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Illness-Related Diabetes Social Support and Glycemic Control Among Middle Aged and Older Adults

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ILLNESS-RELATED DIABETES SOCIAL SUPPORT AND GLYCEMIC CONTROL AMONG MIDDLE AGED AND OLDER ADULTS

by

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DEDICATION

I dedicate this thesis to my mother, Cecilia Mondesir. Your support, encouragement and sacrifices have made it possible for me to be successful.

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ABSTRACT

Objective

The objective of this study is to investigate the association between illness-related diabetes social support (IRDSS) and glycemic control (GC) among a racially diverse sample of middle aged and older adults. In gender-stratified models we examine whether the relationship between IRDSS and GC is modified by race/ethnicity. Additionally, we explore the association between eight individual types of IRDSS and GC.

Methods

We used the Health and Retirement Study (HRS) 2002 and the 2003 Diabetes Survey. The final analytic sample consisted of 914 study respondents. Gender-stratified multivariable logistic regression models were used to calculate odd ratios (ORs) and 95% confidence intervals (CIs) for the association between IRDSS and GC, test an interaction between race/ethnicity and IRDSS, and investigate the association between individual IRDSS variables and GC. Final models were adjusted for socio-demographic characteristics, lifestyle factors and clinical characteristics.

Results

79.5% and 76.7% of males and females respectively are classified as having adequate glycemic control. Among females, there was a significant association

between IRDSS and GC (OR: 2.39; 95% CI: 1.44, 4.00), but no significant association was observed among males. There was a significant interaction between race/ethnicity and IRDSS (p-value < 0.10). Among Hispanic females, there was a higher odds (OR: 5.75; 95% CI: 1.01, 32.63) of adequate glycemic control in those who had high levels of IRDSS. The strongest association was found between high levels of emotional oriented social support and GC among females (OR=2.05; 95% CI: 1.18, 3.54).

Conclusion

Our findings suggest that the relationship between IRDSS and GC varied by gender, where we only observed an association among females. Although we found a significant interaction between Hispanic race/ethnicity and IRDSS among females, our results should be interpreted with caution due to small sample sizes for the groups. We found that type of social support for self-care activities may play a role in achieving GC, where emotional support was most important. Further studies should aim at identifying factors which may determine gender differences in the association between IRDSS and GC. Race/ethnicity as an effect modifier of this association also needs further exploration in studies with larger sample sizes.

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LIST OF ABBREVIATIONS

BRFSS.....Behavioral Risk Factor Surveillance System

CDC.....Centers for Disease Control and Prevention

CI ..... Confidence Interval

HbA1c.....Glycosylated hemoglobin A1c

HRS ..... Health and Retirement Study

HS.....High School

IRDSS..... Illness-related diabetes social support

GC .....Glycemic Control

NHANES..... National Health and Nutrition Examination Survey

OR ..... Odds Ratio

SAS..... Statistical Analysis Software

SD..... Standard Deviation

Y .....Years

CHAPTER 1

INTRODUCTION

Diabetes is a highly prevalent chronic disease and it has been estimated that 25.8 million (8.3%) of the American population has diabetes (1). This resulted in estimated direct and indirect diabetes health care costs of $174 billion in 2007 (1-3). The prevalence of diabetes has increased from 2000 to 2010 particularly among middle-aged and older adults: from 8.6% to 12.3% in those aged 45- to 64; 15.4 % to 20.7% in those aged 65 to 74; and 13.0% to 20.1% in those aged 75 and over (4). Uncontrolled diabetes results in poorer health status, increased morbidity, disability, and mortality (5-9). Adequate diabetes management which entails performing diabetes related self-care activities such as following meal plans, taking medication, taking care of their feet, getting enough physical activity, testing blood glucose and going to the doctor or nurse to keep appointments is critical for minimizing complications (5). However, optimal control of diabetes remains a public health and clinical challenge. Only 44% of adults with diabetes have their diabetes controlled (10). Socio-economic status, access to health care, treatment adherence and disease severity partially explain the reasons for poor diabetes management and ethnic differences in management. However, it is possible that psychosocial factors such as social support may advance our understanding of racial/ethnic disparities in diabetes management.

Social support has been shown to be positively associated with glycemic control. For example, some studies have demonstrated that social support is positively associated with improvements in self-care activities, following treatment regimens, increasing exercise and reducing smoking (11-13). Additionally, a positive association between social support and improved blood pressure and reductions in heart disease has also been observed (1, 12, 13). Further, evidence shows that the association between improved diabetes outcomes and social support is stronger for illness-related diabetes social support in comparison to general social support. However, there is a scarcity of studies which focus on the association between illness-related diabetes social support and glycemic control.

It is possible that the clarification of these relationships will help shed light on factors that account for disparities in diabetes management among older adults. These mechanisms required greater clarity and comprehension so that interventions aimed at diabetes management can be better tailored. Therefore, this thesis sought to investigate the association between illness-related diabetes social support and glycemic control among a racially diverse sample of middle aged and older adults. More specifically, we explored whether the relationship between illness-related diabetes social support and glycemic control was modified by race/ethnicity. Further, we investigated whether the association between individual illness-related diabetes social support for different self-care activities and glycemic control differ.

CHAPTER 2

LITERATURE REVIEW

2.1 PUBLIC HEALTH SIGNIFICANCE

Diabetes is the seventh leading cause of death in the US (14, 15). It contributes to substantial morbidity, disability, lowered quality of life, and high economic and health care expenditures (10). Furthermore, diabetes is a leading cause of cardiovascular disease, stroke, non-traumatic lower limb amputations, blindness, end-stage renal disease, suffering, and lost productivity (3, 10, 16, 17). The incidence, prevalence and mortality of diabetes and its complications, especially cardiovascular disease complications are higher with older age (5, 6, 15). Approximately 23% of middle-aged and older adults in the US have type 2 diabetes (18). The prevalence of diabetes varies by race/ethnicity, where blacks and Hispanics have higher disease prevalence in comparison to whites (17, 19).

Adequate diabetes management is of great importance in order for people to improve their health and reduce morbidity and complications. There is currently no cure for diabetes but it can be managed through checkups, medication, and self-care activities (14). Self-management is concerned with activities carried out by individuals to control their diabetes such as following a meal plan, taking medicine, taking care of their feet, getting enough physical activity, testing their

blood sugar, going to the doctor or nurse, keeping their weight under control and handling their feelings about diabetes. These activities serve to reduce the detrimental effect of diabetes on physical health and functioning. This in turn helps these individuals deal with the psychosocial sequelae of diabetes (20). It has been found that adequate self-management of diabetes is connected to achieving improvements in complete physical and psychological health outcomes (20).

The performance of diabetes self-care activities is known to be associated with better glycemic control (21). Glycosylated hemoglobin A1c (HbA1c) is used to measure control of blood glucose. It is an indicator of glycemic concentrations over the past 3 months (10). For adults with diabetes, the American Diabetes Association (ADA) recommends that HbA1c levels be less than 7% (10). For older adults with diabetes duration of at least 10 years, other comorbidities and use of combined medications for treatment of diabetes including insulin, Kirkman and associates have recommended that HbA1c levels be less than 8% (22). High glycemic concentration has been associated with increased risk of developing diabetes related macrovascular and microvascular complications (23). The risk of deaths from macrovascular complications in individuals with diabetes is two to four times the risk in individuals without diabetes after adjusting for age and gender (16). Glycemic control has been shown to be difficult to achieve among many individuals with diabetes (3, 10). However, if blood glucose concentrations are decreased, it has been shown that

this can reduce the risk of cardiovascular complications and mortality (10, 15, 24).

Diabetes management and glycemic control are known to vary by race/ethnicity. One recent study showed that 36.9% of blacks, 35.4% of Hispanics, and 48.6% of whites had their diabetes controlled (10). The disparities in diabetes control may also account for racial/ethnic disparities in diabetes complications. These disparities are still observed even after adjusting for socio-demographic, clinical characteristics, medication use and other co-morbidities (3, 8, 10, 17, 19, 25-30). Some ethnic minority groups may have at most a 50 percent higher rate of diabetes complications compared to all individuals with diabetes (31). Therefore, identifying factors that may help improve glycemic control can ultimately reduce the burden of these complications.

2.2 SOCIAL SUPPORT

Prior research has shown that achieving optimal management of diabetes is better facilitated if individuals have high levels of social support. Social support involves having a feeling that one is loved and cared for and is part of a network which may involve parents, relatives, friends, a spouse, or social and community contacts within churches and clubs (32). There are four subtypes: emotional support (caring, loving, reassuring, respect); appraisal support (stress-related help); informational support (giving advice); and tangible assistance or practical-instrumental support (material or other practical help such as services, financial assistance, or goods (32-34). Emotional support has the most widespread use in

published research related to cardiovascular disease (34). However, research shows that practical-instrumental support has a stronger correlation with treatment adherence for chronic diseases compared to emotional support (21, 35). Family members and significant others have a significant part to play in terms of providing support and practical help in the management of diabetes (36).

2.3 SOCIAL SUPPORT AND GLYCEMIC CONTROL

Social support is important in the management of diabetes. Studies have shown that social support results in increased knowledge, understanding and awareness of diabetes (37) as well as improved glycemic control (24, 37). Several studies have found a positive association between social support and glycemic control (24, 27, 37). One of the studies also found that when individuals with diabetes perceive greater support, they achieve better diabetes management (27). It was also stated that lack of social support results in poor diabetes self- management (20).

Social support may operate in two ways to have a positive influence on optimal diabetes management. It may have a direct effect or an indirect (buffering) effect (32). The direct effect results in the promotion of better health in diabetes patients because of the perceived presence of social support (1, 32). The buffering effect acts during stressful situations such as times of illness (1, 32, 35) and helps patients manage their stress through its effect on affective states

and change in behavior (32, 35). It has further been shown that greater social support is a predictor of lowered depression (27, 35, 38).

Social support is also associated with treatment adherence. Adherence to treatments may be a mediator of the relationship between social support and health outcomes (35) such as glycemic control.

On the other hand, it has also been found that there is no significant association between social support and glycemic control or self-care activities. Some studies have found that social support does not significantly predict HbA1c levels or glycemic control and that family support is not associated with adherence to health-promoting activities and diabetes self-care (20, 33, 39). These contrasting results suggest the need for further investigation into the role of social support in diabetes management as it relates to glycemic control.

Further inconsistencies were found in a review of controlled intervention studies. The review found that social support from peers may lead to improvements in lifestyle activities which then lead to better diabetes care (32). However, this same review also found that participation of family and friends in diabetes education groups had no association with diabetes control (32).

2.4 RACIAL/ETHNIC DIFFERENCES IN SOCIAL SUPPORT AND GLYCEMIC CONTROL

Differences also exist in the subtypes and sources of social support and the relationship with glycemic control by race/ ethnicity (33). The way social support is delivered may determine its effect on glycemic control especially in African

American populations (24, 33). Prior studies have shown that achieving diabetes self-care activities and adequate glycemic control in African Americans is more successful in “informal” social networks compared to whites (17, 24, 30, 33). It was noted that certain economic and cultural factors may result in large households of African Americans (33). This means that there are high levels of social support and blacks tend to rely heavily on this (30, 33). Additionally, social support from African American church congregations, result in an increase in health promoting behaviors (33). Research has also shown that social support was negatively associated with HbA1c levels in whites but no association was found between race/ ethnicity and self-care behaviors related to diabetes (30). In another study by Rees and colleagues, no association was found between social support and race (30). Additionally, one study found that there was no significant association between social support and diabetes self-care in Caucasians and African Americans but this study had a small sample size (39).

Further, it has been found that in comparison to whites, social support predicts better clinical outcomes and improvements in self-care behaviors in blacks (1). Conversely, whites were found to have improved low-density lipoprotein (LDL) levels compared to blacks (1). For Hispanics, there were no significant effects seen for clinical outcomes (1).

2.5 THE IMPORTANCE OF ILLNESS-RELATED DIABETES SOCIAL SUPPORT

The previous discussion highlighted that social support may have a positive impact on management of diabetes and glycemic control through improvements in self-care, diet, medication adherence, physical activity, disease control and lowered risk of mortality (13, 18, 20, 27, 30, 37, 40) . It is important to note that many studies make use of the general term “social support” to refer to different sources of social support including peer support, support from family and friends, support from couples/ spouse or even support from nurse managers (1) and to refer to the different subtypes of social support discussed previously.

However, there is a scarcity of studies which specifically mention, “illness-related diabetes social support,” “regimen specific social support” or “diabetes-related social support.” All of these phrases can be used interchangeably. The phrase, “illness-related diabetes social support” has been and will continue to be used in the rest of this document. Despite this scarcity, it has been shown that illness-related social support may be a stronger predictor of chronic disease outcomes compared to general social support (13, 20). It was further suggested that illness-related diabetes social support may be positively associated with improvements in self-management behaviors (20). Recent evidence suggests that illness-related diabetes social support, a form of practical-instrumental social support, has the strongest association with adherence to activities associated with self-care of chronic diseases such as diabetes (20, 21, 35).

Therefore, the availability of illness-related diabetes social support in the 2003 HRS Diabetes Study as a measure of practical-instrumental support, provided the opportunity to use a source of social support which is directly linked to activities related to diabetes management. This facilitated the investigation of the association between illness-related diabetes social support for diabetes self-care activities (as a whole and individually) and glycemic control and whether the association between the summary IRDSS variable and GC is modified by race/ ethnicity.

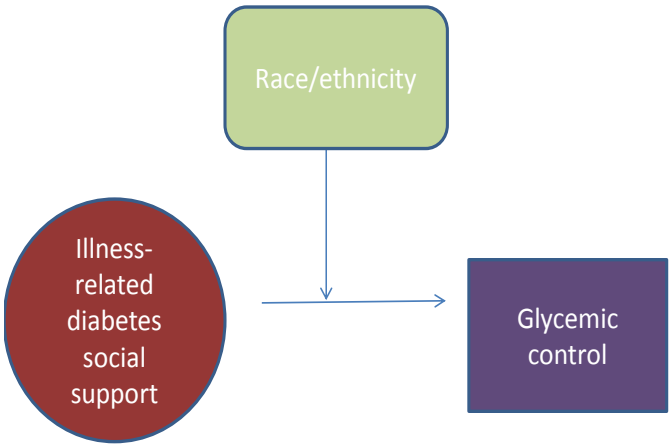


Figure 2.1 Conceptual Model

2

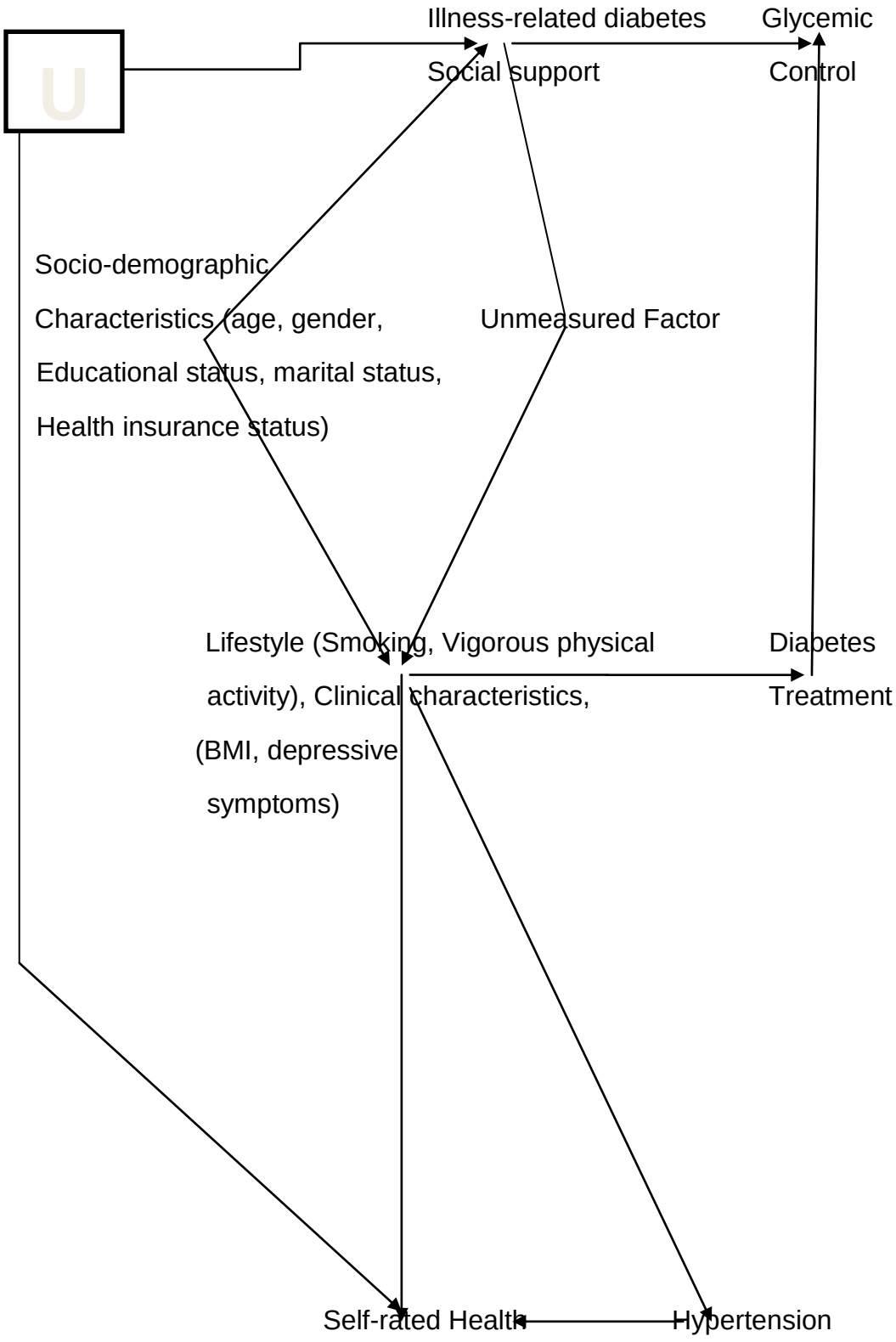


Figure 2.2 Directed Acyclic Graph

represents an unmeasured factor.

Based on the DAG, it is necessary to minimally adjust for socio-demographic characteristics (marital status, age, gender, educational status, health insurance status) and lifestyle factors (vigorous physical activity, smoking, BMI). Adjusting for diabetes treatment will not introduce bias, so it may also be adjusted for. Self-rated health status is a collider and so conditioning on or adjusting for it would open up a backdoor path. Therefore, it is not necessary to adjust for it. Further, it is not necessary to adjust for hypertension.

CHAPTER 3

METHODS

3.1 AIM AND RESEARCH QUESTIONS

Specific Aim: To investigate the association between illness-related diabetes social support and glycemic control among middle aged and older adults.

Research Questions:

1 a) Is illness-related diabetes social support associated with glycemic control? In gender-stratified models, we will examine whether the association between illness-related diabetes social support is associated with glycemic control independent of confounders.

> Hypothesis 1a: It is hypothesized that higher scores of illness-related diabetes social support will be associated with good glycemic control.

1 b) Is the association between illness-related diabetes social support and glycemic control modified by race/ethnicity?

Hypothesis 1b: It is hypothesized that there will be statistically significant interactions between illness-related diabetes social support and race/ethnicity in relation to glycemic control, independent of confounders.

1c) Does the strength of the association between type of illness-related diabetes social support and glycemic control differ?

Hypothesis 1c: It is hypothesized that there will be different associations between IRDSS for lifestyle modification, medically oriented, or emotional support oriented activities and glycemic control. It is further hypothesized that the association between individual types of illness-related diabetes social support and glycemic control will be the strongest for lifestyle modification self-care activities (i.e. illness-related diabetes social support for meal plan, getting enough physical activity, and weight control) after adjusting for confounders.

3.2 DATA SOURCE

The Health and Retirement Study (HRS)

The Health and Retirement Study (HRS) is a longitudinal biennial survey conducted on a nationally representative sample of U.S. adults aged 50 and older. These individuals were born from 1931 to 1941 but beginning in 1998, individuals who were born before 1948 were selected to participate in the survey (41, 42). Data collection began in 1992 and detailed information on physical health and functioning, cognition, disability, socioeconomic factors, and health

care expenditures was collected (41, 42). In 1992, the response rate was 81.4% and in the following waves, response rates were between 85-90% (41, 42). Further information concerning the sample design, recruitment and measurement are extensively discussed elsewhere (41, 42). Data from wave 6, (year 2002) was the only wave used in the analysis. Selected socio-demographic characteristics (race/ ethnicity, educational status and marital status), lifestyle factors (smoking, vigorous physical activity) and clinical characteristics (diabetes treatment, depressive symptoms) were obtained. Wave 6 and data from two HRS-related sources, the 2003 Diabetes supplemental study and RAND HRS dataset, were merged together to create the final analytic dataset.

The 2003 Mail Survey on Diabetes was a supplemental study which was used to obtain self-reported data on diabetes related treatment and management by use of a questionnaire (5). Additionally, HbA1c, a clinical biomarker of glycemic control was also collected (5). Individuals for the 2003 survey were a subsample of individuals (n = 3194) who self-reported having diabetes in 2002. Only 2,385 individuals were eligible to participate in the supplemental survey (680 excluded due to participation in the Consumption and Activities Mail Survey and 129 excluded due to death). Of these people, 1,901 (79.7%) individuals completed the survey; and only 1233 (64.9%) had valid HbA1c readings. The 2003 Diabetes Survey was used to obtain the following variables: socio-demographic characteristics (age) and the illness-related diabetes social support variables.

The RAND Corporation created a RAND HRS data file including HRS data from eleven waves (1992 – 2010). This data file contains cleaned variables that have been named consistently across each wave, derived variables for a variety of measures, and imputations of wealth and income (43). Selected variables (i.e. gender, income, health insurance status, BMI) were ascertained from this dataset.

3.3 STUDY POPULATION

Exclusion and Inclusion criteria:

Respondents who were missing any of the illness-related diabetes social support variables (n=180) or age and were younger than 50 (n =16) were excluded. Further, respondents who were missing on any of all the variables which measured depressive symptoms (n = 81) were excluded. There is a higher prevalence of depressive symptoms in individuals with diabetes and a positive association has been found between poor glycemic control and high levels of social support (44-48). As a result, completeness of data on depressive symptoms is necessary for all individuals who are included in the analysis. An additional number of respondents were excluded based on missing race/ethnicity variables (n=25) and for having zero weight variables (n=17). The final analytic sample yielded for the analysis was 914 (74% of the 1233 individuals who had valid HbA1c readings).

3.4 DEFINITION OF VARIABLES

Outcome

Glycemic control: Glycosylated hemoglobin (HbA1c) levels were used to measure glycemic control. Home kits were mailed to respondents of the 2003 Diabetes study. Flexsite Diagnostics, Inc was used for performing blood spot assays for HbA1c in 2003 (49). Participants with HbA1c $\geq$8.0% were classified as having poor glycemic control based on two previously published papers focusing on older adults and on a consensus report written by Kirkman and colleagues (22, 23, 50) . The two categories which were used in the analyses are good glycemic control (HbA1c < 8.0%) and poor glycemic control (HbA1c $\geq$ 8.0%).

Exposure

Illness-related diabetes social support: The 2003 Diabetes Study included eight questions ascertaining illness-related diabetes social support from the Diabetes Care Profile (5). These questions focused on the help and support diabetes patients received from family or friends for eight self-care activities. The questions asked: *"*How much would you agree that you can count on your family or friends to help and support you a lot with each particular diabetic care" for the following 8 conditions: 1) following meal plan; 2) taking medicine; 3) taking care of feet; 4) getting enough physical activity; 5) testing sugar; 6)going to the doctor or nurse; 7) keeping weight under control; and 8) handling feeling about diabetes?'' The response choices were strongly agree (represented by 5), agree (represented by 4), neither disagree nor agree (represented by 3), disagree

(represented by 2), and strongly disagree (represented by 1). A summary illness-related diabetes social support variable was created by summing across the eight different questions. Since there were 8 questions and 5 response choices (represented with numbers from 1-5), the lowest score was 8 and the highest score was 40. This summary variable was then used to categorize illness-related diabetes social support into two categories; low support and high support. Responses of agree and strongly agree were used to represent high support. Since these two responses were represented by 4 and 5 respectively and there were 8 questions, scores ranging from (8 x 4 =32) to (8 x 5 =40) were used for the category, high support. Low support was based on the responses, strongly disagree, disagree and neither agree nor disagree which were represented by 1, 2 and 3 respectively. As such, the lowest score for low support was (8 x1 =8) and the highest score was less than 32 since 32 was used as the lowest score for high support. Therefore, low support had scores in the range of 8 to 31. Each of the 8 types of illness-related diabetes social support (IRDSS) was also categorized as low (strongly disagree, agree, neither agree or disagree) versus high (agree or strongly agree) support. This is consistent with the way the summary illness-related social support variable was categorized. However, the use of a continuous summary IRDSS variable and continuous individual IRDSS variables will be explored in future analyses.

Effect modifier

Race/ethnicity: This variable was formed based on responses from two questions. The questions were “Do you consider yourself primarily White or

Caucasian, Black or African American, American Indian, or Asian, or something else?" and "Do you consider yourself Hispanic or Latino?" The following mutually exclusive categories were created based on the responses to the questions: "white", "black" and "Hispanic."

Confounders

The confounders which were included are based on apriori hypotheses, or considered in prior studies focused on social support, glycemic control, diabetes management) (5, 11, 17, 29, 30, 37, 40, 51-55).

Socio-demographic Characteristics

Age: This was collected continuously but it was categorized as "50-64", "65-74", and "≥ 75" for the descriptive statistics based on prior studies (5, 6, 53). Age was also used as a continuous variable in the models.

Gender: Gender was categorized as collected: "male" and "female."

Educational status: This variable was collected by the question: "What is the highest grade of school or year of college you completed?" It was categorized as "less than high school," "high school" and "more than high school."

Annual household income: This refers to all 2001 income of family members who reside in the household. This continuous variable was categorized into the following quartiles: "less than $17, 000," "$17, 000-$31, 000," "$31, 001-$54, 000" and "more than $54, 000."

Marital status: Response categories to the question about marital status were “married,” “separated,” “divorced,” “widowed” and “never married”. This variable was recoded as: “married/coupled” (married, separated) and “not married” (divorced, widowed, never married).

Health insurance status: Health insurance status was created based responses to four variables: “covered by federal government Health insurance program”, “covered by health insurance from a current or previous employer”, “covered by his/her spouse's employer”; “covered by other health insurance.” The responses required for these questions were either “yes” or “no”. Based on these responses, health insurance status was categorized as “insured” and “uninsured.”

Lifestyle Factors

Current smoking status: This was collected by the question, “**Do** you smoke cigarettes now?” This was categorized as “yes” and “no.”

Vigorous physical activity: This was collected by the question, “On average over the last 12 months have you participated in vigorous physical activity or exercise three times a week or more? By vigorous physical activity, we mean things like sports, heavy housework, or a job that involves physical labor.” This was categorized as “yes” and “no.”

Clinical characteristics

Diabetes Treatment: Diabetes treatment refers to the treatments used to manage diabetes symptoms. This variable was created from the following two questions: "In order to treat or control your diabetes, are you now taking medication that you swallow?" and "Are you now using insulin shots or a pump?" The variable was categorized as "no medication," "oral medications" "insulin" and "combination of oral medications and insulin."

Body Mass Index (BMI): BMI was categorized as "underweight/ normal" (less than 18.5 to 24.9), "overweight "(25.0 to 29.9) and "obese" (30 or more).

Depressive symptoms: Participants were asked about the possibility of having one of eight symptoms ("I felt depressed"; "I felt that everything I did was an effort"; "my sleep was restless"; "I could not get going"; "I felt lonely"; "I enjoyed life"; "I felt sad"; "I was happy") "much of the time" in the past week. All the questions except two ("I enjoyed life" and "I was happy") were based on affirmative responses and so they were reverse coded. The total scores ranged between 0 and 8 with higher scores meaning a greater number of depressive symptoms. Depressive symptoms was categorized using a modified version of the Center for Epidemiological Studies Depression Score (CES-D); "< 3" and "≥ 3". This cut-point was also used by the World Health Organization's Composite International Diagnostic Interview short form (CIDI-SF) (56).

3.5 STATISTICAL ANALYSIS

The final analytical sample of 914 eligible individuals was used in the analyses.

Descriptive statistics: Gender-stratified frequency statistics were used in the bivariate analysis to examine illness-related diabetes social support and glycemic control by socio-demographic characteristics (age, gender, race/ethnicity, educational status, marital status, health insurance status), lifestyle factors (smoking, vigorous physical activity) and clinical characteristics (diabetes duration, diabetes treatment, BMI, depressive symptoms) to obtain descriptive statistics of the sample population. Means and standard deviations were obtained for the continuous variables, and numbers and percentages of respondents were used for the categorical variables. Analysis of variance with t-tests was used to compare continuous variables and chi square (X^2) tests were used to compare categorical variables by levels of illness-related diabetes social support in order to obtain p-values.

Gender- stratified frequency statistics were also used in a bivariate analysis of race/ ethnicity by each individual illness-related diabetes social support variable. The 8 individual illness-related diabetes self-care activities were further divided into three groups: 1) IRDSS for lifestyle modification activities (following meal plan, getting enough physical activity, weight control); 2) IRDSS for medically oriented activities (taking medication, testing blood sugar, going to the doctor or nurse to keep appointments, foot care) and 3) IRDSS for emotionally oriented activity (handling feelings about diabetes). Chi square (X^2) tests were used to

compare the race variable and the ethnicity variable by levels of illness-related diabetes social support in order to obtain p-values.

Association between illness-related diabetes social support and glycemic control: Multivariable logistic regression models were used to estimate the association between illness-related diabetes social support and glycemic control. Sequential adjustments were made using five different models. Model 1 was the crude model which included illness-related diabetes social support. Model 2 was adjusted for age, race/ethnicity, and marital status. For model 3, model 2 was further adjusted for education, income and health insurance status and in model 4, model 3 was adjusted for smoking status and vigorous physical activity. Model 4 was then further adjusted for diabetes treatment, BMI, depressive symptoms to produce model 5.

Effect modification by race/ethnicity: Effect modification was formally tested using a cross-product term between race/ethnicity and IRDSS in the gender-stratified fully adjusted multivariable logistic regression models. *P*-values <0.10 were considered as statistically significant.

Association between individual illness-related diabetes social support and glycemic control: Multivariable logistic regression models were used to estimate the association between each individual illness-related diabetes social support and glycemic control. For each illness-related diabetes social support variable, model 1 was the crude model which included the illness-related diabetes social support variable. For each illness-related diabetes social support variable, model

2 was adjusted for age, education, annual household income, marital status, health insurance, smoking status, vigorous physical activity, diabetes treatment, BMI, depressive symptoms.

All analyses were stratified by gender. For each analysis, odds ratios (OR) and 95% confidence intervals (CI) were obtained. Analyses were weighted to take into account the complex sampling design of the HRS. All analyses used an alpha level of 0.05, with the exception of the test for interaction ($p<0.10$). The statistical software, SAS version 9.3; SAS Institute, Inc, Cary, North Carolina was used for data management and to perform all analyses.

CHAPTER 4

Results

The characteristics of the sample of individuals with diabetes are shown in table 4.1. Over one third of the sample (42.8%) fell in the 65-74 age category with the mean age being 69.8 (SD = 8.0) and about half (49.8%) of the sample was female. It was a predominantly white sample (75.4%) with 15.1% blacks and 9.5% Hispanics. A little over one third of the sample (37.4%) had more than a high school education and about two thirds (67.8%) of the sample was married/ coupled. Almost everyone (96.4%) had health insurance. The majority of the sample (91.1%) was composed of non-smokers and a little less than two-thirds (63.4%) of study participants indicated participation in vigorous physical activity. Oral medication was the most popular (64.8%) diabetes treatment used in the sample. A high percentage (81.3%) of the sample was overweight or obese and a little less than one quarter (24.2%) of the sample had a high number of depressive symptoms.

Table 4.2 shows the sample characteristics by levels of illness-related diabetes social support for males. Males with high levels of illness-related diabetes social support made up 57.3% of the sample. A significantly higher percentage of these males were in the 65-74 age category compared to the 50-64 age category and the ≥ 75 age category(p-value = 0.0052). In addition, a significantly higher

percentage of them had more than a high school education compared to those who had less than a high school education and a high school education (p-value = 0.0001). Further, a significantly higher percentage of these males did not participate in vigorous physical activity in comparison to those who participated in vigorous physical activity (p-value = 0.0379).

Table 4.3 shows the sample characteristics by levels of illness-related diabetes social support for females. Females with high levels of illness-related diabetes social support made up 55.6% of the sample. A significantly higher percentage of these females were white in comparison to being black or Hispanic (p-value = 0.0070). In addition, a significantly higher percentage of them had less than a high school education compared to those who had more than a high school education and a high school education (p-value = <0.0001). Further, a significantly higher percentage of these females took oral medications to treat diabetes in comparison to taking no medication, insulin and a combination of oral medications and insulin (p-value = 0.0192).

In table 4.4, the sample characteristics are shown for males by glycemic control levels. 79.5% of males had adequate glycemic control. A significantly higher percentage of these males were in the 65-74 age category compared to the 50-64 age category and the ≥ 75 age category (p-value = 0.0321).In addition, a significantly higher percentage of these males were white in comparison to being black or Hispanic (p-value = 0.0487). Further, a significantly higher percentage of these males took oral medications to treat diabetes in comparison to taking no

medication, insulin and a combination of oral medications and insulin (p-value = 0.0001).

In table 4.5, the sample characteristics are shown for females by glycemic control levels. 76.7% of females had adequate glycemic control. A significantly higher percentage of these females were in the 65-74 age category compared to the 50-64 age category and the ≥ 75 age category (p-value = 0.0070). In addition, a significantly higher percentage of these females were white in comparison to being black or Hispanic (p-value = 0.0017).Further, a significantly higher percentage of these females were insured in comparison to being uninsured (p-value = 0.0429). Additionally, a significantly higher percentage of these females were non-smokers in comparison to being smokers (p-value = 0.0177). A significantly higher percentage of these females took oral medications to treat diabetes in comparison to taking no medication, insulin and a combination of oral medications and insulin as well(p-value = <0.0001).

In figure 4.1, the percentage of males with a high level of illness-related diabetes social support (IRDSS) for lifestyle modification activities (following meal plan, getting enough physical activity, weight control) is displayed by race/ethnicity. There were no statistically significant differences observed (p-values > 0.05) between the percentages of white and Hispanic males by high levels of illness-related diabetes social support for all lifestyle modification activities (following meal plan, getting enough physical activity, weight control). There were also no statistically significant differences observed (p-values > 0.05) between the

percentages of white and black males in terms of high levels of illness-related diabetes social support for lifestyle modification activities.

Figure 4.2 displays the percentage of males with a high level of illness-related diabetes social support (IRDSS) for medically oriented activities (taking medication, testing blood sugar, going to the doctor or nurse to keep appointments, foot care) by race/ethnicity. There were statistically significant differences observed (p-values < 0.05) between the percentages of white and Hispanic males by high levels of illness-related diabetes social support for one of the four medically oriented activities (testing blood sugar). A significantly higher percentage of males with a high level of illness-related diabetes social support for testing blood sugar were Hispanic compared to white. There were no statistically significant differences observed (p-values > 0.05) between the percentages of white and Hispanic males in terms of high levels of illness-related diabetes social support for three of the medically oriented activities (taking medication, going to the doctor or nurse to keep appointments, foot care). There were no statistically significant differences observed (p-values > 0.05) between white and black males in terms of the percentages of high levels of illness-related diabetes social support for any of the medically oriented activities. There were no statistically significant differences observed (p-values > 0.05) between the three race/ethnicity categories in terms of the percentages of high levels of illness-related diabetes social support for going to the doctor or nurse to keep appointments.

In Figure 4.3, the percentage of males with a high level of illness-related diabetes social support (IRDSS) for the emotional support oriented activity (handling feelings about diabetes) among males is displayed by race/ ethnicity. There were statistically significant differences observed (p-values < 0.05) between the percentages of white and Hispanic males as well as between the percentages of white and black males by high levels of illness-related diabetes social support for the emotional support oriented activity (handling feelings about diabetes). A significantly higher percentage of males with a high level of illness-related diabetes social support for the emotional support oriented activity were Hispanic or black compared to white.

Figure 4.4 displays the percentage of females with a high level of illness-related diabetes social support (IRDSS) for lifestyle modification activities (following meal plan, getting enough physical activity, weight control) by race/ethnicity. There were statistically significant differences observed (p-values < 0.05) between the percentages of white and Hispanic females by high levels of illness-related diabetes social support for all lifestyle modification activities (following meal plan, getting enough physical activity, weight control). A significantly higher percentage of females with a high level of illness-related diabetes social support for all lifestyle modification activities were Hispanic compared to white. There were no statistically significant differences observed (p-values > 0.05) between white and black females in terms of high levels of illness-related diabetes social support for lifestyle modification activities.

In figure 4.5, the percentage of females with a high level of illness-related diabetes social support (IRDSS) for medically oriented activities (taking medication, testing blood sugar, going to the doctor or nurse to keep appointments, foot care) is displayed by race/ ethnicity. There were statistically significant differences observed (p-values < 0.05) between the percentages of white and Hispanic females by high levels of illness-related diabetes social support for three of the four medically oriented activities (taking medication, testing blood sugar, foot care). A significantly higher percentage of females with a high level of illness-related diabetes social support for these three medically oriented activities were Hispanic compared to white. There were no statistically significant differences observed (p-values > 0.05) between the percentages of white and Hispanic females in terms of levels of illness-related diabetes social support for going to the doctor or nurse to keep appointments. There were also no statistically significant differences observed (p-values > 0.05) between the percentages of white and black females in terms of levels of illness-related diabetes social support for any of the medically oriented activities.

Figure 4.6 displays the percentage of females with a high level of illness-related diabetes social support (IRDSS) for the emotional support oriented activity (handling feelings about diabetes) by race/ethnicity. There were statistically significant differences observed (p-values < 0.05) between the percentages of white and Hispanic females. A significantly higher percentage of females with high levels of illness-related diabetes social support for the emotional support oriented activity were Hispanic compared to white. There were no statistically

significant differences observed (p-values > 0.05) between the percentages of white and black females by high levels of illness-related diabetes social support for the emotional support oriented activity (handling feelings about diabetes).

Table 4.6 illustrates the crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for respondent characteristics associated with poor glycemic control and illness-related diabetes social support for males. There were no significant associations between illness-related diabetes social support and glycemic control among males in any of the models. After adjusting for socio-demographic characteristics, lifestyle factors and clinical characteristics, male respondents have 1.04 (95% CI: 1.01, 1.08) times the odds of adequate glycemic control for every one year increase in age. Hispanic males had consistent lower odds of adequate glycemic control compared to white males with the odds being 0.28 (95% CI: 0.12, 0.68) in the fully adjusted model. Interestingly, males who did not participate in vigorous physical activity had 2.35 (95% CI: 1.42, 3.90) times the odds of adequate glycemic control compared to males who participated in vigorous physical activity. Males who took oral medications, insulin or a combination of oral medications and insulin all had a very low odds of adequate glycemic control compared to males who used no medication; (OR: 0.32; 95% CI: 0.14, 0.73), (OR: 0.18; 95% CI: 0.05, 0.60) and (OR: 0.12; 95% CI: 0.04, 0.39) respectively.

Table 4.7 illustrates the crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for respondent characteristics associated with poor

glycemic control and illness-related diabetes social support for females. In all the adjusted models, there were consistently higher odds of adequate glycemic control among females with high levels of illness-related diabetes social support compared to those with low levels of illness-related diabetes social support. In the fully adjusted model, the odds was 2.39 (95% CI: 1.44, 4.00) times higher. Black and Hispanic females had consistently lower odds of adequate glycemic control compared to white females with the odds being 0.40 (95% CI: 0.20, 0.79) and 0.19 (95% CI: 0.08, 0.47) respectively in the fully adjusted model. Females who were current smokers had lower odds of adequate glycemic control compared to females who were not current smokers; 0.40 (95% CI: 0.21, 0.73) in the fully adjusted model. Females who took insulin had very low odds of adequate glycemic control compared to females who used no medication; (OR: 0.09; 95% CI: 0.03, 0.22).

We checked for interaction between IRDSS and race/ethnicity in gender-stratified models fully adjusted for socio-demographic characteristics, lifestyle factors, and clinical characteristics. Among males, we did not find evidence of interaction between IRDSS and black race/ethnicity (p-value =0.9422) or Hispanic race/ethnicity (p-value = 0.2973) and IRDSS relative to white race/ethnicity. Among females, the p-value for the interaction between IRDSS and black race/ethnicity relative to white race/ethnicity was not significant (p-value =0.2168). However, we observed a significant interaction among females (p-value = 0.0715) between Hispanic race/ethnicity and IRDSS relative to white race/ethnicity.

Table 4.8 shows the adjusted model with odds ratios (OR) and 95% confidence intervals (CI) for illness-related diabetes social support among females stratified by race/ ethnicity. These results show that among white and black females, there were no statistically significant associations between IRDSS and glycemic control We found higher odds of adequate glycemic control among Hispanic females with high levels of IRDSS compared to Hispanic females with low levels of IRDSS; (OR: 5.75; 95% CI: 1.01, 32.63).

Table 4.9 shows the crude and adjusted models with odds ratios (OR) and 95% confidence intervals (CI) for individual illness- related diabetes social support variables stratified by gender. In the crude models, there were no significant associations between any of the individual illness-related diabetes social support variables and glycemic control for males or females. In the adjusted models, the only significant association was seen among females. The odds of adequate glycemic control among female respondents with high levels of illness-related diabetes social support for handling feelings about diabetes was 2.05 (95% CI: 1.18, 3.54) times the odds of adequate glycemic control among female respondents with low levels of illness-related diabetes social support for handling feelings about diabetes.

Table 4.1: Socio-demographic, lifestyle, and clinical characteristics of the study sample of individuals with diabetes, Health and Retirement Study, 2002 and 2003 Diabetes Survey

Characteristics	N	%, SD
TOTAL	914	
Socio-demographics		
Age (mean, SD)	69.8	8.0
Age		
50-64	265	29.0
65-74	391	42.8
≥ 75	258	28.2
Gender		
Female	455	49.8
Male	459	50.2
Race/Ethnicity		
Whites	689	75.4
Blacks	138	15.1
Hispanics	87	9.5
Education		
< HS	267	29.2
HS	305	33.4
> HS	342	37.4
Annual Household Income		
<$17,000	237	25.9
$17,000-$31,000	224	24.5
$31,001-$54,000	225	24.6
>$54,000	228	25.0
Marital Status		
Not married	294	32.2
Married/coupled	619	67.8
Health insurance		
Uninsured	33	3.6
Insured	874	96.4
Lifestyle factors		
Current Smoker		
No	832	91.1
Yes	81	8.9
Vigorous Physical Activity		
No	579	63.4
Yes	334	36.6
Clinical Characteristics		
Diabetes Treatment		
No medication	116	12.7
Oral medications	592	64.8
Insulin	102	11.1
Combination of oral medications and insulin	104	11.4
BMI		
Underweight/ Normal	169	18.7
Overweight	339	37.6
Obese	394	43.7
Depressive symptoms		

<3	693	75.8
≥ 3	221	24.2

Abbreviations: HS = high school
[a]The frequencies and percentages are unweighted and may not add up to the total sample size due to missing.

Table 4.2: Sample characteristics by levels of illness-related diabetes social support among males

	Low level support		High level support		P-value
Characteristics	N	%, SD	N	%, SD	
TOTAL	196	42.7	263	57.3	
Socio-demographics					
Age (mean, SD)	69.1	7.8	71.1	7.6	0.0078
Age					**0.0052**
50-64	64	32.7	52	19.8	
65-74	78	39.8	134	50.9	
≥ 75	54	27.5	77	29.3	
Race/Ethnicity					0.3549
Whites	168	85.7	212	80.6	
Blacks	18	9.2	32	12.2	
Hispanics	10	5.1	19	7.2	
Education					**0.0001**
< HS	29	14.8	84	31.9	
HS	60	30.6	71	27.0	
> HS	107	54.6	108	41.1	
Annual Household Income					0.0561
<$17,000	15	7.7	40	15.2	
$17,000-$31,000	62	31.6	68	25.9	
$31,001-$54,000	48	24.5	71	27.0	
>$54,000	71	36.2	84	31.9	
Marital Status					0.6627
Not married	35	17.9	51	19.5	
Married/coupled	161	82.1	211	80.5	
Health insurance					0.2679
Uninsured	5	2.6	3	1.2	
Insured	191	97.4	254	98.8	
Lifestyle factors					0.4272
Current Smoker	177	90.3	243	92.4	
No	19	9.7	20	7.6	
Yes					**0.0379**
Vigorous Physical Activity	123	62.8	139	53.0	
No	73	37.2	123	47.0	
Yes					
Clinical Characteristics					
Diabetes Treatment					0.0754
No medication	25	12.8	24	9.1	
Oral medications	132	67.3	178	67.7	
Insulin	25	12.8	25	9.5	
Combination of oral medications and insulin	14	7.1	36	13.7	
BMI					0.4061
Underweight/ Normal	33	17.0	42	16.1	
Overweight	75	38.7	117	44.8	
Obese	86	44.3	102	39.1	
Depressive symptoms					0.5179
<3	161	82.1	222	84.4	
≥ 3	35	17.9	41	15.6	

Abbreviations: HS = high school

[a]The frequencies and percentages are unweighted and may not add up to the total sample size due to missing.

Table 4.3: Sample characteristics by levels of illness-related diabetes social support among females

	Low level support		High level support		P-value
Characteristics	N	%, SD	N	%, SD	
TOTAL	202	44.4	253	55.6	
Socio-demographics					
Age (mean, SD)	68.8	8.1	69.7	8.3	0.2680
Age					0.5333
50-64	71	35.2	78	30.8	
65-74	79	39.1	100	39.5	
≥ 75	52	25.7	75	29.6	
Race/Ethnicity					**0.0070**
Whites	152	75.3	157	62.1	
Blacks	33	16.3	55	21.7	
Hispanics	17	8.4	41	16.2	
Education					**<0.0001**
< HS	46	22.8	108	42.7	
HS	82	40.6	92	36.4	
> HS	74	36.6	53	20.9	
Annual Household Income					0.7049
<$17,000	77	38.1	105	41.5	
$17,000-$31,000	40	19.8	54	21.4	
$31,001-$54,000	52	25.8	54	21.3	
>$54,000	33	16.3	40	15.8	
Marital Status					0.3777
Not married	97	48.0	111	43.9	
Married/coupled	105	52.0	142	56.1	
Health insurance					0.6419
Uninsured	10	5.0	15	6.0	
Insured	192	95.0	237	94.0	
Lifestyle factors					0.4510
Current Smoker	181	89.6	231	91.7	
No	21	10.4	21	8.3	
Yes					0.7950
Vigorous Physical Activity	142	70.3	175	69.2	
No	60	29.7	78	30.8	
Yes					
Clinical Characteristics					
Diabetes Treatment					**0.0192**
No medication	35	17.3	32	12.6	
Oral medications	130	64.4	152	60.1	
Insulin	13	6.4	39	15.4	
Combination of oral medications and insulin	24	11.9	30	11.9	
BMI					0.4097
Underweight/ Normal	37	18.5	57	23.1	
Overweight	65	32.5	82	33.2	
Obese	98	49.0	108	43.7	
Depressive symptoms					0.0807
<3	129	63.9	181	71.5	
≥ 3	73	36.1	72	28.5	

Abbreviations: HS = high school

[a]The frequencies and percentages are unweighted and may not add up to the total sample size due to missing.

Table 4.4: Sample characteristics by glycemic control among males

	Good glycemic control		Poor glycemic control		P-value
Characteristics	N	%, SD	N	%, SD	
TOTAL	365	79.5	94	20.5	
Socio-demographics					
Age (mean, SD)	70.6	7.5	68.7	8.3	0.0369
Age					**0.0321**
50-64	83	22.7	33	35.1	
65-74	171	46.9	41	43.6	
≥ 75	111	30.4	20	21.3	
Race/Ethnicity					**0.0487**
Whites	308	84.4	72	76.6	
Blacks	39	10.7	11	11.7	
Hispanics	18	4.9	11	11.7	
Education					0.5606
< HS	87	23.8	26	27.7	
HS	108	29.6	23	24.5	
> HS	170	46.6	45	47.9	
Annual Household Income					0.7202
<$17,000	43	11.8	12	12.8	
$17,000-$31,000	102	28.0	28	29.8	
$31,001-$54,000	99	27.1	20	21.3	
>$54,000	121	33.1	34	36.1	
Marital Status					0.0941
Not married	74	20.3	12	12.8	
Married/coupled	290	79.7	82	87.2	
Health insurance					0.7521
Uninsured	6	1.7	2	2.1	
Insured	354	98.3	91	97.9	
Lifestyle factors					
Current Smoker					0.6743
No	335	91.8	85	90.4	
Yes	30	8.2	9	9.6	
Vigorous Physical Activity					0.1133
No	215	59.1	47	50.0	
Yes	149	40.9	47	50.0	
Clinical Characteristics					
Diabetes Treatment					**0.0001**
No medication	46	12.6	3	3.2	
Oral medications	254	69.6	56	59.6	
Insulin	33	9.0	17	18.1	
Combination of oral medications and insulin	32	8.8	18	19.1	
BMI					0.3393
Underweight/ Normal	58	16.0	17	18.3	
Overweight	159	43.9	33	35.5	
Obese	145	40.1	43	46.2	
Depressive symptoms					0.6550
<3	306	83.8	77	81.9	
≥ 3	59	16.2	17	18.1	

Abbreviations: HS = high school

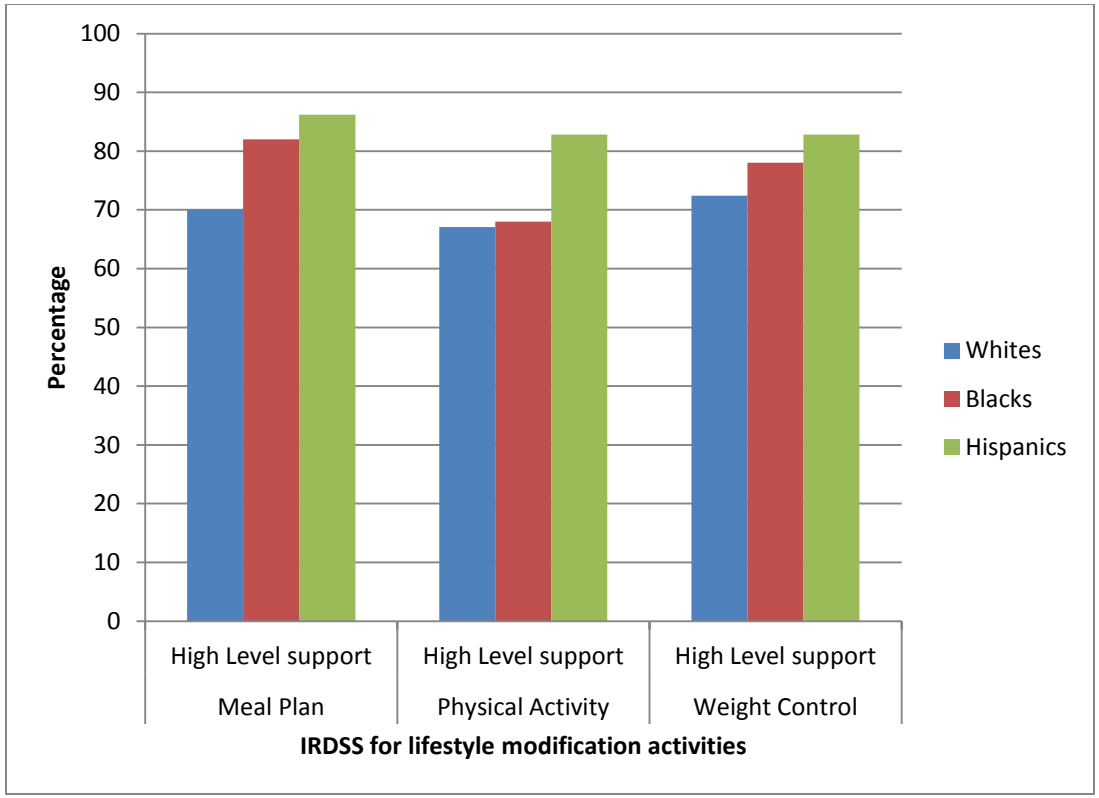
[a]The frequencies and percentages are unweighted and may not add up to the total sample size due to missing.

Table 4.5: Sample characteristics by glycemic control among females

	Good glycemic control		Poor glycemic control		P-value
Characteristics	N	%, SD	N	%, SD	
TOTAL	349	76.7	106	23.3	
Socio-demographics					
Age (mean, SD)	69.8	8.2	67.7	8.1	0.0252
Age					**0.0070**
50-64	101	29.0	48	45.3	
65-74	146	41.8	33	31.1	
≥ 75	102	29.2	25	23.6	
Race/Ethnicity					**0.0017**
Whites	252	72.2	57	53.8	
Blacks	58	16.6	30	28.3	
Hispanics	39	11.2	19	17.9	
Education					0.0907
< HS	112	32.1	42	39.6	
HS	143	41.0	31	29.3	
> HS	94	26.9	33	31.1	
Annual Household Income					0.6390
<$17,000	136	39.0	46	43.4	
$17,000-$31,000	70	20.0	24	22.6	
$31,001-$54,000	85	24.4	21	19.8	
>$54,000	58	16.6	15	14.2	
Marital Status					0.7312
Not married	158	45.3	50	47.2	
Married/coupled	191	54.7	56	52.8	
Health insurance					**0.0429**
Uninsured	15	4.3	10	9.4	
Insured	333	95.7	96	90.6	
Lifestyle factors					
Current Smoker					**0.0177**
No	322	92.5	90	84.9	
Yes	26	7.5	16	15.1	
Vigorous Physical Activity					0.6041
No	241	69.0	76	71.7	
Yes	108	31.0	30	28.3	
Clinical Characteristics					
Diabetes Treatment					**<0.0001**
No medication	62	17.8	5	4.7	
Oral medications	222	63.6	60	56.6	
Insulin	27	7.7	25	23.6	
Combination of oral medications and insulin	38	10.9	16	15.1	
BMI					0.8429
Underweight/ Normal	73	21.4	21	20.0	
Overweight	114	33.3	33	31.4	
Obese	155	45.3	51	48.6	
Depressive symptoms					0.1388
<3	244	69.9	66	62.3	
≥ 3	105	30.1	40	37.7	

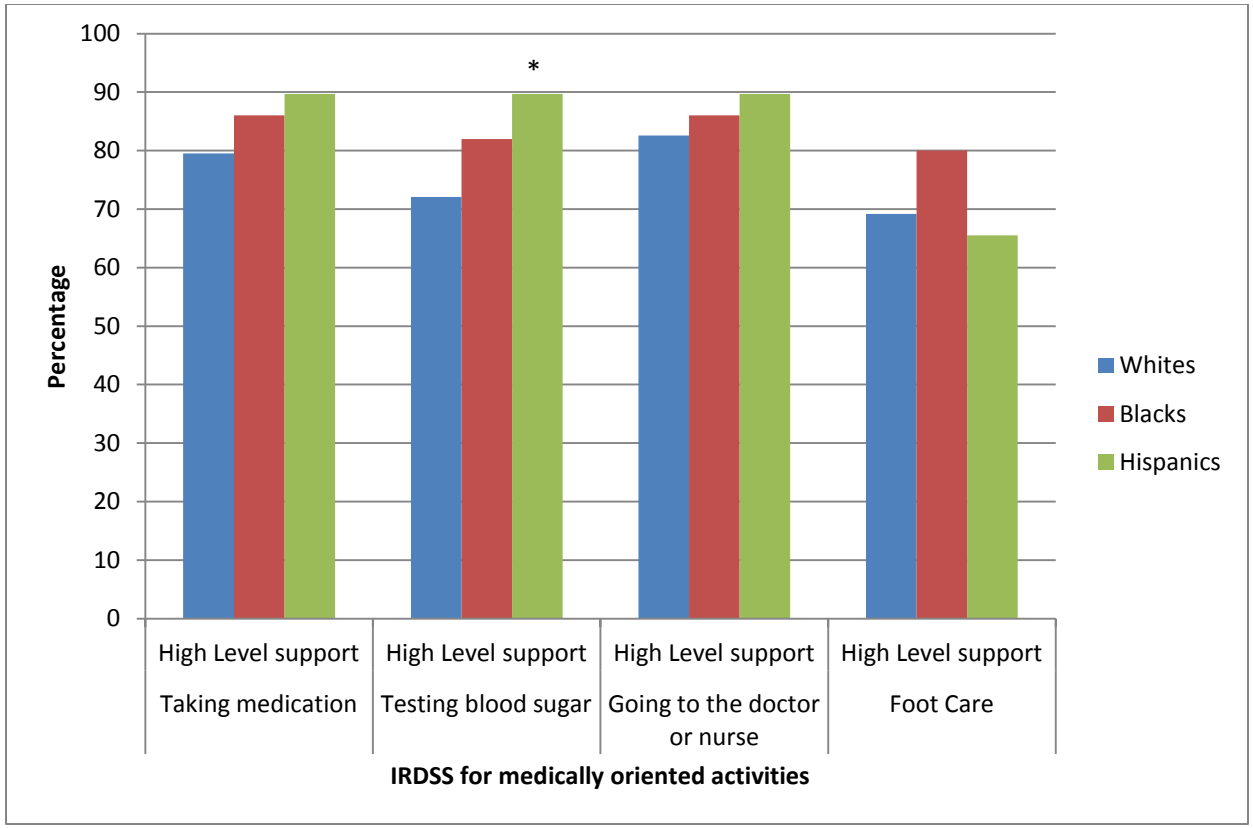
Abbreviations: HS = high school

[a]The frequencies and percentages are unweighted and may not add up to the total sample size due to missing.



Abbreviations: IRDSS = illness-related diabetes social support

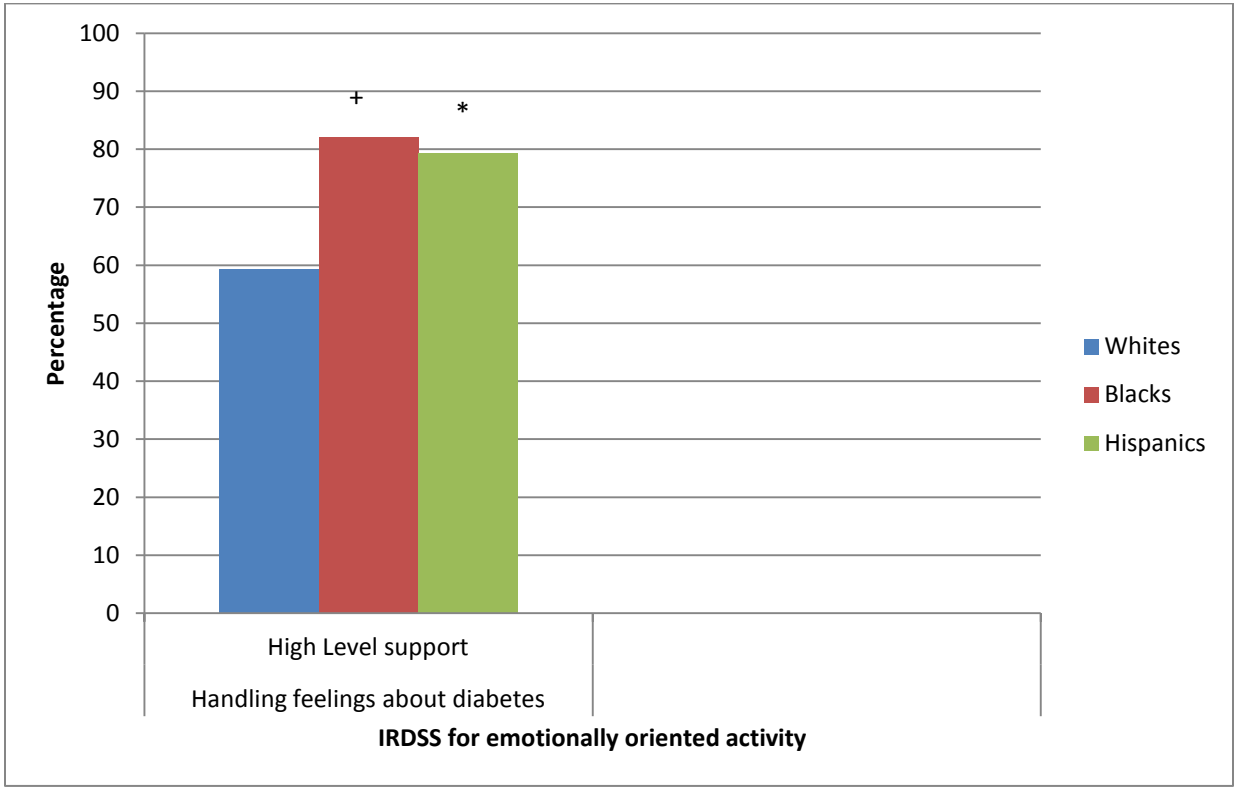
Figure 4.1: Percentage of males with a high level of illness-related diabetes social support (IRDSS) for lifestyle modification activities (following meal plan, getting enough physical activity, weight control) by race/ethnicity



Abbreviations: IRDSS = illness-related diabetes social support

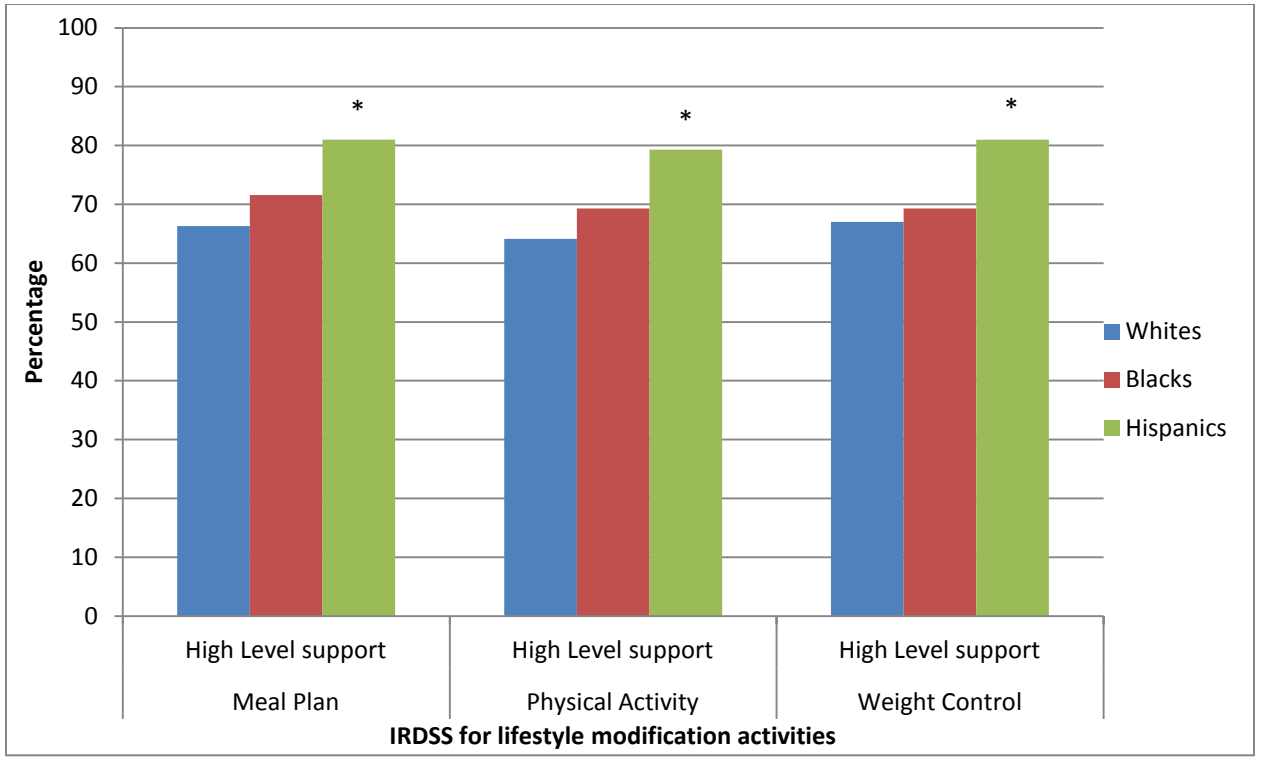
[a]*: p-value < 0.05 for chi-square test of significant differences between white and Hispanic males

Figure 4.2: Percentage of males with a high level of illness-related diabetes social support (IRDSS) for medically oriented activities (taking medication, testing blood sugar, going to the doctor or nurse to keep appointments, foot care) by race/ethnicity



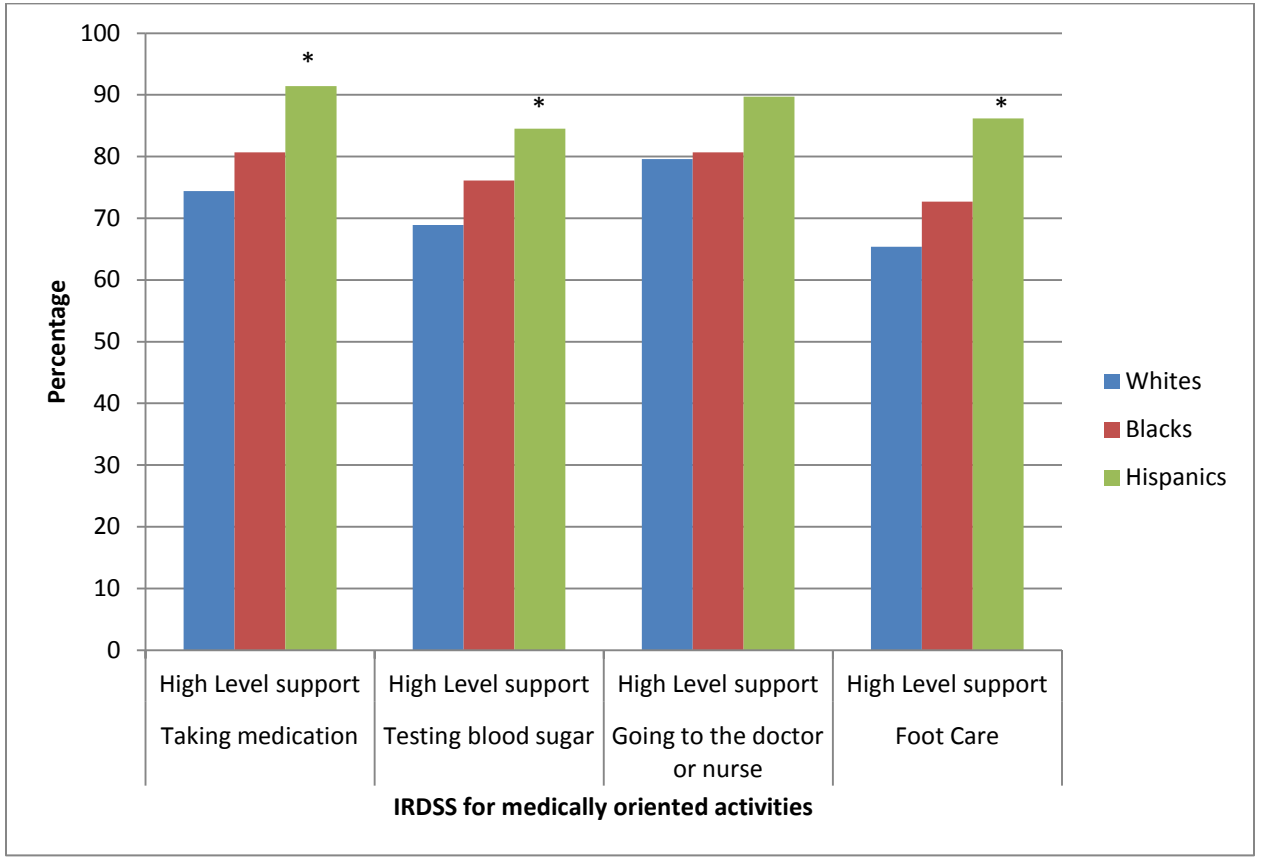
Abbreviations: IRDSS = illness-related diabetes social support
[a]*: p-value < 0.05 for chi-square test of significant differences between white and Hispanic males
[b]+: p-value < 0.05 for chi-square test of significant differences between white and black males

Figure 4.3: Percentage of males with a high level of illness-related diabetes social support (IRDSS) for emotional support oriented activity (handling feelings about diabetes) among by race/ethnicity



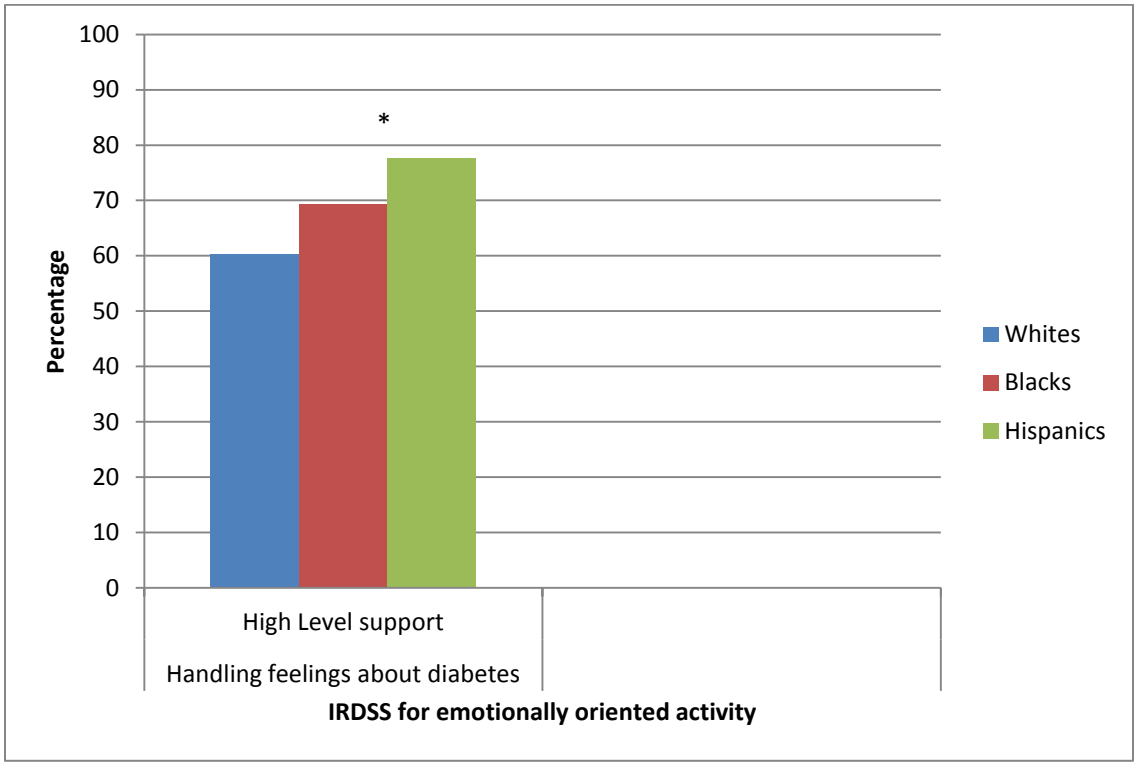
Abbreviations: IRDSS = illness-related diabetes social support
[a]*: p-value < 0.05 for chi-square test of significant differences between white and Hispanic females

Figure 4.4: Percentage of females with a high level of illness-related diabetes social support (IRDSS) for lifestyle modification activities (following meal plan, getting enough physical activity, weight control) by race/ethnicity



Abbreviations: IRDSS = illness-related diabetes social support
[a]*: p-value < 0.05 for chi-square test of significant differences between white and Hispanic females

Figure 4.5: Percentage of females with a high level of illness-related diabetes social support (IRDSS) for medically oriented activities (taking medication, testing blood sugar, going to the doctor or nurse to keep appointments, foot care) by race/ethnicity



Abbreviations: IRDSS = illness-related diabetes social support
[a]*: p-value < 0.05 for chi-square test of significant differences between white and Hispanic females

Figure 4.6: Percentage of females with a high level of illness-related diabetes social support (IRDSS) for emotional support oriented activity (handling feelings about diabetes) among by race/ethnicity

Table 4.6: Crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) of the associations of Illness-related diabetes social support and other respondent characteristics with adequate glycemic control among males

Characteristics	Model 1[a]		Model 2[b]		Model 3[c]		Model 4[d]		Model 5[e]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
IRDSS										
Low support	1.00		1.00		1.00		1.00		1.00	
High support	1.07	(0.60, 1.91)	0.95	(0.52, 1.73)	0.88	(0.48, 1.60)	0.92	(0.50, 1.70)	0.98	(0.51, 1.90)
Socio-demographics										
Age			**1.04**	**(1.01, 1.07)**	1.04	(1.00, 1.07)	1.04	(1.00, 1.08)	**1.04**	**(1.01, 1.08)**
Race/Ethnicity										
Whites			1.00		1.00		1.00		1.00	
Blacks			0.58	(0.29, 1.14)	0.49	(0.23, 1.04)	0.49	(0.22, 1.09)	0.58	(0.29, 1.17)
Hispanics			**0.39**	**(0.16, 0.92)**	**0.39**	**(0.16, 0.93)**	**0.38**	**(0.15, 0.93)**	**0.28**	**(0.12, 0.68)**
Marital Status										
Not married			2.01	(0.92, 4.41)	2.21	(0.87, 5.65)	2.14	(0.81, 5.60)	2.64	(0.89, 7.80)
Married/coupled			1.00		1.00		1.00		1.00	
Education										
< HS					1.50	(0.70, 3.22)	1.49	(0.68, 3.24)	1.31	(0.61, 2.84)
HS					1.64	(0.91, 2.98)	1.59	(0.86, 2.96)	1.47	(0.76, 2.85)
> HS					1.00		1.00		1.00	
Annual Household Income										
<$17,000					0.94	(0.28, 3.16)	0.80	(0.23, 2.77)	0.86	(0.22, 3.36)
$17,000-$31,000					0.84	(0.44, 1.62)	0.81	(0.41, 1.60)	1.05	(0.52, 2.13)
$31,001-$54,000					1.29	(0.61, 2.72)	1.25	(0.58, 2.71)	1.45	(0.62, 3.36)
>$54,000					1.00		1.00		1.00	
Health insurance										
Uninsured					0.91	(0.12, 6.70)	0.91	(0.14, 6.04)	0.85	(0.21, 3.55)
Insured					1.00		1.00		1.00	
Lifestyle factors										
Current Smoker										
No							1.00		1.00	

Yes	0.92	(0.34, 2.48)	1.02	(0.31, 3.35)
Vigorous Physical Activity				
No	**1.78**	**(1.12, 2.82)**	**2.35**	**(1.42, 3.90)**
Yes	1.00		1.00	
Clinical Characteristics				
Diabetes Treatment				
No medication			1.00	
Oral medications			**0.32**	**(0.14, 0.73)**
Insulin			**0.18**	**(0.05, 0.60)**
Combination of oral medications and insulin			**0.12**	**(0.04, 0.39)**
BMI				
Underweight/ Normal			1.00	
Overweight			1.12	(0.49, 2.56)
Obese			1.11	(0.57, 2.17)
Depressive symptoms				
<3			1.00	
≥ 3			1.18	(0.57, 2.43)

Abbreviations: HS = high school
IRDSS = illness-related diabetes social support
[a]Model 1: crude model;
[b]Model 2: Model 1 + age, race/ethnicity, marital status,
[c]Model 3: Model 2 + education, annual household income, health insurance;
[d]Model 4: Model 3 + smoking status, vigorous physical activity;
[e]Model 5: Model 4 + diabetes treatment, BMI, depressive symptoms.

Table 4.7: Crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) of the associations of illness-related diabetes social support and other respondent characteristics with adequate glycemic control among females

Characteristics	Model 1[a]		Model 2[b]		Model 3[c]		Model 4[d]		Model 5[e]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
IRDSS										
Low support	1.00		1.00		1.00		1.00		1.00	
High support	1.64	(0.98, 2.75)	**1.95**	**(1.21, 3.15)**	**1.96**	**(1.20, 3.19)**	**1.92**	**(1.17, 3.15)**	**2.39**	**(1.44, 4.00)**
Socio-demographics										
Age			1.02	(1.00, 1.05)	1.02	(1.00, 1.05)	1.01	(1.00, 1.04)	1.01	(0.98, 1.04)
Race/Ethnicity										
Whites			1.00		1.00		1.00		1.00	
Blacks			**0.34**	**(0.17, 0.70)**	**0.37**	**(0.19, 0.73)**	**0.36**	**(0.18, 0.69)**	**0.40**	**(0.20, 0.79)**
Hispanics			**0.29**	**(0.13, 0.62)**	**0.32**	**(0.14, 0.71)**	**0.28**	**(0.11, 0.68)**	**0.19**	**(0.08, 0.47)**
Marital Status										
Not married			0.78	(0.42, 1.44)	0.84	(0.37, 1.91)	0.79	(0.35, 1.78)	0.77	(0.33, 1.80)
Married/coupled			1.00		1.00		1.00			
Education										
< HS					1.04	(0.57, 1.88)	1.12	(0.63, 1.99)	1.30	(0.72, 2.34)
HS					1.43	(0.77, 2.65)	1.39	(0.74, 2.58)	1.66	(0.86, 3.20)
> HS					1.00		1.00			
Annual Household Income										
<$17,000					1.00	(0.33, 3.05)	1.18	(0.38, 3.69)	1.43	(0.35, 5.92)
$17,000-$31,000					0.82	(0.29, 2.29)	0.84	(0.29, 2.45)	0.92	(0.26, 3.23)
$31,001-$54,000					1.28	(0.50, 3.30)	1.24	(0.48, 3.21)	1.32	(0.46, 3.75)
>$54,000					1.00					
Health insurance										
Uninsured					0.71	(0.34, 1.47)	0.65	(0.31, 1.36)	0.70	(0.26, 1.92)
Insured					1.00		1.00		1.00	
Lifestyle factors										
Current Smoker										
No							1.00		1.00	
Yes							**0.44**	**(0.22, 0.87)**	**0.40**	**(0.21, 0.73)**
Vigorous Physical Activity										
No							0.84	(0.46, 1.55)	1.04	(0.54, 2.00)

Yes	1.00	1.00	
Clinical Characteristics			
Diabetes Treatment			
No medication		1.00	
Oral medications		0.42	(0.16, 1.08)
Insulin		**0.09**	**(0.03, 0.22)**
Combination of oral medications and insulin		0.34	(0.10, 1.17)
BMI			
Underweight/ Normal		1.00	
Overweight		1.06	(0.49, 2.31)
Obese		1.37	(0.72, 2.60)
Depressive symptoms			
<3		1.00	
≥ 3		1.31	(0.68, 2.51)

Abbreviations: HS = high school
IRDSS = illness-related diabetes social support

[a]Model 1: crude model;
[b]Model 2: Model 1 + age, race/ethnicity, marital status,
[c]Model 3: Model 2 + education, annual household income, health insurance;
[d]Model 4: Model 3 + smoking status, vigorous physical activity;
[e]Model 5: Model 4 + diabetes treatment, BMI, depressive symptoms.

Table 4.8: Adjusted model[a] with odds ratios (OR) and 95% confidence intervals (CI) of the associations of illness-related diabetes social support with adequate glycemic control among females stratified by race/ ethnicity

	Whites (N= 309)		Blacks (N= 88)		Hispanics (N= 58)	
	OR	95%CI	OR	95%CI	OR	95% CI
IRDSS						
Low level	1.00		1.00		1.00	
High level	1.42	(0.91, 2.22)	0.56	(0.30, 1.04)	**5.75**	**(1.01, 32.63)**

Abbreviations: IRDSS = illness-related diabetes social support

[a]Adjusted model: illness-related diabetes social support, age, education, annual household income, marital status, health insurance, smoking status, vigorous physical activity, diabetes treatment, BMI, depressive symptoms.

Table 4.9: Crude and adjusted models with odds ratios (OR) and 95% confidence intervals (CI) of good glycemic control by individual types of illness- related diabetes social support variables stratified by gender

	Males				Females			
	Model 1		Model 2		Model 1		Model 2	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
LIFESTYLE MODIFICATION								
Meal Plan								
Low support	1.00		1.00		1.00		1.00	
High support	1.12	(0.62,2.04)	1.15	(0.61,2.15)	1.14	(0.63,2.06)	1.20	(0.66,2.20)
Physical Activity								
Low support	1.00		1.00		1.00		1.00	
High support	0.88	(0.51,1.50)	0.80	(0.41,1.55)	1.56	(0.92,2.64)	1.59	(0.91,2.80)
Weight Control								
Low support	1.00		1.00		1.00		1.00	
High support	0.96	(0.51,1.83)	0.95	(0.44,2.04)	1.44	(0.78,2.67)	1.32	(0.68,2.55)
MEDICALLY ORIENTED								
Taking medication								
Low support	1.00		1.00		1.00		1.00	
High support	0.93	(0.44,1.97)	1.25	(0.51,3.04)	0.77	(0.37,1.62)	0.95	(0.43,2.09)
Testing blood sugar								
Low support	1.00		1.00		1.00		1.00	
High support	0.94	(0.47,1.88)	1.10	(0.50,2.44)	1.23	(0.73,2.08)	1.38	(0.74,2.58)
Keeping appointments								
Low support	1.00		1.00		1.00		1.00	
High support	0.92	(0.40,2.09)	1.10	(0.42,2.86)	1.22	(0.68,2.22)	1.10	(0.59,2.05)
Taking care of feet								
Low support	1.00		1.00		1.00		1.00	
High support	1.13	(0.58,2.20)	1.18	(0.56,2.49)	1.42	(0.77,2.61)	1.85	(0.88,3.89)
EMOTIONAL ORIENTED								

Feelings about diabetes								
Low support	1.00		1.00		1.00		1.00	
High support	1.00	(0.58,1.74)	0.93	(0.50,1.71)	1.68	(0.96,2.94)	**2.05**	**(1.18,3.54)**

Abbreviations: HS = high school
IRDSS = illness-related diabetes social support

[a]Model 1: illness related variable

[b]Model 2: Model 1 + age, race/ethnicity, education, annual household income, marital status, health insurance, smoking status, vigorous physical activity, diabetes treatment, BMI, depressive symptoms.

CHAPTER 5

Discussion

5.1 ASSOCIATION BETWEEN ILLNESS-RELATED DIABETES SOCIAL SUPPORT AND GLYCEMIC CONTROL

The results from our study indicate that the association between illness-related diabetes social support (IRDSS) and glycemic control (GC) differs among males and females. While there were no significant associations between IRDSS and GC for males, there were significant associations between IRDSS and GC for females. Although the crude association between IRDSS and GC among females was not significant, after adjusting for key confounders, high levels of IRDSS were positively associated with adequate glycemic control.

To our knowledge, there are no other studies which have investigated the association between IRDSS and GC. Prior studies have demonstrated that the influence of social support on diabetes outcomes has different results in males and females who have diabetes. In a review by van Dam et al., spousal support in a peer education program targeted at weight loss had better results for women while the absence of spousal support had better results for men (32). Another review conducted by Gallant revealed that there was a positive association between illness-related diabetes social support and self-care in men but there were no significant associations in women (20). However, the outcome in each case was not glycemic control but diabetes self-care activities which are

pre-cursors to achieving glycemic control. While these studies do not provide direct support for or against our results, their results indicate that there are differences between males and females in the association between illness-related diabetes social support and diabetes outcomes.

The results found among males in our study on illness-related diabetes social support are generally consistent with that of other studies which have found no association between social support and glycemic control or HbA1c levels. In a study of adults with diabetes who were 40 and older using the National Health and Nutrition Examination Survey (NHANES), 2005- 2006, Rees et al. found that in general, there was no association between social support and HbA1c levels in models adjusted for age, gender, education, health insurance status, insulin use, self-reported health, functional disability and depression (30). However, this may be due to the fact that Rees et al. did not stratify by gender in their models. The findings from this study may also differ from Rees et al. because they used a measure of general social support and the present study used a measure of social support specific to diabetes self-care activities. The latter type of social support is linked specifically to activities which are both critical in diabetes management and are known to influence glycemic control as compared to general social support with a focus on support for everyday activities which are not disease-specific. An analysis of a convenience sample of 91 black and white individuals aged 19 and over who had type 2 diabetes found that there was no significant association between social support score and glycemic control (39) . Five things are noteworthy in light of those findings; 1) the

study had a small sample size and used a convenience sample; 2) the measurement scale for social support was different from what we used in our analyses; 3) the study focused on general social support as opposed to illness-related diabetes social support; 4) the study population did not specifically include only older adults and only consisted of blacks and whites and 5) The models were not stratified by gender.

The results of our study suggest that there are differences by gender in the way that illness-related diabetes social support affects the ability of middle-aged and older adults to achieve adequate glycemic control. It appears that IRDSS plays no role in achieving glycemic control for males but may be very important for females. In a study by Misra and Lager, females were found to have more challenges in performing certain self-care activities in comparison to males (24). Therefore, it is possible that females may have a greater reliance on family or friends in helping them cope with the challenges of carrying out diabetes self-care activities.

Consistent with the prior literature on health disparities in glycemic control, our results demonstrated significant racial/ethnic differences. Hispanic males and females had lower odds of adequate glycemic control compared to white males and females, even after adjusting for confounders. Black females had lower odds of adequate glycemic control in comparison to white females; however, we did not observe any differences between black males and white males. Our results are also consistent with another study conducted in a population of black and white older adults using the Health, Aging and Body

Composition Study in which poor glycemic control was categorized as HbA1c ≥ 7% and in which there was no stratification by gender (19). This study found glycemic control to be worse in blacks compared to whites (19). In yet another study on a sample of adults aged 18 and over using the third National Health and Nutrition Examination Survey (NHANES III) with comparable results to our findings, HbA1c levels were higher in blacks than in whites in both unadjusted models and models adjusted for factors including fasting and 2-hour oral glucose tolerance test results (28). Saydah et al., in a study using NHANES, 1999- 2002, a nationally representative sample, also found that in fully adjusted models, Hispanics had significantly lower odds of HbA1c < 7% (good glycemic control) compared to whites (10). However, this association was not significant in blacks in the fully adjusted model. These analyses were not stratified by gender.

Our results are to some degree, inconsistent with two longitudinal analyses on a sample of black and white veterans where HbA1c levels were used continuously as well as categorically (3, 25). The categories were exactly the same as that used in our study. In both studies, blacks had poorer glycemic control compared to whites with the use of both the continuous and the categorical variables (3, 25). However, both samples consisted of 98% males. In this case, the results are different from our findings for males which showed no significant association between race (blacks compared to whites) and glycemic control. These studies had larger sample sizes in comparison to ours. Therefore, it is possible that we did not have enough statistical power to show these differences.

Generally, our results show that Hispanics and blacks have greater difficulty in achieving adequate glycemic control even after adjusting for confounders. It is still not clear what the reasons for these differences are. Our results suggest that IRDSS partially accounts for some of the racial/ethnic differences in glycemic control. If intervention strategies are developed to address IRDSS, it will only have a moderate impact on social disparities in glycemic control.

Our results show that increasing age is associated with adequate glycemic control in males. Chiu and Wray also found similar results in general (not stratified by gender) with a negative association between age and HbA1c levels (57). However, this was seen in a model which only adjusted for age and race/ ethnicity. These results do not show a clear link between increasing age and adequate glycemic control as this was only seen in males and was marginally significant. Further studies in that regard are necessary using other samples.

Interestingly, males who did not participate in vigorous physical activity had higher odds of adequate glycemic control than those who participated but there were no significant associations seen in females. This may have been seen because our physical activity variable measured vigorous physical activity as opposed to moderate physical activity. Low levels and lack of physical activity have been cited as risk factors for the development of diabetes (16, 58). In future analyses studies, it would be important to evaluate the potential for an association between moderate physical activity and glycemic control using a proxy which better measures moderate physical activity.

We also found that females who were current smokers had lower odds of adequate glycemic control compared to those who were not smokers at the time. This is a finding which has been mirrored in a review where current smokers were found to be more likely to have higher HbA1c levels (59). Conversely, there were no significant associations seen in males. Ali et al. conducted a study using data from NHANES and the Behavioral Risk Surveillance System (BRFSS) on a nationally representative sample of adults who self-reported diabetes which spanned the period, 1999-2010 and found that there was no significant change in the proportion of individuals who used tobacco (60).

Smoking and physical activity are known to influence diabetes and are both modifiable activities. Therefore, it is vital that health practitioners continue to stress the importance of lifestyle modification activities to individuals who have diabetes.

Males and females who used insulin had lower odds of adequate glycemic control compared to individuals who took no medication. In addition, males who took oral medications or a combination of oral medications and insulin had lower odds of adequate glycemic control compared to males who took no medication. Consistent with the results seen in males, Saydah et al. found that there were lower odds of HbA1c < 7% (good glycemic control) in those who took insulin alone, oral medications alone or a combination of insulin and oral medications compared to those who took none of those medications (10). From these results, it appears that individuals who take some form of medication for diabetes have a harder time achieving glycemic control. Further, Ali et al note that diabetes

medications are becoming more complex and expensive (60).This suggests that individuals require more intensive drug therapies to help in managing diabetes and its symptoms. Therefore, in an effort to help these individuals, lifestyle modification may be of greater importance to help offset the effects of medication use.

5.2 RACE/ETHNICITY AS AN EFFECT MODIFIER OF THE RELATIONSHIP BETWEEN ILLNESS-RELATED DIABETES SOCIAL SUPPORT AND GLYCEMIC CONTROL

Our findings provide weak evidence for race/ethnicity as an effect modifier of the relationship between IRDSS and GC. We observed that Hispanic females with high levels of IRDSS, after adjusting for socio-demographic characteristics, lifestyle factors and clinical characteristics, had a 5.75 (95%C CI: 1.01, 32.63) odds of adequate glycemic control in comparison to those with low levels of IRDSS; however we did not see a significant association among white and black females. It is important to note the wide confidence interval which is the result of the small sample size of Hispanics. These results should therefore, be interpreted with caution. Nonetheless, it has been noted that Hispanics have poorer access to health care and lower adherence to treatment even if access to health care is available (27). Interpersonal relationships are also of great importance for Hispanics and receiving support from family members has been known to result in an increased desire to perform recommended self-care activities among Hispanics (27).Further, it has been noted that Hispanics with

diabetes feel that checking their blood sugar is more challenging in comparison to blacks and whites (27).

This coupled with the greater reliance of females for support from family and friends may be a reason for the observed association. In general, our findings are somewhat consistent with prior studies. For example, in the study by Rees et al., no significant interactions were found between social support and race/ethnicity for models with HbA1c levels as an outcome (30). Rees and colleagues, however, did not use a sample specific to older adults and their social support scale and operational definition of social support were different from that used in our analyses.

5.3 ASSOCIATION BETWEEN INDIVIDUAL ILLNESS-RELATED DIABETES SOCIAL SUPPORT VARIABLES AND GLYCEMIC CONTROL

The mechanisms linking social support and diabetes outcomes are not clearly understood (1). To further elucidate the mechanisms, we examined whether the strength of the association between type of IRDSS and glycemic control differed by self-care support for lifestyle modification activities, medically oriented activities, or emotional support? Our hypothesis that the association between individual types of illness-related diabetes social support and glycemic control will be the strongest for lifestyle modification self-care activities (i.e. illness-related diabetes social support for meal plan, getting enough physical activity, and weight control) after adjusting for confounders was not supported. Our findings suggest that, among females, those with emotional support were

more likely to achieve adequate glycemic control (OR: 2.05; 95% CI: 1.18, 3.54). It is an emotional support oriented activity which may have an influence on all the other diabetes self-care activities. In a meta-analysis by Lustman et al, it was found that depression was significantly associated with poor glycemic control (61). It follows that a lack of IRDSS for handling feelings about diabetes may lead to depressive symptoms and or depression (61). Depression may then result in a lack of motivation to carry out lifestyle modification and medically oriented diabetes self-care activities with the outcome being poor glycemic control. In a study conducted among Mexican Americans with type 2 diabetes, it was found that these women are more likely to choose extreme responses on survey items based on their social gender roles (62). These roles are of two types; assertive or submissive (62). Assertive women are more likely to choose responses which do not show a vulnerable nature and submissive women are more likely to choose responses which show their submissive nature (62). Therefore, it is possible that "assertive" females in this study chose responses to the IRDSS questions which would indicate poor reliance on support from family and friends while "submissive" females may have chosen responses which showed high reliance on support from family and friends. Since Mexican Americans are also Hispanics, this may be a reason as to why this association was seen only among Hispanic females. In descriptive analyses, we observed several significant racial/ethnic differences in the reported levels of IRDSS support for individual self-care behaviors. We lacked the statistical power to test whether there was effect

modification present by race/ethnicity. Future studies with more adequate sample sizes may help to explore this.

5.4 STRENGTHS AND LIMITATIONS

Our study has many strengths. The HRS is a multi-ethnic study of adults aged 50 and over which afforded us the opportunity to perform analyses based on data from three different racial ethnic groups; whites, blacks and Hispanics. Additionally, the measure of HbA1c is a direct measure from biomarker data. The reliability of the classification of individuals based on the outcome is therefore, increased. Our sample represented a fairly high percentage (74%) of the total number of individuals who had valid HbA1c readings which increased the generalizability of the findings. Another strength is the use of illness-related diabetes social support as opposed to general social support since IRDSS is known to have a stronger association with diabetes outcomes in comparison to general social support. Further, data was available on individual types of illness-related diabetes social support variables for important self-care behaviors.

The study was not without limitations. The analysis was cross-sectional in nature. Therefore, the temporality sequence was not clear and causality could not be determined. For example, it is not possible to assess whether a Hispanic females' levels of IRDSS influenced their glycemic control status or if having a certain glycemic control status resulted in higher or lower levels of IRDSS. There is also the potential for exposure misclassification since individuals who neither agreed nor disagreed were placed in the same category of low support as those

who strongly disagreed and disagreed that they had IRDSS. It is possible that the latter individuals had no support while those who neither agreed nor disagreed had low support. This could have resulted in differential misclassification of the exposure and could have biased the results towards the null. The result would be an attenuated measure of association. This may partially explain the lack of non significant associations between IRDSS and GC observed among males and the associations seen among females could have been diluted. The use of a categorical exposure variable may have also resulted in a loss of power and may have led to only partial adjustment for confounders. This may have biased the results away from the null and led to an accentuated measure of association. The use of a continuous exposure variable for illness-related diabetes social support would help to alleviate these issues and it will be explored in further analyses. In addition, many of the variables used were based on self-reported data and this may have resulted in social-desirability bias leading to differential misclassification of important confounders such as current smoking status, vigorous PA, income, BMI, depressive symptoms. Further, the sample sizes for blacks and Hispanics were small in comparison to whites. Therefore, this may have resulted in a lack of statistical power for testing the interactions by race/ethnicity. Since different time points were used, namely 2002 and 2003, confounders such as marital status, smoking status, vigorous physical activity status, diabetes treatment and BMI may have changed with time. This may have resulted in random measurement error which may have biased the results towards the null. However, we do not believe that this would have a

significant impact on our results. Further, it was not possible to examine other measures of social support such as social networks and social ties as these variables were not available in the HRS. The availability of these measures would be another way of assessing the association between yet another social support measure and glycemic control in an effort to better understand the impact of other psychosocial factors on diabetes outcomes. There is also the possibility of residual confounding if certain confounders, especially those based on self-report like income, smoking status, vigorous PA, BMI, were measured erroneously. As such, the residual effect of these confounders would still be present even after adjusting for them.

5.5 CONCLUSION

In summary, our findings suggest that there are differences in the role of illness-related diabetes social support and glycemic control by gender. However, Hispanic race/ethnicity also influences the role of IRDSS on GC among females. Additionally, IRDSS for handling feelings about diabetes is also significant in achieving adequate glycemic control in females. Although the literature in general supports the association between high levels of social support and diabetes outcomes such as improved self-care activities and glycemic control, there is still much debate regarding the direction of causality of this association, the use of different sources and means for delivery of social support and understanding the specific mechanisms of how social support operates to influence diabetes

outcomes. For example, most studies examining social support and glycemic control, including this one have used cross-sectional study designs. However, this study contributes to the literature in several important ways. It is the first study which explored the association between social support and glycemic control using a measure of social support which focused on diabetes related support. This study is also, by extension, the first study which looked at race/ethnicity as an effect modifier of the association between illness-related diabetes social support and glycemic control. Further, it is the first study, to our knowledge, which investigated the association between individual illness-related diabetes social support variables and glycemic control.

Despite these limitations, the results of this study have the following potential implications. Firstly, interventions should be targeted at Hispanic females so that they have the necessary illness-related diabetes social support to help them in achieving adequate glycemic control. Secondly, it is also necessary to continue stressing the importance of lifestyle modification through the use of diabetes education groups and health care providers, as it relates to smoking and physical activity. This may be especially helpful to individuals who take oral medications, insulin or a combination of these medications as they were found to have poorer glycemic control. Thirdly, interventions need to be tailored to blacks and Hispanics in an effort to help them with better diabetes management and in achieving adequate glycemic control.

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APPENDIX A – ILLNESS-RELATED DIABETES SOCIAL SUPPORT BY GLYCEMIC CONTROL 2 X2 TABLES

	Males		Females	
Whites	Poor glycemic control	Good glycemic control	Poor glycemic control	Good glycemic control
Low level support	34	134	34	118
High level support	38	174	23	134
Blacks				
Low level support	2	16	12	21
High level support	9	23	18	37
Hispanics				
Low level support	3	7	9	8
High level support	8	11	10	31