Physicians in light of health disparities, comparisons of A1C by ethnicities or race may not be indicative of glycemic control differences, even controlling for age. Currently, there are no ethnically-specific guidelines for A1C. In fact comparisons for glycemic control are usually based on an A1C value that may not be equally attainable by all members of a particular race. The consensus of comparison for assessing glycemic control has been based on the American Diabetes Association's and the NIDDK's guideline of < 7% (NIDDK, 2008). Using this cut-off point, and data from NHANES, 2003-2004, Hoerger, Segel, Gregg and Saaddine (2008) reported slightly more than half of individuals with type 2 diabetes (55.7%) have adequate glycemic control (A1C).

With respect to obesity indicators, the age adjusted prevalence of obesity (percent BMI ≥ 30 kg/m^2) was 35.7, for Blacks, 28.7 for Hispanics, and 23.7 for WNH considering data from the 2006-2008 BRFSS (Center for Disease Control and Prevention, 2009a). The age-adjusted percent of adults aged ≥ 20 years who are obese during 2003-2006 were highest for women as compared to men (except WNH women compared to BNH men) (53.3% for BNH; 41.8% for MA; and, 31.6% for WNH); whereas for men the percentages of obesity were as follows: 35.0% for BNH; 32.0% for WNH; and 28.8% for MA (Center for Disease Control and Prevention, 2009b). Health disparities in weight management were apparent by the following comparison of data from NHANES 2006-2008: BNH had a 51% higher and MA had a 21% higher obesity rate compared to WNH (Center for Disease Control and Prevention, 2010).

The results from the BRFSS and NHANES were for the general adult population and not the sub-population of adults with diabetes. The present study did not distinguish race as a determinant of obesity regardless of covariates and interactive terms with BMI ≥ 30 kg/m^2 or WC as outcomes. The findings were most likely due to the collinearity of diabetes status with obesity. The populations from this study were adults with diabetes compared by race and more than two-thirds were considered obese; whereas, obesity percent estimates of the general population are closer to one-third.

The result for self-monitoring blood glucose agrees with some studies, in that SMBG, was not associated with diabetes outcomes (Aikens et al, 2005; Gallichan, 1997). However, Poolsup, Suksomboon and Rattanasookchit (2009) found that SMBG improves A1C for individuals with type 2 diabetes and an A1C $\geq$ 8%. A meta-analysis of 15 trials with non-insulin dependent patients with type 2 diabetes (N = 3270) reported SMBG was associated with a reduction in A1C (Allemann, Houriet, Diem, & Stettler, 2009). Using random effect models, they found a weighted mean difference between SMBG and non-SMBG of-0.31% (95% CI: -0.44, -0.17) (Allemann et al, 2009). Blacks and Hispanics were found to have poorer glycemic control (higher A1C) (Brown et al, 2003; Kirk et al, 2005; Kirk et al, 2008; Ziemer et al, 2010); yet few studies examined the interaction of DSM skills, such as SMBG by race with A1C and other diabetes outcomes. For our sample, BNH and WNH were more likely to SMBG when A1C levels were high; while, MA with higher A1C were less likely to check their glucose levels.

It was expected that medical advice would result in better diabetes outcomes independent of race (hypothesis 4.c.); nevertheless, there were several interactions of race by advice. Reporting being told to control weight resulted in lower A1C levels only for MA; while being WNH concurrently with being told to reduce fat or calories was related to higher SBP. Reporting not being told to reduce fat or calories and being MA was associated with higher LDL cholesterol. Improvements in diabetes outcomes may not occur for minority patients, even when physicians are made aware of racial disparity in diabetes care and outcomes. A 12-month randomized controlled trial applying cultural competency training found no improvements in diabetes outcomes, despite the physicians' increased awareness of health disparities (Sequist et al, 2010).

The findings of this study indicated effective communication between providers and patients differs by patient characteristics such as race, education, age, and years with diabetes. The results suggest the need to tailor DSM advice to the background of the individual. On the other hand, there is a need for standard procedures regarding delivery methods and evaluation of the effectiveness of the medical advice based on patient feedback. The delivery methods could be developed, initially, by community-based participatory research and then refined by patient feedback. The patient-provider relationship may be equally important in determining clinical outcomes as the patient's own diabetes care. Aikens, Bingham and Piette (2005) found that patient's perception of the quality of provider communication and DSM independently predicted diabetes outcome (glycemic control and quality of life); and, that the patient-provider communication process did not mediate DSM in explaining diabetes outcomes.

Important aspects of DSM, aside from directly improving A1C and BMI, can be addressed by community-based diabetes education programs. Lorig, Ritter, Villa & Armas (2009) recruited patients with type 2 diabetes, but normal A1C levels into a 6-week, peer-led, randomized control diabetes self-management program as compared to usual care for (N = 345). The investigators found improvements in symptoms of hypoglycemia, glucose monitoring, confidence for self-management, communication with physicians, food practices and depression with the intervention group as compared to the control (usual care group) with no differences in baseline variables between groups.

The patient empowerment approach, similar to peer-led interventions, has been applied to DSM with success in metabolic (Phili-Tsimikas et al, 2004; Tang et al, 2005) and dietary (Deakin, Cade, Willima & Greenwood (2006) improvements. Patient empowerment has been clearly defined as it relates to DSM by Anderson and Funnel (2002). The authors identified three key principles toward effective patient-empowerment: 1) Diabetes is a patient-managed disease. 2) Diabetes care requires patient-provider relationship with a collaborative approach. 3) The patient should choose the area of DSM that is most meaningful for them to make and sustain a behavioral change. Tang, Funnell, Brown & Kurlander (2010) reported significant reduction in A1C for African-Americans involved in an empowerment-based diabetes self-management intervention involving patient-driven discussion.

Potential confounders in the analyses

A confounder or confounding variable is a factor that is related to both the independent (explanatory) variable and dependent (outcome) variable. Since access to health care and continuity of care may vary by race (an explanatory variable) and may influence health behaviors and health outcomes (outcome variables), they are considered confounders. Level of reporting having health care can be considered an operational definition of access to health care and frequency of visits to a physician can be used as an operational definition of continuity of care. Yet these definitions fail to recognize the patient's perceived quality of health care. For this study log-A1C, the major health outcome for patients with diabetes was not explained by frequency of doctors' visits, or level of having health insurance. Furthermore, race and gender did not modify the relationship of health insurance in predicting log-A1C. Despite these results, access and continuity of health care may be confounders since the operational definitions do not take into account the quality of care. As mentioned earlier, Parchman et al (2002) and El-Kebbi et al (2003) reported frequency and continuity of care was associated with improvements in A1C. As such the lack of agreement of this study with the literature concerning health care and health outcomes may be due to multiple confounders that contribute to health care access and continuity of care.

Language barriers and place of birth could have been another possible confounder in this study; particularly for MA and Haitian Americans (grouped with BNH) who are considered immigrant minorities. Gucciardi, Smith and DeMelo (2006) found Canadian patients with diabetes who were not native and whose primary language was not English reported using fewer resources for diabetes care than their counterparts. Immigrant minorities, not only face language barriers, but may have other obstacles, such as lack of proper documentation and perceived discrimination by the provider (Garces, Scarinci & Harrison, 2006).

Another major confounder for this study was health beliefs. The individual's health beliefs are strongly influenced by cultural values concerning views of traditional medicine and recommendations (Gucciardi, Smith, DeMelo, 2006; Santos, Hurtado-Ortiz & Sneed, 2009). It has been suggested that Latinos, who are less assimilated to the United States culture, give credence to alternative treatments and folk remedies (Coronado, Thompson, Tejeda & Godina, 2004; Santos, et al, 2009; Sullivan, Hicks, Salazar & Robinson). Haitian Americans may believe an illness is an act of God and this belief may interfere in their compliance with DSM (Holcomb, Parsons, Giger & Davidhizar, 1996). Similarly, Latinos may believe that they do not have any control over their health (Garces, Scarinci & Harrison, 2006). In particular, low levels of acculturation have been negatively associated with self-regulation of health outcomes (Latham & Calvillo, 2009). Spirituality, an understanding of a non-material force that influences life, has been indicated as a major cultural factor for African-Americans that may influence their DSM and that their beliefs coupled with the patient-provider relationship predicts their level of diabetes care (Polzer, 2007).

The communication process between the provider and patient may be affected by the patient's health beliefs, as well as the level of linguistic and cultural competency of the provider. For example, participants who have a 'fatalistic' outlook and believe that they are not in control of their health outcomes may selectively filter medical recommendations. Similar to fatalism is the belief that medication or home remedies are the preferred means to control health outcomes. Both these views negate the importance of lifestyle in diabetes self-management. There were no questions included in this survey to measure health beliefs. Communication may have been further confounded by the level of linguistic and/or cultural competency in the medical advice and diabetes education given. Moreover, linguistic/cultural competency may not have been consistent across races. Linguistic competency could have been assessed by the participants' understanding of advice; whereas cultural competency could be measured by attitudes toward their experiences with the provider. Albeit, there were no questions included in this survey to assess either linguistic or cultural competency. This is the reason that patient provider communication was considered a precursor of this study's theoretical model.

Current analysis in light of the preliminary study

The preliminary study was conducted to determine if associations of diabetes self-management and social factors differed by race. From the preliminary study, African-Americans had higher family social support scores than Haitian or Cuban Americans. Moreover, there was a positive association with family social support and diabetes self management for African-American and the relationship was not significant for Cuban or Haitian Americans. Aikens, Bingham and Piette (2005) found the perceived quality of the provider communication process predicted diabetes health outcomes. Family social support is another variable that can affect the patient-provider communication process and DSM. As such, family social support may be considered a confounder in the assessment of race by communication predicting DSM behaviors and skills.

Strengths and limitations

There were several main limitations of this study. First, cause and effect could not be established by this study since the data were comparing groups from a single time point. Second, there may have been subject bias in some of the variables. Although clinical data were directly measured and/or based on calculations of direct measurements, the demographic data and data concerning medical advice received were self-reported. Third, the comparisons by race were not of completely homogenous groups. Within the category “Black, non-Hispanic” several Caribbean cultures were combined with African-American. As discussed, immigrant minorities (Haitian and Jamaican Americans) are likely to have acculturation and health belief differences from non-immigrant minorities (African-Americans). Within the “Mexican-American” classification differences in length of time in the United States accounted for variation of homogeneity. Even though NHANES over-samples the poor for each racial group, and the variable education level was chosen as a control, income could not be completely equalized across groups. Fourth, there were variations in exposure variables. While the major exposure variables for medical advice were standard question, their interpretation may vary by the individual or across races. Comparably, diabetes education varied by frequency (within the past two years) and duration (contact time with the diabetes educator) and may have differed in effectiveness. The setting was not specified (hospital or outpatient) and, whether the sessions were presented as individual counseling or in a group setting. Furthermore, it was possible that the exposure to diabetes education could have been unequal across races. Fifth, diabetes status was based on self-report and did not include undiagnosed and unreported diabetes. One major limitation of this study was the limited data inherent in all secondary analysis research. In particular, data regarding the patient-provider communication processes were absent in the NHANES database; hence in this study. It has been well-documented that the patients' participation in treatment goals improves health outcomes. Several studies have indicated health disparities in participatory patient-provider relationships (Cooper-Patrick et al1999; Dixon, 2004; DiMatteo, Murray & Williams, 2009; Johnson, Roter, Powe & Cooper, 2004). Finally, there were multiple confounders (as previously discussed) such as linguistic/cultural competency and health beliefs.

Despite the limitations, a major strength of this study was the use of a national database (NHANES), which has specialized in collecting health data by race. Since this was the first year that NHANES included data concerning medical advice for DSM; this study was one of the first to use a national database to assess health disparities of reported medical recommendations. One strength of the project was using data directly without having to control for reported income. Since NHANES over-sampled the poor, differences across racial groups were less likely to be a factor of income. There was 6.0% of missing values for income; however, two options for not reporting income were provided: 'refused' and 'don't know'. The sample reporting an annual income was proportionately different by race to those not furnishing an income. The ratio between MA and WNH was 20.6% more MA selected to decline reporting their income or reported 'don't know'; therefore, eliminating non-responders may have introduced a bias.

In lieu of income, to establish race as an explanatory variable, other sociodemographic factors, such as education, gender and age were used as covariates. Since education and income have been established throughout the literature as collinear variables, the use of both would be redundant. A benefit for using education as a control variable as opposed to income was that since education level did not have 'non-report options' there was one missing value for reporting education (0.2%), so the chance for bias was reduced. The purpose of this study was to compare a demographically homogenous sample of BNH and MA with WNH and the NHANES sampling technique contributed toward this goal. The missing values for income constituted more than ten percent; yet of greater concern was the potential bias in sociodemographic and health related characteristics between the income reporting sample and the respondents with missing income. In a state-wide survey of women in California, Kim, Egerter, Cubbin, Takahashi and Braveman (2007) reported that risk factors decreased with increasing income and that the participants with missing values for income were more likely to be younger, reside in poor neighborhoods and to have less education.

It has been strongly recommended to include sample weights whenever conducting analyses with NHANES data. Sample weights are constructed as estimators for a representative sample of US citizens and differ for each national survey. A sample weight was assigned to each participant and used in conjunction with the stratification measures: primary and secondary, contains adjustments for unequal probability of selection and non-response. Over sampling of certain ethnicities, ages and income levels is also compensated by the use of sample weights to produce unbiased national estimates of trends. However, it has been suggested that generalizing may over-inflate the variability of the measure without reducing bias for variables where there is little difference between the mean square error of the weighted and unweighted samples (Little & Vartivarian, 2004). Maitland, Casas-Cordero & Kreuter (2009) argue that traditional variables used for sample weights may have weak correlations with the variables of interest and therefore may be inadequate. These authors suggest that bias may be introduced by using sample weights that correct for non-response when the likelihood of participation is related to the study variables. It was possible that persons not responding to a health survey may have different health beliefs than those who participate. In turn health beliefs may influence health behavior and interpretation of medical advice.

Along similar lines, sample weights introduce a design variance referred to as the design effect (DEFF). This effect is the ratio of variances of the complex to the simple sample design (DEFF) = Variance estimate (cluster) / Variance estimate (simple random sample) (NCHS, 2010). The square root of the design effect (DEFT) is estimated for each parameter of an analysis. Using either the DEFF or DEFT, most variables were less than 2 .0. For well-designed studies, DEFT is not greater than 3.0 (Shackman, 2001). When the DEFT is greater than 1.0, it is possible that the variance calculated is too low and the actual significance levels are over-stated. This would mean type 1 error is possible for estimators such as odds ratios for design effects greater than 1.0. Design effect, thereby, cautions the interpretation of estimators of low magnitudes. Since the range of design effects were approximately 0.8 to 1.5 for these analyses, odds ratios close to 1.00 needed to be interpreted with caution. Earlier, OR < 1.5 was considered suspect for inadequate sample size. For a few analyses, sample size for MA was not adequate with multiple factors and covariates. In these cases, lack of significant findings were neither confirmed nor renounced.

This study served as a practical example of using NHANES with and without sample weights, to assess model fit and estimate adequate sample size. Overt environmental influences such as income, education and health insurance status were controlled in the analyses by inclusion in the model. An environmentally homogenous sample was preferred as compared to a sample representative of the nation. Trends in health services and outcomes for minorities as compared to the nation's average or another reference group (White non-Hispanics) have been widely studied and labeled as health disparities. Specifically, poorer health services and outcomes of minorities as compared to White non-Hispanics are referred to as health disparities. Furthermore, it has been widely accepted that these disparities can be explained, in part, by income, education, language barriers and psychosocial factors. Public health researchers, in an effort to eliminate health disparities, have investigated broad trends as well as specific health behaviors of minorities. The use of NHANES data for epidemiological studies has uncovered trends in health disparities; however, health behavior and health outcomes have not been studied using NHANES to select homogenous samples by ethnicity/race: volunteer method. This study of diabetes care compared the volunteer (actual sample cases) to the traditional method (weighted sample) using NHANES 2007-2008 for adults with diabetes.

An inherent limitation to NHANES 2007-2008 sample weights is that they are based on the US census of 2000 and minority populations, such as Blacks and Hispanics, have grown. However, since the objective of this study was to compare ethnic/cultural differences in reported medical advice and ensuing health behaviors, rather than to compare population parameters, this limitation was not relevant. In terms of the conceptual model, the volunteer method sought to measure micro-environmental differences in health behaviors across race by selecting a sample with biases toward homogeneity of personal traits. That is, rather than select a sample representative of each race compliant, attributes of willing subjects were compared. As such, these participants share some common personality traits. In addition, control of macro-environmental factors such as health insurance and education, applied in a hierarchical manner, reduced variation of the participants' macro-environment. Within the framework of the Ecological Model of Health Behavior applied to public health, the micro-environmental influences such as cultural identity, family, small groups were left to explain the individual's health behaviors.

Although the trends for the simple versus complex sampling techniques were the same, there were several notable differences. The behavior of SMBG for the homogenous sample for MA in this study differed by years with diabetes and gender; where these factors were not significant for the representative population. Reporting having received a goal for LDL for MA depended on education level for the simple sample technique, only. It may be an assumption built into the sample weights that reporting receiving medical advice matches actual medical advice received. The premise of this study was that patient-provider communication depends on the patient's understanding of the message. Actual reported values for a homogenous study sample may be of added benefit in determining racial differences in health barriers.

Implications for public health

There are several implications and recommendations for physicians, diabetes educator, and health care policymakers from this study. Medical advice and diabetes education are the cornerstones of diabetes self care. Diet, weight management and physical activity are essential components to diabetes management. This study found differences by race in reporting receiving medical advice and current diabetes education.

Diabetes education (DE) was defined as a series of classes aimed at improving diabetes self care and conducted by a health professional (the exact wording of the question is found in the appendix). Albeit, the quality, effectiveness, and, demographic differences of DE could not be directly determined by the single question. Considering the importance of DE for DSM, it would behoove researchers and clinicians for future NHANES to add questions that might ascertain quality and effectiveness measures of DE and their association with demographic factors. It would be of interest, for this investigation, to determine the association of effectiveness indicators of DE by race. As such, this investigator recommends that NHANES adds follow-up questions for participants that responded receiving DE. A summary of implications and recommendations is warranted. Implications and recommendations for public health improvement are suggested in **Table 11**, and specific recommendations to NHANES are shown in **Table 12**.

Table 11. Implications and recommendations for public health improvement

Implications	**Recommendations**
There are reported differences in medical advice for diabetes health received by race.	Programs and workshops for providers concerning patient-provider communication process are warranted. The Agency for Healthcare Research and Quality (AHRQ) should initiate a comprehensive program evaluation for diabetes treatment plans for providers and other health care personnel. Evaluation reports from the AHRQ need to be utilized by the American Medical Association to reformulate standards of care for persons with diabetes.
Diabetes self-management behaviors were associated with recent diabetes education, regardless of race.	Diabetes educators should continue to play a vital role in motivating compliance of recommended diabetes self management practices.
Receiving current diabetes education differs by type of medical insurance.	Public policy should be initiated to mandate standardize treatment plans for persons with diabetes which include ongoing, annual diabetes education.
Factors indicate having received recent diabetes education intervenes in race receiving medical advice for diabetes care. Since BNH were twice as likely to report having received recent diabetes education as compared to WNH, accessibility of these classes by neighborhood may be a factor	Diabetes education centers need to be located in all neighborhoods. In an effort to narrow the gap in health disparities, a recommended service, in this case diabetes education, was twice-as likely to be provided to Black non-Hispanics than White non-Hispanics (diagnosed with diabetes) according analysis of data from the National Health and Nutrition Survey (NHANES), 2007-2008.

Table 12 Recommendations for additional data collection by future NHANES

Implications	**Recommended Questions**
The effectiveness of diabetes education and medical treatment was associated with several positive health outcomes, albeit they were not adequately assessed.	
Diabetes education assessed by setting: • The number of session conducted in a hospital and in an outpatient setting.	*The same question repeated for outside a hospital setting:* • How many times in the past year did you see a diabetes nurse educator, dietitian or nutritionist for your diabetes *in the hospital?* Do not include doctors or other health professionals.
The degree of patient-satisfaction with diabetes education: • Self-rated participants' reports of useful information, motivation, and confidence to perform DSM behaviors.	*The same question repeated for outside a hospital setting:* • How useful was your diabetes education that you received *in the hospital*? o Very useful o Useful o Not that useful
Diabetes education frequency: • The number of sessions offered and how many were attended.	• How many times did you meet with the diabetes nurse educator, dietitian or nutritionist • On average, how long was each session?
Type of diabetes care: • Were individual or group instructions were provided?	• Did you see the diabetes nurse educator, dietitian, or nutritionist alone or with a group?
The degree of satisfaction with medical care for diabetes • Self-rated participants' reports of useful information, motivation and confidence to perform DSM behaviors.	• How satisfied were you with the quality of your medical care from doctors and other health professionals? (Do not include nutritionists, dietitians, or diabetes educators). o Very satisfied o Satisfied o Not that satisfied
The degree to which health beliefs and cultural competency influenced diabetes education and medical treatment.	• Questions that measure participants' health beliefs and attitudes toward their provider adapted from standardized questionnaires and pilot tested need to be added to subsequent NHANES. *Examples*: o Do you believe that exercise can control your diabetes? o Do you believe that if you eat the right foods you can control your diabetes?

Conclusions

With respect to conducting a study comparing races with data acquired from a national database, this study implied that there are several viable methods. One approach is to follow the suggested use of sample weights to approximate a representative sample of the nation for data that has a known population. This scheme can be augmented by comparison of the model fit with the corresponding analysis without sample. Another tactic considers the actual un-weighted sample as volunteers. The later approach may be suitable for data that has a limited basis of comparison, such as new questions or behavioral data which is difficult to extrapolate to a population representative of the nation by sample weight. The direct use of national survey data without sample weights may be suitable when the goal is to compare health behaviors across races who share a common bias (willingness to participate in a health survey) while controlling for demographics.

There were racial differences across reported areas of medical advice received, DSM health behaviors and outcomes. These results suggest that DSM may be explained by an ecological model for public health. That is, the ecological system: cultural influence as represented by race, medical advice and diabetes education were attributed toward influencing DSM behaviors. Moreover, interactions among the ecological system and health behavior were likely to be attributed to health beliefs, access to health care and/or patient- provider communication.

In particular, level of receiving diabetes education, an environmental factor, influenced the level of receiving medical advice by race. In an effort to eliminate health disparities, the majority of diabetes education programs may be located in minority neighborhoods. Differences in access to diabetes education may explain why BNH were twice as likely to report receiving diabetes education in the past two years when compared to WNH. The relationships among health beliefs, patient-provider communication, with respect to access to health care and diabetes education by ethnicity/race have not yet been determined.

Race/ethnicity interacted with medical advice in predicting several health outcomes. These findings suggest that patient-provider communication and health beliefs may be areas to target when designing interventions. In agreement with the American Diabetes Association's recommendation for diabetes education and the literature supporting positive diabetes outcomes as a result of diabetes education was the finding that diabetes self-management behaviors were associated with recent diabetes education (< 2 years), regardless of race. These findings suggest that standardized treatment plans for persons with diabetes which include ongoing diabetes education, be mandated by public policy.

It is recommended that future studies include in-depth, qualitative analyses, for each major ethnic/racial group with research questions directed at uncovering these relationships. This qualitative information should be used to design longitudinal studies with more specific measures of patient-provider communication and diabetes outcomes taking into account health beliefs and family social support.

Footnotes

[1]Information concerning the NHANES 2007-2008 paraphrased from

NHANES 2007–2008 Public Data General Release File Documentation. Retrieved January 24, 2010 from: http://www.cdc.gov/nchs/nhanes/nhanes2007-2008/generaldoc_e.htm. The website provides more detail on sampling techniques.

[2] Funding Source for the preliminary study: National Institutes of Health: NIH/NIDDK #1SC1DK083060-01 to Fatma G. Huffman, Ph.D

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APPENDICES

APPENDIX 1: NHANES QUESTIONS

Key questions from NHANES 2007-2008 used to construct variables for this study

Diabetes

The next questions are about specific medical conditions. {Other than during pregnancy, {have you/has SP}/{Have you/Has SP}} ever been told by a doctor or health professional that {you have/{he/she/SP} has} diabetes or sugar diabetes?

How old {was SP/were you} when a doctor or other health professional first told {you/him/her} that {you/he/she} had diabetes or sugar diabetes?

When was your diabetes diagnosed?

{Is SP/Are you} now taking insulin?

Medical Advice

To lower {your/his/her} risk for certain diseases, during the past 12 months {have you/has she} ever been told by a doctor or health professional to: reduce the amount of fat or calories in {your/his/her} diet?

To lower {your/his/her} risk for certain diseases, during the past 12 months {have you/has s/he} ever been told by a doctor or health professional to: increase {your/his/her} physical activity or exercise?

To lower {your/his/her} risk for certain diseases, during the past 12 months {have you/has s/he} ever been told by a doctor or health professional to: control {your/his/her} weight or lose weight?

What does {your/SP's} doctor or other health professional say {your/his/her} "A one C" level should be? (Pick the lowest level recommended by your health care professional.)

What does {your/SP's} doctor or other health professional say {your/his/her} LDL cholesterol should be?

What does {your/SP's} doctor or other health professional say {your/his/her} blood pressure should be?

Diabetes Education

When was the last time {you/SP} saw a diabetes nurse educator or dietitian or nutritionist for {your/his/her} diabetes? Do not include doctors or other health professionals.

Health Behavior

To lower {your/his/her} risk for certain diseases, {are you/is she/he} now doing any of the following: reducing the amount of fat or calories in {your/his/her} diet?

To lower {your/his/her} risk for certain diseases, {are you/is s/he} now doing any of the following: increasing {your/his/her} physical activity or exercise?

To lower {your/his/her} risk for certain diseases, {are you/is s/he} now doing any of the following: controlling {your/his/her} weight or losing weight?

How often {do you check your/does SP check his/her} blood for glucose or sugar? Include times when checked by a family member or friend, but do not include times when checked by a doctor or other health professional.

How often {do you check your feet/does SP check (his/her) feet} for sores or irritations? Include times when checked by a family member or friend, but do not include times when checked by a doctor or other health professional.

How often {do you check your feet/does SP check (his/her) feet} for sores or irritations? Include times when checked by a family member or friend, but do not include times when checked by a doctor or other health professional.

APPENDIX 2: PRELIMINARY STUDY

(*Preliminary*)**Title** Family social support and diabetes self-management in a tri-ethnic population with type 2 diabetes

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(Preliminary) **Abstract**

(Preliminary Abstract) ***Purpose***

This cross-sectional study aimed to investigate the following associations: ethnicity; family social support; health beliefs and behaviors regarding diabetes self-management; and glycemic control for minorities with a high prevalence of type 2 diabetes and diabetes-related complications.

(Preliminary Abstract) ***Methods***

The participants were recruited by community outreach methods including letters to community leaders, flyers and announcements in places of congregation. The subjects included 174 Cuban-, 121 Haitian- and 110 African-Americans with self-reported diagnosis of type 2 diabetes and whose laboratory results confirmed their diagnosis. Measures encompassed demographics; family social support; diabetes self management; and biometrics including glycated hemoglobin A1C.

(Preliminary Abstract) ***Results***

The results indicated that gender, ethnicity and family social support were associated with diabetes self management beliefs and behaviors. African-American with higher levels of family social support scored higher in diabetes self management practices. Level of family social support was highest in Haitian- as compared to African-Americans; yet Haitian Americans had the highest glycated hemoglobin levels indicating poor glycemic control.

(Preliminary Abstract) ***Conclusions***

The findings suggest family social support together with their ethnicity influences health beliefs and practices. These results imply that goals for treatment should be a collaborative effort of the patient with the health care provider. Discussion of family

social support is vital in determining the degree to which family members are to be included in medical treatment plans.

(Preliminary) **Introduction**

Diabetes leads to complications such as heart disease and stroke, high blood pressure, blindness, kidney disease and nervous system disease; moreover, the risk of death for persons with diabetes is twice that of persons without diabetes (CDC, 2008a). Type 2 diabetes, the most common form (90-95% of all cases) has increased among the general population, (NIDDK, 2008) and disproportionately among minorities (particularly Blacks, Hispanics and Asians) (Narayan et al, 2003; CDC, 2008b). The projected percent of individuals with diabetes from 2005 to 2050 was reported to be 174% for men and 220% for women with a disproportionate number of minorities having the fastest growth: 481% among Hispanics, 208% among Blacks and 113% among Whites (Narayan et al, 2006). Diabetes-related complications can be minimized and prevented by glycemic control which depends on proper diabetes care.

(Preliminary) ***Diabetes care management***

Diabetes care requires medical management in the context of the individual's health belief system. It is essential for persons with diabetes to acquire and practice adequate diabetes self-management skills in order to reduce the risk factors that lead to morbidity and mortality associated with diabetes-related complications. It has been well-established that ongoing diabetes self management education (DSME) that teaches problem solving skills and coping mechanisms in accordance with National Standards for DSME, DSM has been beneficial in helping patients achieve optimal metabolic control, prevent and manage diabetes-related complications and maximize their quality of life

(ADA, 2010). Diabetes self management (DSM) includes achieving adequate glycemic and blood lipid and pressure control as well as weight management (ADA, 2010; Stolar et al, 2008). Successful DSM requires medical personnel to instruct persons with type 2 diabetes so they are able to achieve proper eye and foot care, schedule and follow meal plans, monitor their hemoglobin A1C (A1C) and overcome barriers preventing adequate physical exercise (ADA, 2010).

(Preliminary) ***The role of family support in diabetes care and DSM***

Family social support is another area that has been associated with DSM. Several studies of social support on chronic disease have found social support vital to self management (Albright, Parchman & Burge, 2001; Bai, Chiou & Chang, 2009, Ciechanowski et al, 2010; Gallant, 2003). Diabetes self-management is a complex social phenomenon (Anderson et al, 2008) and type 2 diabetes is a multifaceted disease (Tucker et al, 2000). Understanding the role social support plays with self-care behavior is vital in the development of medical standards of care practices. There are several facets of social support: social network, enacted support and perceived support as well as different functional aspects (Hanna, 2006). Social network, an objective measure of the number of relationships, does not take into account the quality or the relationships (Hanna, 2006). Enacted support, behaviors performed by others, may not be perceived as beneficial to the individual; on the other hand, perceived support, the receivers' perceptions of support has been viewed as a valid indicator of beneficial, supportive behavior (Hanna, 2006). Functional definitions of social support may be classified as emotional, informational or tangible (Hanna, 2006). Despite advances in theory concerning social support and self-care, many patient treatment plans do not routinely involve the family and other support networks.

(Preliminary) ***Health beliefs, cultural background and DSM***

Another aspect of DSM is health beliefs. Health beliefs may either augment or interfere with the behavioral changes required for successful diabetes care. Even when access to medical care is not a factor, there are significant differences in use of preventive services and DSM behaviors by ethnicity (Oster et al, 2006). As such, quality medical care for persons with type 2 diabetes includes diabetes self management education (DSME) that addresses health beliefs.

Health beliefs that contribute to noncompliance may differ by culture. For example, Haitian-Americans' high rate of noncompliance has been attributed, in part, to their health beliefs (Kemp, 2006). Haitian-American beliefs about health and illness may be influenced by life in Haiti where limited access to health care and poor health conditions influenced a reliance on folk and/or spiritual explanations and treatments for illness (Kempt, 2006). Yet, Haitians have a strong set of protective factors that are conducive to health educational programs including a strong work ethic; entrepreneurial spirit, extended family support system and increasing neighborhood-based social services (Metellus et al, 2004).

On the other hand, Cubans who have illnesses would rather rely on the physician to direct their care than to learn and practice self-care skills (Kemp, 2006). Cubans' weight management and dietary compliance may be in direct contradiction with their health beliefs. Many Cubans believe that obesity is indicative of good health and leanness is indicative of poor health (Kemp, 2006; Varela, 2005). Not only does their traditional diet (fried foods, beans, sweets) contribute to obesity, but the affordability of meat, sweets and fast food in this country further promotes obesity and other health-related diseases such as diabetes and hypertension (Kemp, 2006).

Findings of health beliefs and compliance with African -Americans suggest multiple influences, including religion, spirituality and folklore. African-Americans were found to be more than twice as likely to use home-remedies as Whites (Brown and Segal, 1996). In a qualitative study, focus groups of African-Americans believed hypertension was treatable with vitamins, garlic and herbs (Wilson, 2002). Spirituality was reported as an influence of hypertension management in African-Americans (Lewis and Ogedegbe, 2008). Hypertensive control and health beliefs have been widely studied in African-Americans. Several studies concur that factors beyond knowledge and access to medical care such as noncompliance and lay beliefs inconsistent with medical practice are responsible for inadequate hypertensive control among this population (Middleton, 2009). Health beliefs, compliance and guidelines for spiritual assessment addressed by *The National Medical Association* and the *Joint Commission on Accreditation of Healthcare Organizations* are of particular importance for African-American patients (Levin, Chatters & Taylor, 2005). Nwasuruba et al (2007) found significant differences among Blacks, Hispanics and White non-Hispanics in DSM behaviors, based on data from the 2003 Behavioral Risk Factor Surveillance survey (BRFSS); however, they did not take into account different origins of persons classified as “Black” or “Hispanic”. Moreover, there are no reported findings of the relationships among health behavior, DSM and glycemic control with respect to ethnicity.

(Preliminary) **(P) Research objectives**

The purpose of this study was to assess the relationships among family social support (FSS), health beliefs, DSM, and glycemic control patterns among Cuban, African and Haitian Americans with type 2 diabetes. The conceptual framework employed to organize the variables was adapted from Fischer and colleague's (2005) ecological approach to disease self-management. Applying the model to this study, the individual's behavior is influenced by their microsystem (family and friends) as well as from their cultural background. The hypothesis of this study was that reported, received family (or friend) social support (FSS) will be associated with adequate DSM behaviors and glycemic control and that ethnicity may moderate the relationships. The hypothetical model is represented by ***Preliminary*** **-Figure 1a.**

(Preliminary) **Methods**

(Preliminary) ***Setting, design and target population***

Data were part of a cross-sectional study to generate hypotheses for a tri-ethnic population in South Florida communities (of the United States) with and without Type 2 diabetes: Cuban (CA), African (AA) and Haitian (AA) Americans. This research included only those participants with type 2 diabetes for whom all variables were available and for the purpose of assessing the interrelationship among FSS, health beliefs, DSM and ethnicity. All aspects of the study were approved by the Florida International University Institutional Review Board.

Respondents were recruited by the following methods: (a) purchased mailing comprised of postal zip code and attained from multiple-databases (KnowledgeBase Marketing, Inc.: Richardson, TX); (b) letters of invitation outlining the study distributed to diabetes educators, university faculty and health professionals in Miami-Dade and Broward counties; and (c) advertisement in community newspapers, shops and radio broadcasts. All participants were eligible respondents who understood, agreed and signed a FIU's IRB's informed consent form. Eligibility was based on interviewers' screening of age ($\geq$ 35 years), self-reported ethnicity and diabetes status. Inquiry of ethnicity included questions of cultural identification and place of birth. Diabetes status was determined by reported year of diagnosis and then confirmed by laboratory report. The participants included 174 Cuban-, 121 Haitian- and 110 African-Americans.

(Preliminary) ***Data collection Procedures***

The protocol was explained in the participants' choice of language (English, Creole, or Spanish) and the IRB approved, informed consent was signed by each participant. Appointments were made for groups of participant bi-weekly until a quota, based on a pre-determined sample size, was reached and all data were collected. The demographics were collected in group settings by trained interviewers. Biometric measures were performed by trained personnel in the corresponding author's laboratory at FIU. Venous blood was collected from each subject after an overnight fast (at least 8 hours) by a certified phlebotomist in the principal investigator's lab using standard laboratory techniques. The analysis was performed by LabCorp®.

(Preliminary) ***Measures***

A composite family social support scale (FSS) was constructed from combining items from the Michigan Diabetes Research and Training Center (MDRTC) questionnaire items for family social support received. Variables chosen were Likert scale questions that measured the reported level of personal, tangible and emotional support received from either family or friends. A higher score reflected greater support. Three items: *My family or friends (a) feel uncomfortable about me because of my diabetes; (b) discourage or upset me about my diabetes; and, (c) nag me about diabetes* were reverse coded to measure greater support. Reliability measured for the 12 items yielded a Crombach's alpha of .815.

The questionnaire for DSM was validated in our laboratory for a Cuban American population and adapted from the MDRTC questionnaire. A composite score for DSM was constructed from the Likert sub-scale variables. Variables where higher scores indicated clinically appropriate DSM were added directly to the composite score. Exercise barriers were reverse-coded so that *rarely having trouble getting exercise responses* reflected a higher DSM. The following subscales were combined to form the DSM composite score: (a) DSM care adherence (I keep my blood sugar in good control; I keep my glycated hemoglobin (A1C) in good control; I keep my weight under control; I do the things I need to do for my diabetes (diet, medicine, exercise, etc.); (b) dietary patterns (following a meal plan; scheduling meals and snacks; weighing or measuring food; meal planning (by you or the person who cooks) such as exchange list or food groups); (c) exercise barrier scale: *How often do you have trouble getting enough exercise because: it takes too much effort?; you don't believe it is useful?, you don't like to do it?, you have a health problem?;it makes diabetes more difficult to control?; and,* (d) health beliefs: *Taking the best possible care of diabetes will delay or prevent: 1.eye problems; 2. kidney problems; 3. foot problems; 4. hardening of the arteries; 5. heart disease*. The DSM composite scale followed a normal distribution. Reliability was measured for the sub-scales using Crombach's alpha (Table 1). By subtracting the health belief sub-scale from the DSM composite score, two scales were formed: DSM behavior (DSMB) and DSM health beliefs (HB). The composite DSM score was made into a binary variable: adequate/inadequate DSM based on quartiles. A score in the 75th percentile or higher was considered adequate and lower values were classified as inadequate DSM. The FSS composite scale was converted to deciles for graphing purposes.

Glycemic control was measured by two outcome variables: glycated hemoglobin (A1C) and fasting plasma glucose (FPG). Both were natural log transformed to achieve linearity. Glycemic control, measured by either A1C or FPG, was used as the clinical indicator of adequate DSM. Monitoring A1C is a critical skill of DSM for persons with type 2 diabetes as well as a sensitive indicator since an increase of 1% in A1C is associated with an 18% increased risk for stroke and other cardiovascular diseases (ADA, 2010; Selvin et al, 2004).

(Preliminary) ***Data analysis***

Exploratory analyses including Q-Q plots were performed to assess linearity of variables. When needed, transformations were applied to achieve normality. Descriptive statistics were performed using means and standard deviations for continuous variables and percentages (and χ^2 if applicable) for categorical variables to determine participants' characteristics.

A linear regression was conducted for the combined sample to determine the degree of FSS that explained DSM. Analysis of variance (ANOVA) for the three ethnic groups: CA. HA, AA was conducted and post hoc analysis was performed for multiple comparisons.

A logistic regression analysis was conducted in order to determine the probability of adequate DSM (>75th percentile) as an interaction of ethnicity and DSM with FSS. The predicted probabilities (adequate DSM) were saved and run as a dependent variable with ethnicity, deciles of FSS and the interaction term (ethnicity*deciles of FSS) applying the general linear model. A graph was generated from this model for each ethnicity (CA, HA and AA).

A full model multiple logistic regression analysis of all possible social and clinical variables was performed and variables with partial *p*-values of < 0.2 were chosen for a forward conditional logistic regression model. Two models were conducted with interactive terms to determine the most parsimonious model that explained DSM binary outcomes (level of glycemic control and DSM). Ordinal logistic regression models were conducted with predictors such as race/ethnicity, DSM score and covariates on health belief Likert-scale outcomes. Differences in ethnicities necessitated mulitnominal logistic regression models comparing ethnic groups for individual DSM and FSS components. A test for the combination of mediation and moderation was preformed. Hierarchical regression was conducted to determine interactions of ethnicity, gender and FSS regressed on DSM and A1C. All statistical analyses were computed with IBM SPSS® version 18.0. At the 95% confidence interval, two-tailed *p*-values ($p<.05$) were considered significant.

(Preliminary) **Results**

The participants' characteristics are compared by ethnicity in ***Preliminary*-Table 2.** There were significant differences in age, years in the United States, marital status, tobacco use and education level among ethnicities. There was a higher percent of unreported income levels for HA and AA than for CA; therefore the reported income may not accurately reflect the mean income by ethnicity. It is worthy to mention that there were no significant differences in self-reported health among ethnicities.

The best model of multiple linear regression factors for the combined sample predicting DSM explained 16.3% (adj. R^2) and included FSS (ß = 0.212), no tobacco use (ß = 0.152), reporting high level of health (ß = 0.249) and receiving diabetes education (ß = 0.130) [F (4, 386)= 20.3, p < 0.001]. Family social support explained 5.8% (adj R^2) of DSM for the combined sample [F (1, 395) = 25.5, beta = 0.246, p < 0. 001] by linear regression analysis. An analysis of variance (ANOVA) revealed differences between ethnic groups for DSM [F (2, 402) = 14.7, p < 0.001] and FSS [F (1, 411) = 3.47, p =0.032]. Post Hoc comparison of mean for FSS and DSM by a one-way ANOVA confirmed significant differences between CA and HA and AA and HA but not between CA and AA. A similar analysis was performed with FPG, A1C and FSS. The results for both analyzes are summarized in Table 3.

We considered the possibility of ethnicity, gender and FSS in a combined framework of either mediated moderation or moderated mediation for DSM. Three criteria needed to be met for ethnicity to be classified as a mediator of family social support in the prediction of DSM: (a) FSS was related to DSM; (b) ethnicity was related to DSM; and (c) the relationship for FSS predicting DSM was significantly reduced when controlling for ethnicity (Barron and Kenny, 1986). Steps (a) and (b) were confirmed by the general linear model; however, mediation failed at step (c) since the relationship was strengthened rather than weakened. In a similar manner, we tested FSS and ethnicity as mediators of DSM predicting A1C and no mediation was found.

Family social support received (FSS) was associated with level of DSM and glycemic control and moderated by ethnicity. ***Preliminary* -Figure 2** depicted FSS scores in deciles increased means for CA and AA but not for AA as the predicted probability of adequate DSM ($\geq 75^{th}$ percentile of the composite DSM score) by estimated marginal. Ethnicity was a modifier of FSS predicting adequate DSM. Mean FSS received by HA (42.5 ± 9.2) was lower than for CA (45.3 ± 8.2) and AA (43.9 ± 9.4); yet the probability of adequate DSM was higher at all levels of FSS for HA than either CA or AA. The marginal means for high A1C levels (> 7.5 %) and deciles of FSS were portrayed in ***Preliminary*-Figure 3**. Although there are significant differences in means across groups ($p < 0.001$), the degree of change (slope) of level of A1C > 7.5 with increasing FSS was most pronounced for AA. Glycemic control improved the most for AA with increased FSS. The results of a hierarchical regression included a tertiary interaction of FSS by ethnicity by gender acting on the outcome variable, DSS (***Preliminary*-Table 4**).

Enablers and barriers of FSS were examined with multinominal regression models. There were differences in direction and magnitude of FSS components among ethnicities. The reduced model, without level of glycemic control, was the best. That is, there was no improvement by controlling for adequacy of percent A1C. Several significant relationships concerning the type of FSS emerged as indicated by the parameter estimates of beta (B), odds ratio (OR) and corresponding p-values. African-Americans were inclined to report their family or friends accepts them and their diabetes as compared to CA ($B = 0.422$, $p = 0.025$) and HA ($B = 0.435$, $p = 0.034$). Haitian Americans were more likely to report their family or friends feels uncomfortable about them and their diabetes as compared to AA (OR = 1.28 (1.03-1.58), $B = 0.244$, $p = .027$) and CA (OR = 1.39

(1.13-1.72), *B* = 0.332, *p* = 0.002). On the other hand, both CA (OR = 2.23 (1.68-2.96), B = 0.803, *p* <0 .001) and AA (OR = 1.92 (1.43-2.57), *B* = 0.650, *p* < 0.001) were more likely to report their family or friends nag them about diabetes than HA. Gender was confirmed as a modifier of ethnicity predicting received family social support by an ANOVA stratified by gender and post Hoc analysis. Cuban American males reported higher mean FSS than HA [mean difference = 4.46 (0.38 - 8.5), *p* = 0 .028]; whereas, the relationship was not significant for AA males or females (regardless of ethnicity).

To examine the relationship between items of health beliefs (HB) and diabetes self management behavior (DSMB) a GLM was conducted with DSMB as the dependent variable analyzing the HB scale and ethnicity as independent covariates. Ethnicity was a significant predictor of DSMB (F (2, 402) = 17.1, p < 0.001) controlling for health beliefs. A second GLM was performed with ethnicity as a fixed factor, health beliefs as covariates and ethnicity interactions with each health belief. The results indicated that ethnicity was no longer significant; nor were the HB interactions. Hence, ethnicity was suspected to be a modifier of HB in predicting DSMB. Nominal regression of each health belief as independent variables for ethnicity was performed to determine the direction and magnitude of the health belief (χ^2 (10) = 21.5, p = 0. 018). Haitian Americans were more likely to report believing that *taking care of my diabetes will prevent or delay eye problems* than AA (OR =1.94 (1.02-3.68); *B* = 0.660, *p* = 0. 044) and CA (2.09 (1.19-3.69), *B* =0.738, *p* = 0.011). African-Americans were more likely to report believing that *taking care of my diabetes will delay or prevent foot problems* than CA (OR=1.95 (1.01-3.75), *B* = 0.668, *p* = 0.045).

(Preliminary) **Discussion**

This study aimed to investigate the role of perceived family social support in diabetes-related health beliefs and behaviors among three ethnicities in the context of Fischer and colleagues (2005) ecological theory. There were several notable differences in FSS patterns and glycemic control among the three ethnicities, which supports our hypothetical model. The original hypothesis was that FSS would moderate the association of ethnicity as a predictor of DSM. The results indicated a tertiary moderation: gender by ethnicity by FSS for the dependent variable, DSM**.**

Numerous studies have reported associations of positive social support with adherence to DSM and glycemic control. We found as FSS increased, only CA and HA were associated with a higher probability of having adequate DSM ($\geq 75^{th}$ percentile of composite DSM score). Yet AA had the only positive association of FSS and glycemic control. That is, as family support level increased, the probability of having high A1C (>7.5) decreased for AA; while, for CA and AA the relationship was insignificant (***Preliminary*- Figure 3)**. Conversely, Haitian Americans reported receiving a higher level of FSS, on average, than AA or CA, yet glycemic control did not correspond to FSS for HA. Our hypothetical model (Figure 1a) was supported by the results of this study; however, based on our findings, gender should be depicted as part of the tertiary interaction (FSS by ethnicity by gender) and is presented in the revised model *(***Preliminary*- Figure 1b**).

In this study, gender modified ethnicity in predicting FSS. The finding of gender as an intervening factor in FSS and DSM was in accordance with conclusions drawn from systematic review of six prospective intervention trials of social support and DSM (van

Dam et al, 2005). Gender differences were found in DSM by Lin, et al (2004) and Bai, Chiou and Chang (2009) with Asian populations and by Albright, Parchman & Burge (2001) for diet and exercise DSM components with predominately Mexican-American adults. Misraa and Lagerb (2009) reported that significant ethnic and gender differences in DSM behavior and social support; while, glycemic control varied by ethnicity, but not gender. On the other hand, Toljamo and Hentinen (2001) suggested gender was not associated with diabetes care with a Finnish adult population.

Gender did not modify the relationship between ethnicity and DSM predicting A1C as demonstrated by a stratified post hoc analysis. Gender was not a significant predictor of A1C levels for the combined sample. Our results were supported by Misraa and Lagerb (2009) who found differences with DSM but not for A1C levels for multiethnic adults (34% Hispanics, African-Americans, Asian Indians and White, non-Hispanics) with type 2 diabetes.

Age was a significant predictor of A1C, but not for DSM. A number of studies suggest that within an ethnicity, age and gender may interact with health beliefs and compliance (Misraa and Lagerb, 2009; Courtenay, McCreary & Merighi, 2002; Li, Wallhagen & Froelicher, 2008; Palmer and Rogers, 1997). Social problem solving and multiple social support factors may be confounders of health beliefs and DSM (Glasgow et al, 2007; Hill-Briggs et al, 2007; Thomas et al, 2010).

The present study had several limitations. First, as a cross-sectional design, our study could not assess cause and effect between variables since they were measured at the same time. Second, due to limited geographic sampling (Miami-Dade and Broward Counties, Florida) our study may not be representative of all Cuban, African and Haitian

Americans. Third, although subjects were recruited from multiple-sources of Cubans, African and Haitian Americans residing in Miami-Dade and Broward counties, there is a potential sample bias of those who chose and were eligible to participate. Therefore, the triethnic samples may not represent the target populations. Our study was limited to FSS and did not measure social support obtained through access to healthcare practitioners, patient support groups and worksite programs. Despite these limitations, the present findings add to the literature by demonstrating patterns of perceived FSS and diabetes care among three ethnicities. An ecological theoretical framework was supported by these findings since DSM practices and beliefs were associated with by modifiable environmental influences such as FSS and non-modifiable influences such as ethnicity and gender.

(Preliminary) **Conclusions**

We found a significant association for African-Americans with FSS scores and DSM skills. These patterns were not indicated in CA and HA participants. Even though HA had overall higher FSS than AA and CA; their A1C levels were higher than AA and CA. HA were more likely to report that their family felt uncomfortable about them because of their diabetes than CA or AA. Diabetes self-management differed by gender –race interactions. These results suggest that health beliefs and FSS affect health and differ by ethnicity.

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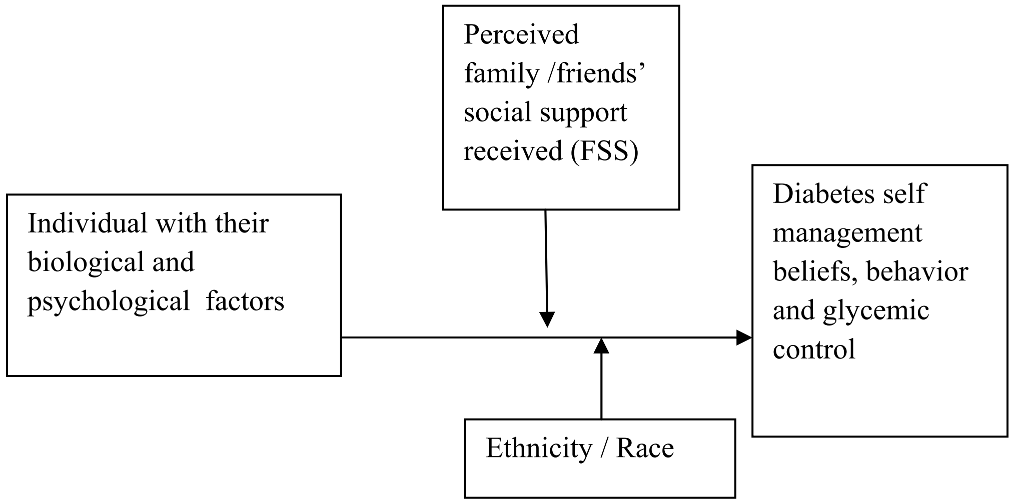
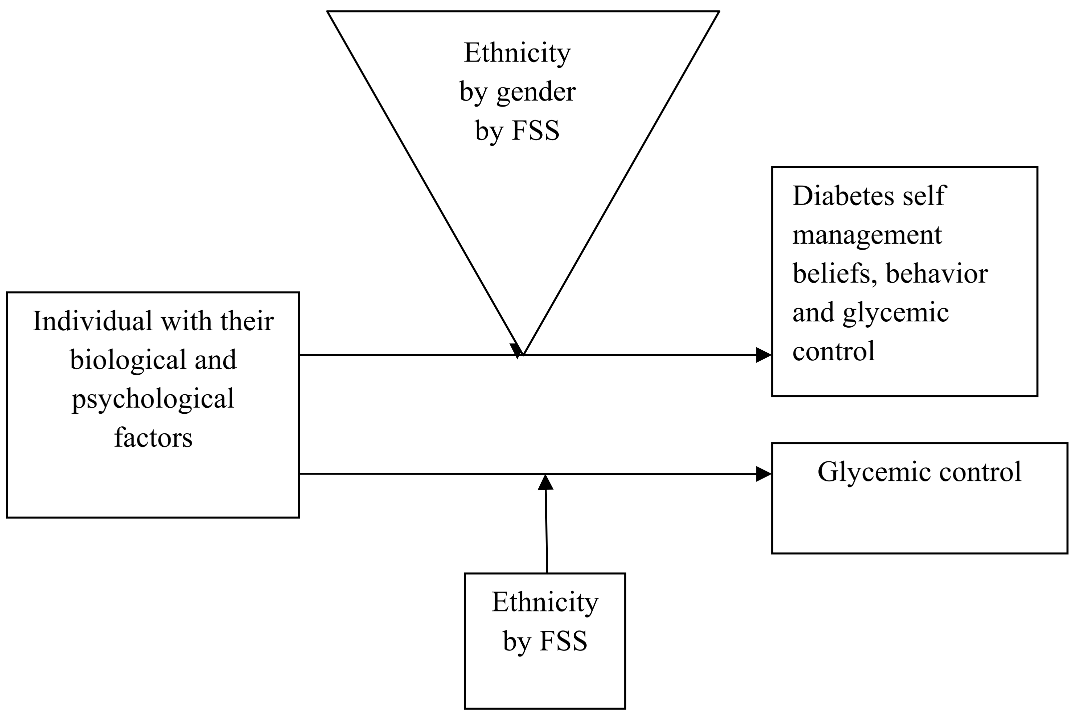
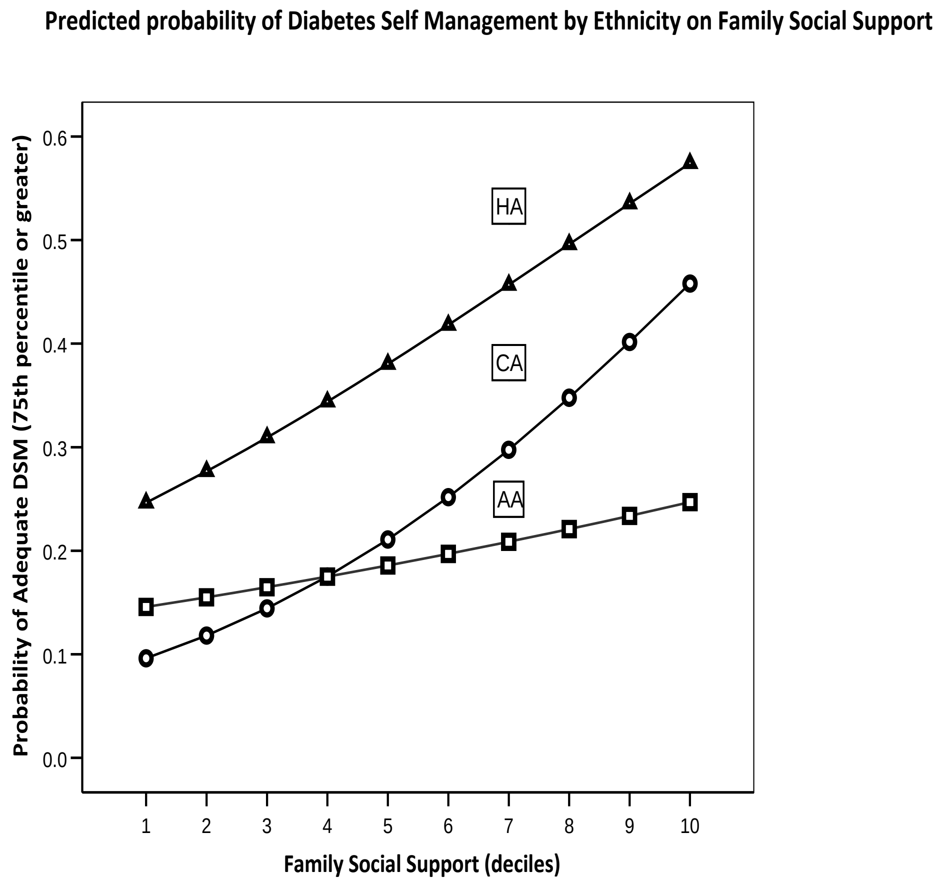
Preliminary- **Figure 1.a**. Conceptual relationships among the individual, ethnicity/race, social support and diabetes management



Preliminary- **Figure 1.b**. Revised conceptual model based on the analyses

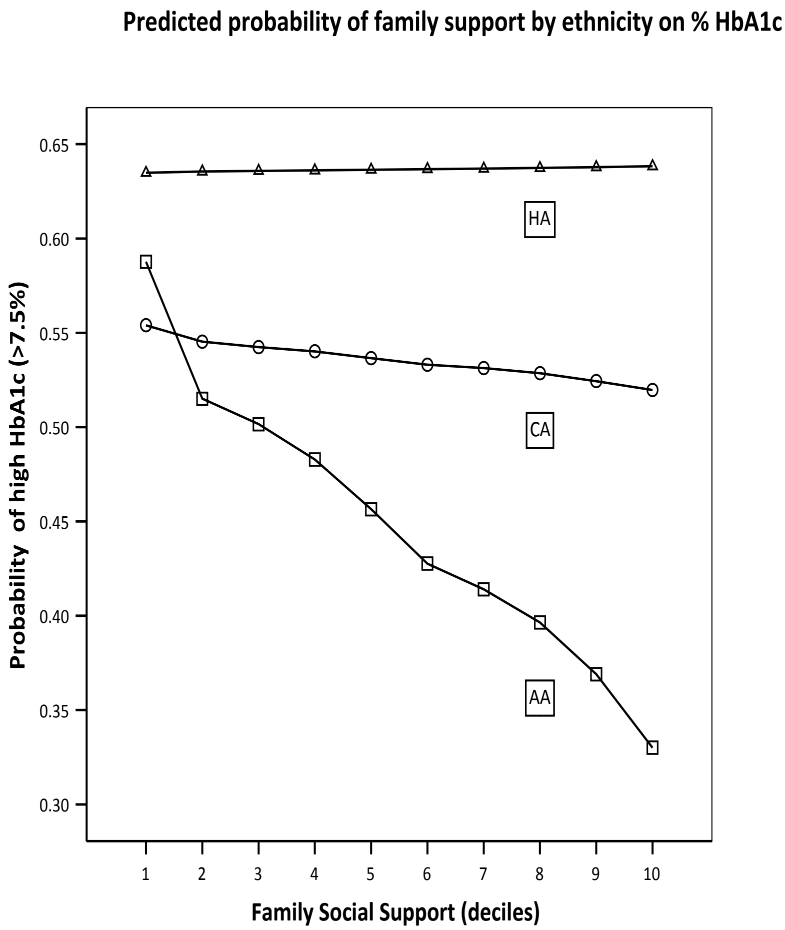


***Preliminary*- Figure 2.** Family support scores in deciles as a function of diabetes self management and ethnicity



Key: HA = Haitian American; CA = Cuban American; AA= African-American

***Preliminary* -Figure 3.** Family support scores in deciles as a function of inadequate A1C and ethnicity



Key: HA = Haitian American; CA = Cuban American; AA= African-American

***Preliminary*-Table 1.** Reliability of the DSM Composite Scale

Sub-Scale	**Number of Items**	**Crombach's alpha**
DSM Care adherence	4	0.813
DSM Dietary patterns	4	0.800
Exercise for DSM	4	0.685
DSM health beliefs	5	0.854

Abbreviation: DSM =diabetes self-management.

***Preliminary* -Table 2.** Participants' characteristics[a]
N = 405 (CA=174, HA=121; AA=110)

Variable	**Ethnicity**	**Mean**	***p* value**
Age	CA	65 ± 12.0	
	HA	58.4 ± 9.9	
	AA	54.1 ± 10.4	
		F (2, 404) = 35.0	<0.001
Gender		**N(%)**	
Male	CA	66 (38)	
Female		108 (62)	
Male	HA	51 (42)	
Female		70 (58)	
Male	AA	47 (43)	
Female		63 (57)	
Currently married	CA	75 (43.1)	
	HA	76 (62.8)	
	AA	28 (25.4)	
		χ^2(2, 405) =19.2	<0.001
No health insurance in past 12 months	CA	26 (14.9)	
	HA	56 (46.3)	
	AA	22 (20.0)	
		χ^2 (2, 405)=39.3	<0.001
		Mean Rank	
Years in USA[b] (categorical)	CA	199	
	HA	166	
	AA	249	
		χ^2 (2, 405) = 54.0	<0.001

Variable	Ethnicity	Mean	*p* value
Income [c]	CA	(n=159)172	
level	HA	(n=89)158	
	AA	(n=89)174	
Education	CA	195	
level	HA	171	
	AA	251	
		χ^2 (2, 405) = 30.2	<0.001
Tobacco use (yes)	CA	26 (14.9)	
	HA	7 (5.8)	
	AA	39 (35.4)	
		χ^2(2, 405) = 36.4	<0.001
Self-reported	CA	209	
Health	HA	210	
	AA	185	
		χ^2 (2, 405) = 4 .16	0.125

Abbreviations: CA = Cuban American; HA = Haitian American; AA = African-American
[a]Analysis of Variance (ANOVA) was performed for continuous variable and reported as mean ± SD. Chi-square was the test statistic for categorical data. Kruskal-Wallis Test was conducted for ranking ordinal variables and was reported as rank means. Nominal variables were reported as N (%).[b]Categorical groups, k=6. [c]Categorical groups, k =11.

***Preliminary* -Table 3.** Post hoc analyses family social support received, DSM composite scale, and glycemic control* across ethnicities

Dependent Variable	Ethnicity (N)	Mean ± SD	Mean Difference	*p value*
FSS	CA (174)	45.3 ± 8.1	CA-HA	
			2.78	0.024
	HA (121)	42.5 ± 9.2	HA-AA	
			-.796	0.913
	AA (110)	43.3 ± 11.2	CA-AA	
			1.98	0.293
	Between Groups F (2, 402)=3.47, P =.032			
DSM	CA (160)	59.2 ± 9.8	CA-HA	
			-5.63	<0.001
	HA (121)	64.8 ± 8.5	HA-AA	
			5.17	<0.001
	AA (110)	59.6 ± 9.1	CA-AA	
			-.458	0.971
	Between Groups F (2, 388) = 14.7, p < 0.001			

Dependent Variable	Ethnicity (N)	Mean ± *SD*	Mean Difference	*p value*
Ln_A1C	CA (170)	2.01 ± .19	CA-HA -.086	0.014
	HA (120)	2.09 ± .28	HA-AA .083	0.050
	AA (108)	2.03 ± .24	CA-AA -.0028	0.999

Between Groups F (2, 395) = 5.40, p =0.005

Percent A1C Medium Values	
CA(170)	7.30
HA(120)	7.70
AA(108)	6.95

Abbreviations: FSS= Family/friends social support received; DSM = diabetes self management; CA = Cuban Americans; HA = Haitian Americans; AA = African-Americans; Ln_A1C = hemoglobin A1C (glycated hemoglobin) transformed as the natural logarithm.
* glycemic control reported for A1C; relationship with fasted plasma glucose (FPG) was not significant (data not shown).

***Preliminary* -Table 4.** Hierarchical General Linear Model Regression of Diabetes Self Management

Independent Variables	Model 1 F (4, 386)		Model 2 F (9, 381)		Model 3 F (11, 379)	
	F	*p*	*F*	*p*	*F*	*p*
Ethnicity	18.8	<0.001	2.84	0.061	2.78	0.063
FSS	30.5	<0.001	30.6	<0.001	31.6	<0.001
Gender	0.97	0.755	0.55	0.460	0.16	0.690
Ethnicity*FSS			0.79	0.453	0.67	0.513
Ethnicity*Gender			0.30	0.744	3.39	0.035
Gender*FSS					0.22	0.638
Ethnicity*Gender*FSS					3.13	0.045
Model	15.6	<0.001	7.21	<0.001	6.54	<0.001
R^2 (adj.)	0.130			0.125		0.135

Abbreviations: FSS = Family/friends social support received; ethnicity: Cuban, African and Haitian Americans
Note: Simple contrast between CA and HA was significant: 13.2 (2.1, 24.2); p=.020. Quadratic contrast among ethnicities: -8.97(-1.4, -16.5), p = 0.020.

APPENDIX 3: COPYRIGHT PERMISSION

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Chapter I Review of Literature; Conceptual Framework

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PEER-REVIEWED PUBLISHED ABSTRACTS AND POSTER PRESENTATIONS

Vaccaro, J. A., & Huffman, F. G. (2011). The relationship of obesity, diabetes status and ethnicity with high sensitivity C-reactive protein. FASEB *Journal ,* 25 (in press).

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MANUSCRIPTS UNDER REVIEW

Vaccaro, J. A., Gundupalli, D. G., Zarini G. G., & Huffman, F. G. Diabetes self-management, family social support, and glycemic control in tri-ethnic population with type 2 diabetes.

Huffman, F. G., & Vaccaro, J. A. Perceived stress, self-rated health and family social-support of Haitian- and African-Americans with type 2 diabetes.

Huffman, F. G., Nusrath, N., & Vaccaro, J. A. Arterial pulse pressure and carbohydrate intake in Cuban Americans with type 2 diabetes.