ASSOCIATION OF NUTRITION EDUCATION WITH THE DELAY OF THE CONVERSION OF PRE-DIABETES TO DIABETES IN HYPERGLYCEMIC VETERANS

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BY

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To the Dean of the Graduate School:

I am submitting herewith a thesis written by Megan Erickson entitled "The Development of Diabetes in Hyperglycemic Veterans Who Receive Nutrition Education." I have examined this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science with a major in Nutrition.

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DEDICATION

For my husband, Seth Erickson, thank you for your never-ending love and support through this whole journey.

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ABSTRACT

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Diabetes is a multi-factorial, complex disease where lifestyle changes including diet and exercise can play a pivotal role in its prevention and management. This retrospective study determined the effectiveness of an outpatient nutrition education program in preventing/delaying the diagnosis of type 2 diabetes. Hyperglycemic Veterans (n=372) were divided into a treatment group that received nutrition education (n=207) and a quasi-control group that did not receive nutrition education (n=165). Body weight, body mass index (BMI) and hemoglobin A1c (HbA1c) changes were analyzed using Cox Proportional Hazards and chi-square tests. Data indicated significantly fewer Veterans were diagnosed with diabetes in the treatment group compared to the control group ($p < 0.0005$). Covariates of age, HbA1c and BMI were positively associated with diabetes. A diagnosis of diabetes occurred 2-3 months later for Veterans receiving nutrition education. Nutrition education significantly delayed the conversion of pre-diabetes to a diagnosis of diabetes among Veterans.

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CHAPTER I

INTRODUCTION

The prevalence of diabetes mellitus (DM) continues to increase around the world. Diabetes Mellitus is a multi-factorial, complex disease, affecting nearly 25.8 million people in the United States, or 8.3 percent of the population (diagnosed or undiagnosed), spanning all age and ethnic groups (Centers for Disease Control and Prevention [CDC], 2011). In 2010, approximately 1.9 million people 20 years or older were newly diagnosed with diabetes. Being the seventh leading cause of death in the United States, diabetes has frequent complications, such as kidney disease, cardiovascular disease (CVD), blindness, amputations, heart disease, and strokes. Some of the major contributors to the development of Type 2 DM are dietary intake, physical inactivity, and obesity (CDC, 2011). The development and/or prevention of diabetes is of interest to many researchers. Studies show the prevention of this disease is cost effective and can be affected by education and changes in lifestyle, self-management, and medical nutrition therapy.

The Veterans Health Administration (VHA) is the nation's largest integrated healthcare system operating with 155 medical centers and 872 community and outpatient clinics. In 2006, five and a half million Veterans were served and more than 60 million outpatient clinic visits were scheduled (Kinsinger et al., 2009). The Michael E. DeBakey VA Medical Center (MEDVAMC), in Houston, Texas, and its outpatient clinics is one of

the largest facilities within the VHA serving approximately 130,000 Veterans as of 2008 (Everett, Jenkins, Kerr, & Cavan 2007). This span and influence provides a unique opportunity to address major health concerns and the VHA has responded by developing and implementing programs. As the VHA continues to increase the number of patients being served, it is prudent to continue evaluating programs targeting the prevention and treatment of diabetes.

In 2002, the VHA National Center for Health Promotion and Disease Prevention (NCP) began developing a multidisciplinary, standardized, evidenced-based weight management program entitled *MOVE!*. After a preliminary trial in 17 volunteer VHA facilities between October 2003 and December 2004, *MOVE!* was implemented nationally in January 2006 (Kinsinger et al., 2009). Unlike VHA programming for weight management a standardized, nationwide approach for pre-diabetes currently does not exist. Diabetic and pre-diabetic patients at the MEDVAMC are referred to an appointment with a dietitian or to diabetes education classes taught by Certified Diabetes Educators (CDEs). The goals of these classes are based on American Diabetes Association's "Nutrition Therapy Recommendations for the Management of Adults with Diabetes." After attending one group diabetes class, participants may autonomously elect to follow up in individual counseling sessions or the *MOVE!* Program. Lifestyle changes can play a pivotal role in its prevention and management.

Understanding the prevalence of diabetes in the Veteran population can help the VHA in terms of care and research priorities. The objective of this study was to evaluate

the efficacy of current efforts at the MEDVAMC in preventing and delaying the onset of diabetes. A database was explored to investigate the effectiveness of the existing outpatient nutrition education. It was sought to establish if existing outpatient nutrition education programs prevented/delayed the diagnosis of diabetes longer in Veterans attending these programs when compared to Veterans who did not receive nutrition education and counseling.

Hypothesis

This study hypothesized that an existing outpatient nutrition education program would be effective in delaying/preventing the conversion of pre-diabetes to the diagnosis of type 2 DM among hyperglycemic Veterans.

CHAPTER II

REVIEW OF LITERATURE

Pre-diabetes and Diabetes

There are two main types of diabetes mellitus (DM): type 1 DM and type 2 DM. Type 2 DM accounts for 90-95% of cases in the United States (Nelms, Sucher, Lacey, & Long, 2007). This disease typically develops in adults and is very commonly associated with obesity. The progression from normal glucose tolerance to type 2 DM can take years, including observation periods of hyperglycemia and insulin resistance. However there is still adequate insulin production to meet demands. Individuals in this transitional step, with glucose levels too high to be considered normal, yet not high enough to be classified as diabetic, are considered "at-risk" for diabetes or to have "prediabetes." This group is defined as having impaired fasting glucose (IFG) (fasting plasma glucose levels of 100-125 mg/dl), impaired glucose tolerance (2-hour oral glucose tolerance test [OGTT] values of 140-199 mg/dl), or a hemoglobin A1c (HbA1c) between 5.7% and 6.4% (American Diabetes Association, 2014). Early treatment has been shown to prevent the development of type 2 DM, and one may lower their risk by 58% with weight loss and exercise in the research setting (Knowler et al., 2002a). However, whether these effects are seen in real practice is a matter of debate. Globally, the prevalence of diabetes is estimated to increase from 382 million to 592 million by 2035 (McLellan, Wyne, Trejo Villagomez, & Hsueh, 2014).

Microvascular and macrovascular damage can be complications from uncontrolled diabetes. This damage can start as early as when one has "prediabetes". Because of elevated glucose levels, damage to the endothelial cells can lead to microvascular disease. Microalbuminuria is an indicator of microvascular damage and is two times more likely present in subjects with prediabetes versus subjects with normal glycemic levels. Also, based on the National Health and Nutrition Examination Survey, there is a 7.1% increase incidence of chronic kidney disease in subjects who had prediabetes versus those without prediabetes (McLellan, Wyne, Trejo Villagomez, & Hsueh, 2014). These observations support the need for early interventions to help prevent the adverse impact prediabetes can have on multiple target organs. The question remains, however, if programs should be implemented when someone is diagnosed with "prediabetes."

Prevalence of Diabetes

Specifically related to type 2 DM, both the elderly and minorities tend to be disproportionately affected. According to the Centers for Disease Control and Prevention (CDC, 2011), type 2 DM is associated with older age, obesity, a family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity. African Americans, Hispanic/Latino Americans, American Indians, some Asian Americans and Native Hawaiians, and other Pacific Islanders are impacted the most. The prevalence among United States Veterans is significantly greater than the general population and is of importance in the Department of Veterans Affairs

(VA) in terms of care and research priorities. One in five patients in the VA have diabetes, and one in four patients who belong to a racial or ethnic minority in the VA have the disease (Miller, Safford, & Pogach, 2004).

Glycemic Control

Many people who are hyperglycemic can make lifestyle changes to prevent the development of type 2 DM. Diabetes mellitus is simply defined as persistent fasting glucose above 125 mg/Dl, a random glucose value over 200 mg/Dl or a glucose over 180 mg/Dl two hours after a glucose load. Dietary modification and increased physical activity improve glycemic control (American Diabetes Association, 2012).

Self-monitoring of blood glucose (SMBG) has been shown to be helpful for patients because it links their lifestyle behaviors to their glucose levels. Behavioral weight loss interventions were studied by McAndrew et al. (2012) to see if there was an impact on weight loss and reduction of HbA1c among participants who practiced SMBG. A positive association was shown between increased frequency of SMBG and greater weight loss and decreased HbA1c. Self-monitoring of blood glucose provides meaning to patients. By becoming motivated to adhere to dietary recommendations and self-management behaviors, it may help prevent further complications of the progressing disease (McAdnrew, 2012).

Cost of Diabetes

Healthcare costs directly associated with DM were estimated as $245 billion in 2012, which is a 41% increase from 2007 of $174 billion (American Diabetes

Association, 2013). Medical expenses for people with diabetes are more than two times higher than for people without diabetes (CDC, 2011). Maintaining a modified lifestyle may lead to the greatest benefits and at a reasonable cost (Caro, Getsios, Caro, Klittich, & O'Brien, 2004).

VA Care Coordination Home Telehealth (CCHT)

The Department of Veterans Affairs (VA) has developed services to aid Veterans in getting treatment for their complex medical conditions via home as it provides more convenience. It also may delay the development of their conditions and prevent future hospitalizations. Home telehealth is a communication tool between the patient and a home care provider providing insight into patients' health information. It has been said home telehealth can help detect early stages of possible health issues, improve access to care and compliance with treatment plans. The national VA Care Coordination Home Telehealth (CCHT) program was developed to help improve accessibility and provide access to care to Veterans with chronic illness, such as diabetes. With diabetes being so costly, this tool may help prevent hospitalizations and further health issues. In 2009, a study was performed to determine if the VA CCHT program lowered the probability of preventable hospitalizations over a four-year period. Veterans enrolled had DM for four years. During the first eighteen months of follow-up, patients enrolled in VA CCHT program were less likely to be admitted (statistically significant) verses the control group for diabetes management (Jia, Chuang, Wu, Wang, & Chumbler, 2009); however there was no significance during the next two and a half years of the study. The frequency of

hospitalization occurrences during the four-year period decreased between the treatment group and control for uncontrolled diabetes, respectively (4, 15) ($p<0.05$). These findings support the benefits of preventive care in chronic illnesses, as well as being cost-effective by reducing hospitalizations.

Lifestyle Education Intervention Programs

According to one study, the incidence of developing type 2 DM could be reduced by fifty-eight percent in participants who make lifestyle changes (Tuomilehto et al., 2001). Another study was conducted to determine if high-risk participants with pre-diabetes (defined as a fasting glucose at 100-125 mg/Dl) and/or the metabolic syndrome who participated in a Group Lifestyle Balance (GLB) program could reduce their risk factors for type 2 DM and CVD. The GLB program was a 12-session group lifestyle intervention adapted from the Diabetes Prevention Program (DPP), which was delivered over 12 to 14 weeks by diabetes educators. Individuals attended each hour-long session at an outpatient hospital-based clinic, and received handouts, weekly self-monitoring booklets, a fat- and calorie- tracking book, and a pedometer. Of the 81 participants, the mean overall weight loss was 11.3 pounds (5.1%, $p<0.001$), and there were significant decreases in fasting plasma glucose, low-density lipoprotein cholesterol, and triglycerides levels and blood pressure. A positive correlation was shown between the number of sessions attended and weight loss ($p<0.001$). A reduction in weight, waist circumference, body mass index, and glucose were effective outcomes for the GLB program. These findings support the positive impact of health professionals, specifically diabetes

educators, on reducing the risk for diabetes in high-risk individuals (Kramer, McWilliams, Chen, & Siminerio, 2011). Also, motivation and adherence seemed to play a role in this study with positive outcomes that may be difficult to apply in VA setting.

Continued research involving group education for patients with suboptimally uncontrolled diabetes is desirable due to the relatively limited number of studies in this area. A prospective multisite randomized controlled study aimed to determine if there was a difference between group education, usual care and individual education for improving glucose control and psychosocial and behavioral outcomes. A total of 623 patients with type 2 diabetes were recruited from two large medical groups in New Mexico and Minnesota. Interventions were derived from the American Diabetes Association (ADA) education program, and both education groups (group and individual) strived to help patients set personalized action-oriented goals. Results revealed the individual education group was significantly ($P=0.03$) more likely than someone who was receiving usual care to have a follow-up HbA1c measurement of 7% or lower. Interestingly, those receiving individual education were more likely to be adherent to interventions and have a greater proportion of participation and completion of the sessions than group education ($P<0.001$). Better glucose control outcomes were indicated, as well as a positive trend toward better psychosocial and behavioral outcomes with individual education (Sperl-Hillen, 2011).

Diabetes Knowledge

Knowledge about diabetes is important in the management of this disease, especially the source of this knowledge. Improvements in diabetes management have been shown with proper instruction. Knowledge about the condition of DM can be obtained from one-to-one encounters with a physician, Registered Nurse, or Registered Dietitian, Diabetes Educators, diabetes education programs, or by self-monitoring of blood glucose (SMBG) (Bruce, Davis, David, & Carole, 2003).

The Fremantle Diabetes Study (FDS) is a prospective observational study of the care, metabolic control and complications in diabetes. Type 2 DM patients were recruited from an urban Australian community (Davis et al., 2000). Participants were asked fifteen standard multiple-choice questions including causes of diabetes, glycemic control and therapy, diet, exercise, smoking, and diabetes complications. Results were 68.1% of the participants attended diabetes education programs, 35.1% visited a Registered Dietitian ($p < 0.001$), and 73.8% performed SMBG ($p < 0.001$). Individuals who had prior participation in one of these categories had a higher knowledge of diabetes and better glycemic control. There was a significant association of knowledge of diabetes with diabetes education, dietitian visits, and SMBG, as well as education level and English fluency. Some participants had low participation in diabetes education due to barriers, such as age, ethnicity, or language. Thirty percent of the elderly (>65 years) were less likely to participate in diabetes education, dietitian visits, and SMBG. Almost 60% of individuals not fluent in English were less likely to participate as well. Thus,

these findings indicate that specific groups of people may benefit from specialized tailored programs (Bruce, Davis, David, & Carole, 2003).

Self-care Skills

When is knowledge not enough? Individuals are held accountable for what they learn, but the development of diabetes and the self-care of diabetes may be related to behavior skills as well. A Skills Program in matching Insulin Requirements to Eating and Exercise (ASPIRE) was designed in 2005 for patients with DM that focused on developing new skills for self-management, including correctly calculating insulin doses to match dietary and exercise habits. The ASPIRE framework was based on the Social Learning Theory, which describes the way people become confident in self-managing their diabetes and developing the ability to make appropriate behavior changes. Groups of six to eight people met at local community centers where a kitchen and exercise facility was available. Teaching strategies such as group work, role play, and workshops were utilized. Participants kept a food, exercise and reflection diaries, and participants' blood glucose levels were shared with the group on a weekly basis. HbA1c was measured at three, six, and twelve months, and a quality of life questionnaire administered. Results indicated that correctly matching insulin doses does improve the physical and psychosocial health of people with type 1 DM. Hemoglobin A1c was improved and can be supported by similar studies (DAFNE Study Group, 2002; Everett, Jenkins, Kerr, & Cavan 2007). An improvement in HbA1c assists in reducing the risk of developing diabetes related complications. The quality of life questionnaire indicated a

notable and highly significant improvement in quality of life. Four key themes were identified in this program by participants: motivation, self management, confidence and empowerment. This study shows that not only is education important in the prevention and/or management of diabetes but other factors such as behaviors can play an important role as well (Clark, 2008).

Self-management

Self-management is an important factor in glycemic control. Patients may have trouble following treatment prescriptions, as well as lifestyle recommendations. Other factors, such as depression may impact on how well someone may adhere to their treatment plan. It is unclear if implementing structured behavioral interventions has a positive effect. A randomized controlled trial was designed to test if highly structured behavioral diabetes education programs would help patients with long-term, poorly controlled diabetes improve their glycemic control. Adults with both Type 1 DM (n=110) and Type 2 DM (n=112) were randomized to attend (1) structured behavioral arm; (2) group attention control arm; or (3) individual control arm. Outcomes were measured at baseline and at three, six and twelve month post-intervention. Cognitive behavior strategies and structured goal-setting activities were a part of the curriculum in the structured behavioral arm. All three arms showed improvement in glycemic control ($P < 0.001$). However, the structured behavioral arm showed the most improvement in glycemic control in Type 2 diabetics. Those with Type 1 diabetes improved equally between the structured behavioral arm and individual control arm. There was an overall

0.67% reduction in HbA1c level over the span of twelve months. This trial was one of the first trials to conduct head-to-head comparisons of self-care interventions. It supports that structured, cognitive behavioral programs are becoming more effective in improving glycemic control in adults with diabetes (Weinger et al., 2011).

Self-management care is an ongoing struggle for providers to implement in their patients as there tends to be barriers due to lack of knowledge, motivation and funding for ongoing support. Literature shows that disease management programs, which may include telephone support, benefit patients and have improved outcomes such as lower HbA1c values. However, socially and economically disadvantaged patients have not been extensively studied. Patients with Type 2 DM consisting primarily of poor, uninsured ethnic minorities that had uncontrolled diabetes were recruited to participate in a randomized controlled trial. Participants in the control group only received a twenty page brochure "4 Steps to Control Your Diabetes for Life." Participants in the treatment group received a twenty-four minutes long DVD program along with a book, as well as five telephone coaching sessions totaling 2.5 hours. The control group was inspired to indentify attainable goals to promote a positive impact on their diabetes. There was a significant reduction in mean HbA1c value from baseline (9.6%) to 6 months (9.1%), but results showed no significance between groups, as well as clinical measures such as lipid levels and blood pressure (Frosch, Uy, Ochoa, & Mangione, 2011). Although there was no significant difference found, the study provides insight on how self-management training can impact someone with diabetes. It also shows five telephone sessions were

not sufficient for this vulnerable population with diabetes. Challenges are faced by many and therefore more interventions may be worthwhile to help control poorly managed diabetes.

Recent research indicates that medical nutrition therapy (MNT) is a key factor of diabetes management. The American Diabetes Association (ADA) 2009 clinical guidelines recommend that "individuals who have pre-diabetes or diabetes should receive individualized MNT as needed to achieve treatment goals" (Morris, 2010). Medical nutrition therapy can also reduce economic burden of DM. Patients who received MNT versus those who did not receive MNT reduced hospital services utilization (9.5%) and physician services overall, thereby reducing their healthcare costs (Pastors, Warshaw, Daly, Franz, & Kulkarni, 2002). Laboratory values, such as HbA1c, can be improved through MNT interventions as well (Johnson & Thomas, 2001). As nutrition experts who are responsible for providing MNT, Dietitians use appropriate education to assist people in managing the disease.

One may accept that lifestyle change along with diet can control or prevent the onset of diabetes. Research studies in the prevention of diabetes often develop specific nutrition interventions for the study. However, outside the research setting, does routine nutritional clinical care and education make a difference? The impact of nutrition education in routine medical care has not been investigated.

CHAPTER III

MATERIALS AND METHODS

Study Population

The design of this study was a retrospective cohort. A database was developed with de-identified information/variables of patients seen in or referred to an out-patient nutrition clinic from 2007 through 2012. A computer program was written by a VA Preventative Medicine Coordinator to collect medical and time data (nutrition encounters, diabetes onset, etc.). Participants were United States Veterans using the services at the MEDVAMC. They were 18+ years old. Patients were not contacted to obtain consent because the database contained no identifiable data or contact information. The study was approved by the Institutional Review Boards at Baylor College of Medicine, The Michael E. DeBakey VA Medical Center and Texas Woman's University.

Veterans' medical records were documented in an electronic health record called CPRS (Computerized Patient Record System). The electronic health record coded clinical encounters by type, date, and clinic, which allowed for identifying and categorizing visits, such as nutrition visits. Within the VA Nutrition and Food Services, patient encounters were categorized by the event capture system that distinguishes between individual and group visit types. Furthermore, electronic objects such as clinic types (weight loss, individual, group, diabetes, etc.) were available in the VA corporate data warehouse.

The variables of interest in this study were height, weight, diagnoses, medications, visits/encounters in specified nutrition clinics, dates or no-shows, and laboratory data including glucose and HbA1c. All of these were available through the VA corporate data warehouse as electronic objects. The distinction between random and fasting glucose values was not noted in the VA's computerized patient record system lab sets; therefore, both appear as "glucose" in the database. The method utilized to measure glucose was a chemistry analyzer by an enzymatic and colorimetric reaction. Hemoglobin A(1c) was measured by high performance liquid chromatography.

Inclusion criteria included patients who had glucose levels between 100-125 mg/Dl, a HbA(1c) between 5.7-6.4 percent, or a diagnosis of hyperglycemia by the physician (fasting glucose >100 mg/Dl) who were scheduled to be seen in an outpatient nutrition clinic between July 2007-2012. The aforementioned dataset was used to define two groups: the treatment group, which consisted of patients who received education with one or more encounters in the nutrition clinics, and the quasi-control group, which consisted of patients who were referred to the clinics but did not attend, had a cancellation or were no-show.

Exclusion criteria included patients who were prescribed glucocorticoids, blood glucose regulation agents, insulin, oral hypoglycemic agents, other hypoglycemic agents, phenytoin, and/or epinephrine between July 2007-2012. Patients were also excluded with baseline diagnoses of diabetes, pancreatic cancer, cystic fibrosis, hemochromatosis, pancreatectomy, or with random glucose above 200 mg/Dl.

Study Design

Once participants were divided into the treatment and control groups, variable changes during the observation periods, from inclusion to 2012 were analyzed. Clinic visits, as well as dates attended, were identified. Changes in diagnoses were identified. Participants with a new diagnosis of diabetes, glucose greater than 200 mg/Dl, or with a HbA1c greater than 6.5 percent in the observation period were considered to have developed diabetes.

Four groups of Veterans existed at the conclusion of this study: (a) Veterans who attended outpatient nutrition education clinics and converted from pre-diabetes to a diagnosis of diabetes [n=136], (b) Veterans who attended outpatient nutrition education clinics and did not convert from pre-diabetes to a diagnosis of diabetes [n=71], (c) Veterans who did not attend outpatient nutrition education clinics and converted from pre-diabetes to a diagnosis of diabetes [n=151], and (d) Veterans who did not attend outpatient nutrition education clinics and did not convert from pre-diabetes to a diagnosis of diabetes [n=14].

Nutrition Education

Diabetic patients at the Michael E. DeBakey VA Medical Center (MEDVAMC) and those at-risk of developing DM are referred, at the discretion of their primary care physician, to diabetes education classes taught by Certified Diabetes Educators (CDEs). The goals of such classes are based on ADA's recommendations for MNT and include the following goals: maintaining blood glucose in a normal range, normalizing blood lipids, obtaining a healthy blood pressure, obtaining and maintaining a reasonable weight,

making healthier food choices, incorporating physical activity into the daily routine, and preventing complications. Participants are also encouraged to consume a consistent amount of carbohydrate at meals and are provided with information on how to read food labels. After attending one group diabetes class, participants may autonomously elect to participate in several one-hour-long individual counseling or a group weight management program or classes (*MOVE!*).

Statistical Analysis

Descriptive statistics, including means and standard deviations for continuous variables were calculated for the treatment and quasi-control groups. Data were analyzed to evaluate if there was a difference in the time converting from pre-diabetes to a diagnosis of diabetes in hyperglycemic Veterans who receive nutrition education versus those who did not. Statistical analysis was completed using the IBM Statistical Package for the Social Sciences (SPSS) software, version 21. An alpha of 0.05 was used. Influential data points were screened. A Cox Proportional Hazards Model was used to analyze the data to determine the odds of converting from pre-diabetes to a diagnosis of diabetes. The four covariates (treatment/quasi-control group, age, BMI and HbA1c) were used to predict the time of converting from pre-diabetes to a diagnosis of diabetes for Veterans. A P-value of <0.05 was considered statistically significant. Odds ratios and 95% confidence intervals were reported for treatment/control group, age, pre-intervention BMI and pre-intervention HbA1c. Survival analyses incorporated both time and outcome in order to determine the time until the occurrence of an event of interest. Survival

analysis was used because this test described the length of time (measured in days) between first nutrition visit and the time of diagnosis of diabetes, if present. Chi-square (used to compare expected data that is collected) or equivalent non-parametric test was used to count the number of Veterans in each of the four categories and tested for significant difference between groups. Descriptive statistics were used for age, ethnicity, weight, height, body mass index (BMI), HbA1c and baseline diagnosis of impaired fasting glucose, hyperglycemia and glucose intolerance.

CHAPTER IV

RESULTS

The study was comprised of 372 subjects that included 204 subjects in the treatment group and 168 subjects in the control group. Scatterplots were created, and two subjects were excluded as outliers. These two outliers had higher HbA1c levels, and the time of diabetes onset could not be determined. Study participant characteristics included age, gender, ethnicity, height, weight, body mass index and diagnosis (Table 1).

Table 1

Pre-intervention Characteristics for Treatment (Diabetes Education) and Quasi-control Groups[1-3]

		Treatment		Quasi-Control	
Variable	All n=372	Attended, Developed DM n=136	Attended, Did Not Develop DM n=71	Did Not Attend, Developed DM n=151	Did Not Attend, Did Not Develop DM n=14
Age (years)	60.9±10.9	62.0±10.8	60.1±11.8	59.9±10.6	65.14±11.7
No. Participant (% male)	353(94.4)	132(97.0)[a]	62(87.3)[a, b]	143(94.7)[b]	14(100.0)[a, b]
Ethnicity (%)					
White	191(52.8)	75(54.3)	34(47.9)	72(47.7)	10(71.4)
Black or African American	159(43.9)	57(41.3)	32(45.1)	66(43.7)	4(28.6)
American Indian or Alaska Native	1(0.3)	0(0.0)	0(0.0)	1(0.7)	0(0.0)

Continued

Asian	1(0.3)	0(0.0)	1(1.4)	0(0.0)	0(0.0)
Native Hawaiian or Other Pacific Islander	10(2.8)	3(2.2)	1(1.4)	6(4.0)	0(0.0)
Height (inches)	69.4±3.5	69.6±3.3	69.0±3.7	69.2±3.5	70.0±2.7
Weight (kilograms)	103.7±24.7	105.0±23.9	95.8±24.5[a]	105.3±24.7[a]	109.9±24.4
Body mass index (kg/m^2)	33.4(7.1)	33.9±6.6[a]	31.0±6.8[a, b]	34.0±7.6[b]	35.2±6.4
HbA1c	5.1±1.0	5.1±0.8[a]	6.0±0.1[a, b]	6.0±0.2[b]	5.8±0.1
Baseline diagnosis (%)					
Impaired Fasting Glucose	31(8.3)	14(10.3)	10(14.1)	4(2.6)[a]	3(21.4)[a]
Hyperglycemia	31(8.3)	14(10.3)	12(16.9)[a, b]	5(3.3)[b]	0(0.0)[a]
Glucose Intolerance	1(0.3)	0(0.0)	0(0.0)	0(0.0)	1(7.1)

[1]Mean ± SD
[2](% of the total)
[3a, b] Means in a row with a common letter are significantly different ($p<0.05$) between groups.

Significantly fewer Veterans developed diabetes in the treatment group compared to the quasi-control group, χ^2 (1, N=372) = 30.672, $p < 0.0005$. Figure 1 shows the percentage of subjects diagnosed and not diagnosed with diabetes in both treatment and quasi-control groups.

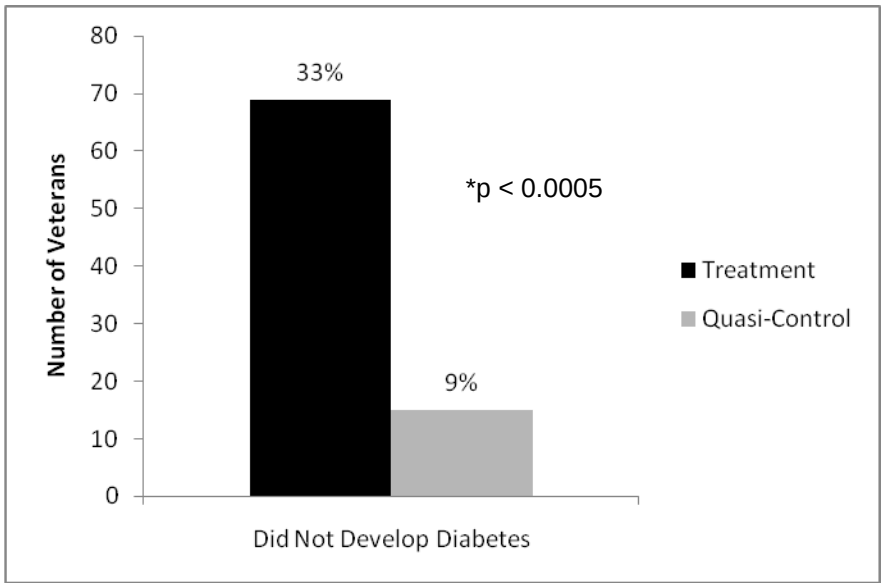

Figure 1. Percentage of veterans not diagnosed with diabetes in treatment and quasi-control groups.

The four covariates (group, age, BMI and HbA1c) predicted the time of converting from pre-diabetes to a diagnosis of diabetes for Veterans, $p < 0.001$ (Table 2). Table 3 provides mean value of diabetes predictor factors. HbA1c was shown to have significant difference ($p < 0.05$) between groups.

Table 2

Factors Affecting the Diagnosis of Diabetes and Odds Ratio

	P-value (<0.05 statistically significant)	**Odds Ratio**	**95% Confidence Interval**
Treatment or Quasi-Control	0.009	.706	0.545, 0.916
Age	0.004	1.017	1.006, 1.029
Pre-intervention BMI	0.027	1.021	1.002, 1.039
Pre-intervention HbA1c	0.0005	1.231	1.144, 1.323

Table 3

Mean Values of Predictive Diabetes Factors[1]

	Treatment Group	**Quasi-Control Group**	**P-value (<0.05 statistically significant)**
Age	61.3±11.0	60.4±10.9	0.423
BMI	32.9±6.7	34.0±7.5	0.137
HbA1c	5.6±0.4	5.8±0.3	0.0005

[1]Mean ± SD

Age, BMI and HbA1c showed a positive association with diabetes (odds ratio >1). Assignment to the treatment group decreased the odds of the conversion from pre-diabetes to a diagnosis of diabetes. The median time of converting from pre-diabetes to a diagnosis of diabetes in the quasi-control group was 142.5 days. The median time of converting from pre-diabetes to a diagnosis of diabetes in the treatment group was 213 days. Therefore, the

time of diagnosis of diabetes occurred about 2-3 months earlier for Veterans who did not receive nutrition education. Figure 2 shows the odds of being diagnoses with diabetes between the quasi-control and treatment groups. The quasi-control group had a higher odds ratio of being diagnosed with diabetes than the treatment group.

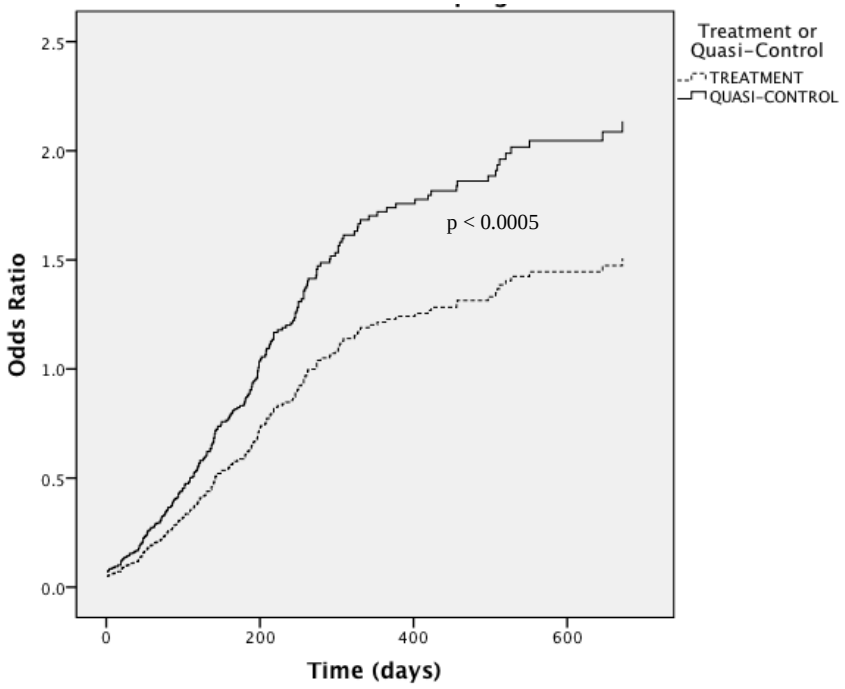

Figure 2. *Odds of diagnosis of diabetes*

CHAPTER V

DISCUSSION

Nutrition education can make a significant difference in the prevention of diabetes. Results showed a significant impact of nutrition education on delaying the diagnosis of diabetes and overall outcome. Approximately three times more Veterans who were referred to existing diabetes education classes or individual nutrition appointments delayed the onset of diabetes compared to those who were not exposed to nutrition education. Also, covariates age, BMI and HbA1c had a positive association with the time converting from pre-diabetes to a diagnosis of diabetes. Older Veterans were more likely to convert from pre-diabetes to a diagnosis of diabetes. The higher the BMI and/or HbA1c, the more likely diabetes was diagnosed. The hypothesis that an existing outpatient nutrition education program would be effective in delaying/preventing the conversion of pre-diabetes to the diagnosis of type 2 DM among hyperglycemic Veterans was accepted.

This study found a positive association between nutrition intervention and outcomes that adds to the existing body of literature. The Diabetes Prevention Program (DPP) appears to be the model for several studies. This "major multicenter clinical research study" was designed to investigate if weight loss through dietary changes, along with physical activity or drug therapy (metformin), would prevent or delay the development of type 2 DM. The DPP revealed that participants who lost the most weight

through dietary changes and physical activity reduced their risk of converting from pre-diabetes to a diagnosis of diabetes. Participants on metformin drug therapy also reduced their risk of converting from pre-diabetes to a diagnosis of diabetes but to a lesser extent (Knowler et al., 2002b). Although the current VA study did not address physical activity, a positive outcome between education and diabetes prevention was revealed.

The LOOK AHEAD (Action for Health in Diabetes) study was a multicenter, randomized controlled trial designed to assess the long-term health consequences of intentional weight loss in overweight individuals (n=5,145) with type 2 DM. Participants received their usual care but were divided into two groups: a diabetes support and education group or a lifestyle intervention group. Look AHEAD assessed whether weight reduction, combined with increased physical activity, reduced cardiovascular morbidity and mortality. The Look AHEAD study was designed to provide insight into how health professionals can reduce cardiovascular morbidity and mortality of overweight patients who have type 2 DM and prevent future health consequences (Look AHEAD Research Group, 2006). Although results indicated that weight loss was greater in the intensive lifestyle intervention group, there was no significant difference between the two groups in mortality and morbidity. Patients were able to lose weight but lifestyle changes indicated no benefit long term cardiovascular outcomes. One explanation was the weight loss was sufficient enough to reveal a significant difference in rates of cardiovascular events between groups. Only an average of 2.5% weight loss was achieved at the end of the study. Nevertheless, Look AHEAD may shed light into other

research opportunities to determine how much weight loss is needed to benefit long-term cardiovascular events and other possible health consequences (CVD Effects of Intensive Lifestyle Intervention in T2DM, 2013).

While one study (Deakin, McShane, Cade &Williams, 2005) showed a positive benefit of group education towards improving diabetes control, another study differed possibly due to larger sample size, dropout rates, or scheduling flexibility that could be barriers for Veterans (Sperl-Hillen, 2011). In addition, this study included both individual and group education classes as treatment but did not distinguish between the two types of nutrition education.

The VA's National Center for Health Promotion and Disease Prevention has several ongoing programs and investigations that support this study's findings. The Diabetes Prevention Program pilot study at the VA is determining whether weight loss through dietary changes and increased physical activity can prevent or delay the onset of type 2 DM in Veterans who participate in the MOVE! Program. MOVE! Is a national weight management program designed to assist Veterans to lose weight, keep it off and improve their overall health. According to the national MOVE! Website, this program is the "largest and most comprehensive weight management and physical activity program associated with a medical care system in the United States" (United States Department of Veterans Affairs, 2014). This program focuses on health and wellness through various techniques, such as healthy eating, physical activity, and behavior change. Interventions are based on an evidence-based, stepped-care model. Staff assist patients to set

achievable goals that are individually tailored. The overall goal of MOVE! Is to improve Veterans' quality of life and health status. Health care professionals encourage Veterans to be personally responsible and empowered to improve their health (United States Department of Veterans Affairs, 2014). The MOVE! Program is a great example of how nutrition education plays a role in health promotion and disease prevention. Prior to the implementation of this program in 2006, less than half of Veteran Affairs Medical Centers had weight management programs; therefore, MOVE! Is an excellent opportunity for the VA facilities to address the obesity epidemic (Nelson, 2006).

Interestingly, similar results were found after performing a retrospective analysis of the MOVE! Program outcomes looking at pre-diabetic patients who were enrolled in the program. Over a three-year follow-up period, patients reduced their incidence of diabetes by 33%. The MOVE! Program suggested weight management programs can lower participants' weight and also improve diabetes management (Jackson 2013; Romanova, 2013). Nevertheless, results from this study showed outpatient nutrition education programs reduced the risk of diabetes even without weight loss.

These findings underscore the importance of early engagement with Veterans regarding health risk, disease prevention, and being proactive and involved in their healthcare. As aforementioned, self-care barriers are more prevalent in the Veteran population. These barriers can be exacerbated with more complex self-management or treatment plans, as in the case with insulin therapy. The benefits of prevention cannot be minimized, and all health care team members should be involved in health screenings and

referring Veterans to effective resources and programs that will support Veteran self-efficacy and health goals. Multiple intervention options may exist, which increases shared decision making and patient empowerment as well as offering flexibility for facilities with limited resources. Participation in nutrition education classes, such as the ones used in this study, and programs such as *MOVE!*, may be a viable intervention for patients in facilities that do not have distinct pre-diabetes intervention groups.

Strengths of this study include large sample size and long observation period. A limitation of the study included an inability to distinguish between random and fasting glucose values with the VA's computerized patient record system. In addition, appointment timing may have been more influential than the impact of education. Some Veterans had a longer period of time from their first nutrition education encounter to their date of diagnosis. With no-shows/cancellations being prevalent among this population, several Veterans may have developed diabetes before a true diagnosis could be made during a clinic visit. This delay in follow-up visit could have affected the odds of a diagnosis of diabetes. Also, this study did not control for number of nutrition education sessions each individual attended and the impact of differences in attendance could not be determined. Findings cannot be generalized to the general population of the United States since this study was specific to the Veteran population. Controlling for random and fasting glucose levels, as well as the number of nutrition education sessions attended, would provide greater insight in future studies.

CHAPTER VI

CONCLUSION

Diabetes is a complex and costly disease in terms of both personal and healthcare costs to the individual. This retrospective study showed the positive impact nutrition education had on preventing or delaying diabetes in hyperglycemic Veterans. The covariates of age, BMI, and HbA1c were positively associated with diabetes. The time converting from pre-diabetes to a diagnosis of diabetes was delayed for Veterans who did receive nutrition education. One can conclude that nutrition education played a major role in the overall disease prevention process and additional research is required to provide continuing support.

VHA has the unique opportunity to study current programs targeting the diabetes epidemic and influence change in a population that is disproportionately affected. This research adds to a body of evidence, which may help elucidate details of nutrition education/counseling intervention, including the possibility of using existing programs and resources to improve outcomes. It provides insights into the impact nutrition education can have in routine medical care. The Veterans Health Administration's (VHA) new model of care is patient centered and physicians as a whole are focused on outcomes. By seeing Veterans, physicians are monitoring care and preventing long-term health consequences. The VA is improving outreach and access, which is reflected by implementing programs, such as Telehealth. Finally, the results from this study can

contribute to the VA Transformation model of care- performing research and development to enhance long-term health and well-being of Veterans if confirmed by a prospective randomized study (Veterans Health Affairs, 2010; Veterans Health Affairs, 2013).

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