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Relationships Between Psychosocial Factors and Adherence to Diet and Exercise in Adults with Type 2 Diabetes: A Test of a Theoretical Model

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Relationships Between Psychosocial Factors and Adherence to Diet and Exercise in Adults with Type 2 Diabetes: A Test of a Theoretical Model

by

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Dedication

I dedicate this work to the individuals who participated in this study and to those who assisted with participant recruitment.

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Relationships Between Psychosocial Factors and Adherence to Diet and Exercise in Adults with Type 2 Diabetes: A Test of a Theoretical Model

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Introduction: Cardiovascular disease (CVD) is the leading cause of premature death among people with diabetes. Diet and exercise adherence are important diabetes self management behaviors that can reduce CVD risk; unfortunately, adherence rates are low among diabetics. Improved understanding of psychosocial factors related to diet and exercise adherence among adults with type 2 diabetes can improve strategies to reduce CVD morbidity and mortality in this population.

Purpose: 1) Evaluate psychometrics of the Health Beliefs related to Cardiovascular Disease scale (HBCVD) which measures perceived susceptibility to and severity of heart attack or stroke and perceived benefits of and barriers to diet and exercise; 2) Explore relationships between selected bio-psychosocial factors and diet and exercise adherence; and 3) Evaluate the ability of a theoretical model integrating the Health Belief Model (HBM) and Stages of Change Model (SOC) to explain diet and exercise adherence.

Methods: The study design was a descriptive correlational cross section using a convenience sample of 212 adults with type 2 diabetes who completed a series of questionnaires measuring study variables. Outcome variables measured were diet and exercise adherence scores. Predictor/independent variables included knowledge related to CVD risk, cues to action, health beliefs, stage of change, social support, depression, comorbidity, diabetes duration, and socioeconomic status. Relationships among model variables were explored using analysis of variance and simple and multiple regression techniques.

Results: The HBCVD demonstrated evidence of validity and reliability, although an improved barriers subscale is recommended. The theoretical model was not supported, although significant paths between model variables were identified. The best model to predict diet included diet stage, susceptibility, self efficacy, social support, and age. The best model to predict exercise included exercise stage, self efficacy, and social support. Models including HBM and SOC provided greater explanatory power for diet and exercise adherence than either model alone. Susceptibility, barriers, and self efficacy varied significantly across stages of change. Significant group differences were found among model variables. Participants with depressive symptoms and the least education had lower diet and exercise adherence scores. Younger age and unemployment were also associated with lower diet adherence.

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Chapter 1: Introduction

INTRODUCTION

In the United States, heart disease, stroke, and diabetes are the first, third, and sixth leading causes of death, respectively, for all ethnic groups (CDC, 2004). While heart disease and stroke are leading causes of death for all people in the U.S., people with diabetes are two to four times more likely to have heart disease or suffer a stroke than people who do not have diabetes (NDEP, 2007). This increased risk is largely due to atherosclerosis (AHA, 2007). Indeed, people with diabetes have a two to three fold increased risk of atherosclerotic disease as compared to people without diabetes (Abbate et al., 2002).

Cardiovascular disease (CVD) includes coronary heart (CHD), cerebrovascular (CBVD), and peripheral vascular diseases (PVD) (National Diabetes Information Clearinghouse [NDIC], 2005) and accounts for sixty-five percent of deaths in people with diabetes (CDC, 2005). CVD is the major cause of morbidity and mortality in type 2 diabetes (Abbate et al., 2002), accounting for over two-thirds of all morbidity, mortality, and health care costs in patients with type 2 diabetes (Duckworth et al., 2001, p. 943). National morbidity and mortality data show that “heart attacks occur at an earlier age in people with diabetes [and] people with diabetes are more likely to die from a heart attack and are more likely than those without diabetes to have a second event” (NDEP, 2001, p.1). Despite these alarming statistics, the American Diabetes Association and American College of Cardiology (ADA/ACC) (2002) reports that the majority of people with diabetes do not believe that they are susceptible to cardiovascular disease or associated complications.

Research has demonstrated that relatively small improvements in blood glucose (Stratton et al., 2006), lipids (Gaede et al., 2003), and blood pressure values (UKPDS, 1998) result in decreased risk for diabetes-related complications, including cardiovascular disease. However, only 7.3% of adults with diabetes achieved recommended goals of blood pressure, total cholesterol, and HbA1c levels according to NHANES 1999-2000 reports (Saydah et al., 2004). Lifestyle modifications are typically the first line of treatment recommended for adults first diagnosed with hypertension, high cholesterol and/or dyslipidemia, and for adults who are overweight or obese (ADA, 2006; NCEP, 2001; NHLBI, 2003). Successful treatments exist, but unfortunately, adherence to treatment recommendations is low (Fletcher & Lamendola, 2004), particularly among diabetics (DiMatteo, 2004). As a result, there is an urgent need for health care providers to have a greater understanding of factors that affect diet and exercise behaviors of diabetic patients in order to inform interventions developed to decrease diabetic CVD morbidity and mortality.

SIGNIFICANCE

Approximately 14.6 million Americans are currently diagnosed with diabetes and an estimated 6.2 million Americans have diabetes but have not been diagnosed, bringing the approximate total to 20.8 million people with diabetes, or 7% of the population of the United States (CDC, 2005). Of these diagnosed diabetes cases, 90-95% are classified as type 2 diabetes (CDC 2005). Worldwide, 150 million people have been diagnosed with type 2 diabetes and this number is likely to double by 2025 (WHO, 2006). Furthermore, cardiovascular disease remains the most costly complication associated with type 2 diabetes, accounting for greater than $7 billion of the $44.1 billion annual direct medical costs for diabetes in 1997 (ADA, 1998). Gender and ethnic disparities exist, as women account for more than half of the annual deaths related to heart disease and African Americans have approximately 30% higher death rates than white adults (CDC, 2004). Although in the general population men are more affected by CVD than women, diabetes causes women to have comparable rates of CVD as men (Lustman & Clouse, 2004), and in some studies it has been demonstrated that women have a higher excess risk for CVD than men (Gu et al., 1999).

Type 2 diabetes is a metabolic disorder characterized by insulin resistance or impaired secretion of insulin from the pancreas (CDC, 2005). In many cases, type 2 diabetes is a preventable disease. Excess body fat and minimal physical activity or daily exercise are known to predispose a person to developing type 2 diabetes. With an estimated 97 million American adults being overweight or obese and approximately 75% of American adults having minimal physical activity or daily exercise (CDC, 2003), diabetes is increasing in epidemic proportions, with rates in the U.S. projected to increase by greater than 165% by 2050 (King et al., 1998). The International Diabetes Federation (2001) cautions that unless CVD prevention is treated with a sense of urgency among persons with diabetes, this marked increase could lead to a cardiovascular disease epidemic despite the recent downward trends in cardiovascular disease for non-diabetic individuals.

Diabetes is often referred to as a state of premature vascular death due to accelerated atherosclerosis (Fisher, 2004; Murcia et al., 2004; Wannamethee et al., 2004), or, a "state of accelerated cardiovascular disease that just happens to be associated with hyperglycemia" (Dhatariya, 2003, p. 371). This is because people with type 2 diabetes have high rates of hypertension, dyslipidemia, and obesity. About 70 percent of people with diabetes also have high blood pressure (CDC, 2005), and ninety-seven percent of adults with type 2 diabetes have one or more lipid abnormality, such as high triglycerides, low HDL cholesterol, and high LDL cholesterol (NDEP, 2001). Compared to the general population, prevalence rates of hypertension are at least twice as high in people with diabetes (IDF, 2001). In addition, 60 to 90 percent of cases of type 2 diabetes appear to be related to obesity or weight gain, both of which can be prevented through healthy diet and regular physical activity (Anderson et al., 2003). Each of the factors mentioned above are also among the major causes of cardiovascular disease.

Diabetes complications generally fall into two categories: microvascular and macrovascular. Microvascular disease includes disease of any of the small blood vessels in the body, such as those found in the kidneys and retina. Macrovascular disease, frequently used interchangeably with CVD, includes disease of any of the large blood vessels in the body, such as those in the heart. In patients with diabetes, mortality rates for macrovascular complications are 70 times higher than mortality rates for microvascular complications (Turner et al., 1996). As is evident, prevention of cardiovascular disease should be the major concern in diabetes management.

The exact physiologic mechanisms responsible for the two to four fold increased risk of cardiovascular disease in diabetic patients is not fully understood. The major mechanisms at work appear to be atherosclerosis, impaired fibrinolysis, increased thrombotic tendencies, and platelet dysfunction (Abbate et al., 2002; NHLBI, 1998). Atherosclerosis is accelerated, more extensive, and more severe in patients with diabetes (International Diabetes Federation, 2001). What is known is that hyperglycemia is associated with endothelial cell dysfunction and glycosylation of proteins, conditions which can contribute to and accelerate the development of atherosclerosis (Abbate et al., 2002) as well as cause alterations in lipids and coagulation factors (NHLBI, 1998).

Hypertension and hyperlipidemia also contribute to endothelial cell dysfunction, thereby promoting atherosclerosis (Abbate et al., 2002). Atherogenic dyslipidemia (AD) typically occurs in patients with type 2 diabetes and is also seen in patients with premature coronary artery disease. AD consists of a triad of clinical findings: abnormal LDL particles, elevated triglycerides, and decreased HDL, all of which are risk factors for CVD. When AD is present in patients with diabetes, AD is a CVD risk equivalent to that of a high-risk LDL cholesterol of 150-220 mg/dL (Abbate et al., 2002). Management of blood pressure and lipids via lifestyle modifications and/or pharmacotherapy in addition to smoking cessation and the use of preventative medications (e.g. aspirin) when indicated have the greatest impact on reducing CVD morbidity and mortality. On the other hand, management of hyperglycemia appears to have the greatest impact on preventing microvascular diseases (Abatte et al., 2002).

In 2001, the International Diabetes Federation (IDF) issued a publication focusing on the relationship between diabetes and CVD that included explanations for why CVD in diabetes is such a major public health concern. The IDF cited a number of factors, which have been summarized as follows. The risk of death following a heart attack is higher in type 2 diabetics. Compared to nondiabetic persons of the same age, sudden death occurs 50% more often in diabetic men and 300% more often in diabetic women. This increased risk of mortality is largely a result of silent ischemia and/or silent heart attack due to autonomic neuropathy, which is a common microvascular complication of diabetes. The atypical presentation of ischemia and heart attack can result in missed diagnosis or delayed treatment for a heart attack. Furthermore, the risk of developing congestive heart failure is up to three times higher in people with diabetes. Data regarding cerebrovascular disease and peripheral vascular disease in persons with diabetes are no more encouraging. Diabetic patients who also have hypertension are at least twice as likely to have a stroke as people with hypertension alone. Finally, when compared to the general population, lower limb amputations due to peripheral vascular disease are as much as 15-40 times more likely to occur in diabetics (IDF, 2001).

Through the adoption of healthy life habits, management of blood glucose, cholesterol, and blood pressure levels are critical primary prevention strategies for cardiovascular disease (Pearson et al., 2002). Moreover, better management of these could decrease the number of deaths caused by heart disease or stroke by as much as 30 percent (CDC, 2005). For most individuals, therapeutic lifestyle change is the first recommended treatment approach for persons with hypertension (NHLBI, 2003), high cholesterol (NCEP, 2001), and diabetes (ADA, 2006); when warranted, pharmacological treatment may also be used. National standards of care for lifestyle modifications to aid in the prevention of diabetic complications include eating a healthy diet, weight control, increased physical activity, and avoidance of tobacco, all of which help in the management of blood glucose, blood pressure, and cholesterol (ADA, 2006; NCEP, 2001; NHLBI, 2003; Pearson, 2002).

Lifestyle Modifications and Cardiovascular Disease

Adherence to a healthy diet and regular physical activity as well as rigorous treatment of hypertension, dyslipidemia, and hyperglycemia with lifestyle modifications and pharmacological therapy are all proven strategies that reduce the risk of cardiovascular disease and/or cardiovascular disease complications (Krumholz et al., 2002; Winer & Sowers, 2004). These strategies are also the cornerstone of diabetes management (ADA, 2006). The current study focuses on diet and physical activity as important management strategies in controlling diabetes complications.

Research has demonstrated the unequivocal effects of diet and physical activity (Diabetes Prevention Program Research Group, 2002) and, when indicated, the combination of medications with diet and physical activity (Gaede et al., 2003) on improvement in health outcomes in patients with diabetes. The United Kingdom Prospective Diabetes Studies (UKPDS) have shown that diabetic complications can be prevented or delayed by adhering to appropriate treatment recommendations, which often includes a healthy diet and regular physical activity, and that any reduction in blood sugar or blood pressure is beneficial to the diabetic patient (UKPDS, 1998). For example, for every 1 percent reduction in Hemoglobin A1c (HgA1c), relative risk decreased by 21 percent for diabetes-related deaths and 14 percent for heart attacks (Stratton et al., 2000). For each 10 mm Hg decrease in mean systolic blood pressure, the relative risk decreased by 15 percent for diabetes-related deaths and 11 percent for heart attacks (UKPDS, 1998). These data illustrate that control of hypertension and hyperglycemia is essential to reduce risk for diabetes complications, because both hyperglycemia and hypertension are independently associated with diabetes and have synergistic effects on diabetic complications (Stratton et al., 2006). It has also been empirically demonstrated that aggressive lipid reduction therapy reduces the risk of CVD in people with diabetes (Gaede et al., 2003; Lee et al., 2004). A healthy diet and regular physical activity are the first line treatments for control of hypertension, glycemia, and hyperlipidemia; when implemented as recommended, they can significantly reduce CVD risk factors in diabetic patients.

While it is important for all persons to engage in healthy behaviors in order to improve their health and quality of life and reduce their risk factors for CVD, it is especially important for persons with diabetes to be especially vigilant due to their two to four fold increased risk of CVD mortality as compared to the general US population. Appropriate diet and exercise are central to the management of diabetes and prevention of other diabetes complications (Franz et al., 2002; Tuomilehto et al., 2001) and should be "the foundation of all therapy for diabetes" (NHLBI, 1998). The importance of self management in diabetes can not be overstated; unfortunately, diabetic patients appear to be among the least adherent patient populations (DiMatteo, 2004).

Diabetes Self Management

Diabetes self management is an essential part of treatment (Norris et al., 2002; Schechter & Walker, 2002). Self-management of diabetes focuses on regulating caloric and carbohydrate intake (diet) and increasing physical activity (exercise) for the physiological benefits as well as weight management, and is a critical component of diabetes care (ADA, 2006).

Weight management is an important component of diabetes self management and is an important goal in diet and exercise recommendations. In fact, some clinicians have asserted that "weight management appears to be the most important therapeutic task for most type 2 diabetic individuals" (p.331)

(Anderson et al., 2003). A reduction in excess body weight improves glycemic control and reduces risk factors for CVD via reductions in blood pressure and lipid profile (Anderson et al., 2003; Anderson & Konz, 2001), while also leading to reductions in inflammatory markers and insulin resistance (Esposito et al., 2003). Increased BMI and physical inactivity are strongly and independently associated with increased risk for a number of comorbid diseases with diabetes, including hypertension, hyperlipidemia and cardiovascular disease (Sullivan et al., 2005). These comorbidity factors underscore the importance of both weight management and physical activity in reducing risk for cardiovascular disease morbidity and mortality.

Diet and Physical Activity

Research supports the benefits of low-calorie diets and physical activity in promoting weight loss and improving metabolic control. In a recent study examining the effects of a six month long lifestyle modification intervention, Kim et al. (2006) found that the intervention, composed of a curriculum covering diet, exercise, and behavior modification techniques, led to significant improvements in glycemic control, systolic blood pressure, BMI and weight. In a study involving patients diagnosed with disease in one or more coronary arteries, lifestyle modifications consisting of low-fat vegetarian diet, moderate exercise, stress management, and smoking cessation resulted in significant decreases in total and LDL cholesterol levels as well as regression of coronary atherosclerosis in 82% of patients (Ornish et al., 1990). Similarly, Schuler et al. (1992) found that a low fat diet and intensive physical exercise led to significant reductions in weight, total cholesterol, and triglycerides and delayed or reversed the progression of coronary lesions in 77% of the participants.

In a recent systematic review on long-term non-pharmacalogical weight loss interventions in adults with type 2 diabetes, Norris et al. (2005) found the largest effect sizes for interventions consisting of very low calorie diet, physical activity and behavioral therapy. In addition, Moore et al. (2004) concluded that, although diet can be effective in preventing or delaying the onset of type 2 diabetes, diet alone is not good enough for optimal glycemic control in patients who already have diabetes.

Physical activity, used interchangeably with the term *exercise*, is also important in the self management of diabetes and has beneficial effects in addition to any associated weight loss. Independent of weight loss, physical activity has been shown to improve glycemic control and the body's response to insulin, decrease triglyceride levels, and lead to decreased body fat content (Thomas et al., 2006; Zinman et al., 2004). Additionally, exercise improved fibrinolysis, blood pressure, and cardiovascular fitness (Zinman et al., 2004), while decreases in small, dense LDL particles was observed when exercise was used in conjunction with diet therapy (Halle et al., 1999).

Recent prospective cohort studies have demonstrated that physical activity substantially reduces risk for cardiovascular morbidity and mortality for both diabetic men and women (Tanasescu et al., 2003; Wei et al., 2000) and women (Hu et al., 2001). This research has demonstrated that moderate levels of physical activity (three to five hours per week of moderate activity such as brisk walking) produce the greatest health benefits (Tanasescu et al., 2003) and can lead to reduced risk for CVD by approximately 40% (Hu et al., 2001). These findings are encouraging because walking is considered safe and easy and can be performed by most diabetic individuals. However, a limitation of these studies is that they were observational and no causal relationships could be evaluated.

Randomized controlled trials (RCT) are necessary to evaluate the effects of behavior modification interventions on CVD risk. One such study has been conducted by Gaede et al. (2003). They randomly assigned a total of 160 type 2 diabetic patients to a control group (n=80) receiving conventional treatment and an experimental group (n=80) receiving an intensive treatment with behavior modification (including diet and physical activity) and pharmacological therapy.

Over a mean follow-up period of eight years, the experimental group had approximately 50% reduction in cardiovascular and microvascular events.

The research findings presented above provide support for the beneficial effects of diet and exercise on biological outcomes and provide direction for the development of effective interventions. However, despite these compelling findings, the majority of diabetic individuals do not engage in regular physical activity (Myers et al., 2003). This is consistent with the adherence literature that reports large deficits in self-care among diabetic patients (Aljasem et al., 2001). Awareness of the increased risk of CVD morbidity and mortality and adherence to prescribed treatment recommendations appear to be two major obstacles for improving cardiovascular health in this population.

Adherence

Low rates of adherence to therapeutic regimens is not a new problem, especially in regard to preventive behaviors such as changes in eating habits and physical activity, smoking cessation, and adherence to prescribed pharmacological therapy (Rogers & Bullman, 1995; Sackett & Haynes, 1976). While adherence to treatment recommendations in general is low (Fletcher & Lamendola, 2004), adherence rates are particularly low among diabetic patients (DiMatteo, 2004). In a recent meta-analysis of studies measuring adherence to medical recommendations, DiMatteo (2004) found that diabetes had the next to last lowest adherence rates (67.5%) compared to 16 other major disease conditions. DiMatteo (2004) suggests that low adherence could be due in part to the complexity of the recommended treatment regimen. Conceptualization of adherence could also be an issue. Patient awareness of the recommendations regarding health behaviors and agreement with the behavioral goals are prerequisites for “adherence”; otherwise, the issue is one of noncompliance or a knowledge deficit rater than non-adherence (Walker & Usher, 2003).

Adherence is not well understood, though it has been extensively studied with significant amounts of published research assessing and measuring the concept of adherence (Trostle, 1997). Yach (2003) has defined adherence as "the extent to which a person's behavior–taking medication, following a diet, and/or executing lifestyle changes—corresponds with agreed recommendations from a health care provider" (p. 3). For this study, adherence is conceptualized as the degree to which the diabetic patient's diet and exercise behaviors correspond with recommendations from their health care provider(s). Some scholars suggest that adherence is a multifactorial phenomenon that is best understood from a bio-psycho-social perspective (Peyrot et al., 1999). In this study, the approach to explaining adherence is consistent with this perspective, as the proposed integrated model includes biological factors (comorbidity and duration of diabetes) as well as psychosocial factors (knowledge, health beliefs, self efficacy, depression, social support, and socioeconomic status).

One contributing factor for low adherence rates could be related to low awareness of the increased risk of CVD morbidity and mortality among persons with diabetes. The majority of persons who have diabetes do not believe that they are susceptible to cardiovascular disease or associated complications despite well-established evidence on the risks for cardiovascular disease in the literature and among clinicians. For example, in a survey of approximately 2,000 persons with diabetes conducted by the ADA/ACC (2002), it was discovered that 68% did not consider cardiovascular disease to be a complication of diabetes; more than 50% did not feel at risk for heart conditions or stroke; 60% did not feel at risk for high blood pressure or cholesterol; and awareness was lowest among elderly and minority persons with diabetes.

These data illustrate the need for strategies to increase knowledge and awareness of the relationship between diabetes and CVD. However, knowledge alone has not been shown to significantly improve adherence rates (Aljasem et al., 2001). A greater understanding of bio-psychosocial factors that contribute to this lack of awareness and poor adherence to recommended therapeutic regimens is needed. Previous studies have shown that biological (Tan, 2004) and psychosocial factors can influence adherence behaviors (Ali, 2002; Janz, 1988; Pallonen et al., 1994; Piano, 1997), but specific pathways through which these factors influence behaviors are largely unknown.

While adherence is certainly dependant upon the individual, evaluating bio-psychosocial factors that are known to influence health behaviors (e.g., comorbidity, duration of illness, socioeconomic status, health beliefs, stage of change, knowledge, social support, depression) in persons with diabetes could lead to an understanding of their motivation for adherence to recommended health behaviors. If any of these bio-psychosocial factors are predictive of adherence to diet and exercise behaviors, then information about that factor(s) could be used to develop individualized plans of care. Use of tailored interventions targeting the individual factors that may be contributing to low adherence, such as erroneous health beliefs or a knowledge deficit, could lead to increases in healthy diet and exercise behaviors, which will, in turn, lead to better health outcomes for persons with diabetes.

Therefore, this study will focus on evaluation of selected biologic and psychosocial factors important for understanding adherence behaviors of diabetics in order to develop theoretically driven interventions for primary and/or secondary prevention of CVD in persons with diabetes. The primary outcome behaviors of interest in this study are adherence to healthy diet and regular physical activity. While many factors have been shown to affect adherence behaviors, the author has selected the following predictor variables as the focus of this study: cues to action, knowledge, health beliefs, self efficacy, stage of change, depression, social support, socio-economic status, comorbid diseases, and duration of diabetes.

Research has shown that cues to action (Witte et al., 1993), knowledge (Ali, 2002; Two Feathers et al., 2005), self efficacy (Champion & Scott, 1997; Tseng, 2000) and social support (Piano, 1997; Talbot et al., 1997) positively influence health behaviors; conversely, depression generally has a negative impact on adherence to recommended therapeutic regimens and lifestyle interventions (DiMatteo et al., 2000). Studies have also demonstrated that health beliefs can be strong predictors of preventive health behaviors (Janz, 1988; Janz & Becker, 1984), and that a person's stage of change regarding a certain behavior can influence their decision of whether or not to adopt that behavior (Campbell et al., 1994; Pallonen et al., 1994). Additional relationships to health behaviors and health outcomes have been found for socioeconomic status (Brown et al., 2004), comorbid diseases among diabetics (Hernández-Ronquillo et al., 2003), and duration of diabetes (Garay-Sevilla et al., 1995).

A theoretically-driven model was constructed based on the review of literature summarized above, and the result was an integrated, bio-psychosocial model of diet and exercise behavior (see Figure 1). The integrated model is made up of two core behavioral theories, the Health Belief Model (HBM) (Rosenstock et al., 1988) and the concept of Stage of Change from the Transtheoretical Model (Prochaska et al., 1997). Each model is described in the following section.

THEORETICAL FRAMEWORK

There are many behavioral models that demonstrate effectiveness in predicting different aspects of health behaviors. However, since behavior is a multifaceted, complex phenomenon, it is questionable if one model can include all variables that will predict behavior. The Health Belief Model, which includes self efficacy (Rosenstock et al., 1988), and Stage of Change model (Prochaska et al., 1997) were chosen to guide this study because of the empirical evidence that supports their usefulness in behavior change interventions and for their emphasis on individual characteristics in the development of interventions to affect behavior change. Individualized interventions are often more effective in changing behavior as opposed to the "one-size-fits-all" approach most commonly used in current interventions designed to affect change in diet and exercise behaviors.

Health Belief Model

The Health Belief Model (HBM) is a health protective model that attempts to explain and predict health behaviors and has been widely used as a theoretical framework for interventions that attempt to influence behaviors (Rosenstock et al., 1988). The HBM was originally developed in the 1950s to explain motivation for health promotion and disease prevention behaviors. Since its inception, it has been expanded to provide a theoretical framework for understanding a number of behaviors, including adherence to a prescribed therapeutic regimen (Becker & Janz, 1985; Rosenstock, 2004). Self efficacy has since been added to the model and has increased the explanatory power of the HBM (Rosenstock, 2004; Rosenstock et al., 1988).

In diabetic populations, health beliefs account for significant proportions of variance in models predicting behaviors (Aalto & Uutela, 1997; Brownlee-Duffeck et al., 1987), which lends support to the importance of health beliefs in diabetes self-management (DSM). The HBM has been applied across a wide range of behaviors and has provided consistent, though not always robust, predictions of health behavior (Harrison et al., 1992; Janz & Becker, 1984; Janz et al., 2002; Sheeran & Abraham, 1996).

As a value expectancy theory, the HBM assumes that an individual's behavior is the result of the subjective value that he or she places on a given outcome (e.g., the desire to avoid illness or to get well) and their belief or expectation that a particular action will lead to that outcome (Rosenstock, 2004). The central constructs of this model include subjective perceptions of susceptibility, severity, benefits, barriers, self efficacy and exposure to cues to action. This model suggests that preventive behaviors are the result of decision making based on an individual's perceived susceptibility and perceived severity—the combination of which is labeled perceived threat—and on perceived benefits of action and perceived barriers to action. Additional components include cues to action and self efficacy.

Definition of Health Belief Model Variables

The following conceptual definitions of the model variables can be found on page 79 in Rosenstock (2004):

- *Perceived susceptibility* is defined as the person's subjective perception of the risk of contracting a given health condition.
- *Perceived severity* is defined as the person's feelings concerning the seriousness of developing the health condition or of leaving it untreated (including evaluations of both medical and clinical consequences and possible social consequences).
- *Perceived threat* is the combination of perceived susceptibility and perceived severity.
- *Perceived benefits* are defined as the person's beliefs about the effectiveness of the particular action in reducing the threat of contracting the health outcome. Perceived benefits help determine whether or not a person will take a particular course of action.
- *Perceived barriers* are defined as the patient's beliefs about the potential negative consequences that may result from taking particular health actions, including physical, psychological, and financial demands; in other words, the costs of engaging in a given behavior. These may act as impediments to adoption of the given behavior or action. Benefits and barriers are applied to a cost-benefit analysis where the individual weighs the benefits of the behavior against the barriers or costs.
- *Self-efficacy* is the confidence in one's ability to perform the given health action.
- *Cues to action* are physical or environmental factors that serve as health motivation (Rosenstock et al., 1988) and include media and educational materials as well as onset of physical symptoms to promote change in health behaviors.

According to the HBM, behavior will occur as a result of "the combined level of susceptibility and severity [which provide] the energy or force to act and the perceived benefits (or less barriers) provides a preferred path of action" (Rosenstock, 2004, p. 79). Self efficacy is an integral component of the HBM because one must feel confident that he or she is capable of taking the necessary action—thus, self efficacy is important in actual performance of a behavior. Low self efficacy for performing the behavior could constitute a barrier, while higher self efficacy increases the likelihood that the behavior will occur.

According to the HBM, behavior change is a process that could not occur without an instigating event to set it in motion; such events are considered cues to action in the HBM. A cue to action can be any stimuli that serve as a trigger to promote change in health behaviors, such as media and educational materials or onset of physical symptoms; as such, cues to action often prove difficult to measure. Indeed, Rosenstock (2004) states that cues to action have not been systematically studied because they are difficult to study, particularly in cross sectional studies, owing to their transitory nature and to the difficulty in identifying the myriad of triggers that exist in our day-to-day environment. In this study, an attempt to measure specific cues to action was employed to evaluate the relationships between exposure to information about diabetes and CVD, knowledge, and perceived threat.

Application of the HBM in this study is conceptualized as follows: The importance of preventing a heart attack or stroke could be a subjective value. Determining whether or not a person will engage in regular physical activity and adhere to a healthy diet to achieve the goal of avoiding a heart attack or stroke is a function of a) whether they believe that they are at risk for a heart attack or stroke (*perceived susceptibility*) and whether a heart attack or stroke is deemed serious and important to avoid (*perceived severity*), b) whether or not they believe that a healthy diet and regular physical activity will help them to avoid a heart attack or stroke and c) a cost-benefit analysis of the barriers to diet and exercise weighed against the perceived benefits of diet and exercise. Additionally, exposure to information about diabetes and CVD will influence knowledge of CVD risk and perceived threat of CVD. Finally, self efficacy related to performance of diet and exercise behaviors will influence actual performance of these behaviors.

Transtheoretical Model

The Transtheoretical model (TTM), often referred to as the Stages of Change (SOC) Model, has proven to be an effective framework to predict behavior, most notably for smoking cessation behaviors. The TTM identifies five stages of behavior change and processes of change within those stages. It was developed by a number leading of behavioral scientists and is a synthesis of the leading psychotherapy and behavioral change theories at the time of its development (Prochaska & DiClemente, 1992). In 1992, Prochaska and DiClemente developed the TTM after conducting a constant comparative analysis of the leading psychotherapy and behavioral change theories of the time. The result was a synthesized behavior change theory with increased predictive power that incorporated individual attitudes and beliefs rather than a “one size fits all” approach to explaining health behaviors.

The assumptions of this model are that behavior change is a process, not an event, and that individuals are at varying levels of motivation, or readiness, to change (i.e., stage of change). The model proposes that people at different stages of change can benefit from personalized interventions matched to their stage at that time. Stages 1-3 (precontemplation, contemplation, and preparation, respectively) are affected by cognitive processes; movement through these stages is dependent upon motivation, itself a direct result of cognition (DiClemente, 1995). Stages 4 and 5 (action and maintenance), on the other hand, are affected by behavioral processes.

Definition of Stages of Change Constructs

Prochaska and DiClemente (1992) define the stages as follows in chronological order:

- *Precontemplation* is the stage at which the individual has no intention to change behavior in the foreseeable future because they are unaware, unwilling, or discouraged.
- *Contemplation* is the stage at which people are aware that a problem exists and are seriously thinking about overcoming it but have not yet made a commitment to take action. Often, contemplators are seeking information regarding the behavior change in this stage.
- *Preparation* is the stage at which the individual is intending to change in the near future and has taken some behavioral steps in this direction and/or learned lessons from unsuccessful attempts in the past.
- *Action* is the stage at which individuals modify their behavior, experiences, or environment in order to overcome their problems. Action involves the most overt behavioral changes and requires considerable commitment of time and energy. The processes of change are most crucial in this stage.
- *Maintenance* is the stage at which people work to prevent relapse and consolidate the gains attained during action. For addictive behaviors, this stage extends from six months up to an indeterminate period past the initial action.

To overcome encountered barriers, people initiate processes of change in order to achieve their goal and/or desired behavior (Prochaska et al., 1988). Stages of change help us understand *when* particular shifts in attitudes, intentions, and behaviors occur, whereas processes of change help us to understand *how* shifts in attitudes, intentions, and behaviors occur (Prochaska et al., 1992). Processes of change vary according to the different stages of change: empirical studies have identified ten processes that are common and consistent across a number of problem behaviors, including smoking, weight control, alcohol abuse, and emotional distress as well as significant relationships between the processes and stages of change (Prochaska & DiClemente, 1992; Prochaska et al., 1988). Based on these findings, Prochaska and DiClemente (1992) purport that the TTM can be effective in accelerating behavior change across a large variety of problem behaviors.

Additional assumptions of this model are that stages are problem- or behavior-specific, with the focus placed on intentional change rather than imposed change. Moreover, it is assumed that motivation is a necessary but insufficient component (by itself) of the model. The underlying premise of TTM-based interventions is that individuals will progress through stages of change toward the goal of reaching the maintenance stage for the target behavior. Facilitating behavior change is most successful when a person is allowed to proceed through the stages gradually. Individualization should occur at each change in stage progression (Procahska & DiClemente, 1992).

Integration of Health Belief Model and Stages of Change

With the numerous factors that influence behavior, it is reasonable that interventions developed from multiple theories would be more effective in changing health behaviors than single theory interventions (Weinstein, 1993). The Health Belief Model, including self efficacy, and the Stages of Change (SOC) model are two theories that have consistently predicted health behaviors and have been successfully applied in intervention studies aimed at improving health behaviors. In this study, a model integrating the HBM and SOC has been evaluated for its ability to explain diet and exercise behaviors in a population of adults with type 2 diabetes. A pictorial representation of the integrated model can be found in Figure 1.

Both the HBM and SOC models place emphasis on the individual and provide important information for the development of personalized interventions targeting individual health beliefs and/or stage of change. In addition, each model complements the other by contributing necessary parameters for understanding behavior change not included in the other model, i.e., HBM provides insight into cognitive factors associated with diet and exercise behaviors and SOC provides insight into where the person is in the change process; taken together, the models allow for an understanding of which cognitive factors are most relevant with each stage of change. The application of this integrated model will provide important information to practitioners working with individuals to promote behavior change.

We hope that integrating these two complementary models will add to our understanding of behavior and could likely provide a model with more explanatory power than that of current paradigms. Green (2002) states that the SOC model has replaced the HBM in terms of frequency of application. However, we believe that SOC should not replace the HBM because the HBM provides critical information about what cognitive factors influence behavior at each stage. Rather, both models should be used together to provide a more comprehensive and nuanced depiction of behavior.

Information obtained from both the HBM and SOC in the context of diet and exercise behaviors will be complementary and more comprehensive than data obtained from either model alone. This has been recognized by Hurley (1990), who refers to the HBM as “a framework for understanding individuals’ psychological readiness to take health actions” (p. 45). Although this integrated model has not previously been tested for its ability to explain diet and exercise behaviors in persons with type 2 diabetes, several research studies have demonstrated significant correlations between beliefs, stages of change, and various other behaviors (Champion, 1994; Champion & Menon, 1997; Champion & Skinner, 2003). In addition, interventions targeting certain health beliefs and SOC have been found to be effective in facilitating appropriate behavior changes (Grimley et al., 1995; Strecher et al., 1994; Tseng, 2000).

It is unsurprising that there is evidence to support the integration of the HBM and SOC for understating behavior motivation, since most of the constructs from both models are complementary. For example, cues to action are similar to the tailored messages used in SOC and both have been shown to influence behavior and motivate progression through stages (Skinner et al., 1994). If an individual is to advance in stages of readiness to change, he or she may require a change in health beliefs that can be initiated by cues to action. For example, one effective way to influence behavior has been suggested by Bowdy (1998) who recommends using health beliefs to influence information message design when stage-matching interventions and then targeting these health beliefs as part of the stage-matched intervention. This is supported by Champion (1994), who states that "the integration of HBM concepts into stage of change theory has potential utility in targeting belief interventions to an individual's specific cognitive stage in relation to a health behavior" (p. 1010).

Researchers have acknowledged the importance of health beliefs within the stages of change, particularly the relationships between change stage and perceived susceptibility, benefits, and barriers. For example, Prochaska et al. (1997) suggest that susceptibility is important in the precontemplation stage: individuals in this stage often do not take action because they are uninformed of the consequences, which translate to low susceptibility perceptions. Interventions tailored to increase knowledge and awareness may result in more accurate susceptibility beliefs, which may, in turn, serve as motivation for progress to the contemplation stage.

Prochaska et al. (1997) also maintain that understanding an individual's perceived benefits and perceived barriers (i.e., pros and cons) are important in the contemplation stage because, in this stage, the individual likely already knows about the pros and cons but has a difficult time making a decision about their unhealthy behavior (i.e., difficulty in balancing the benefits and barriers). In this stage, interventions focusing on reinforcement of the benefits and strategies to overcome barriers may likely be effective in motivating stage progression. Finally, self efficacy has been recognized by Prochaska et al. (1997) as an important factor in the later stages of change. They surmise that greater self efficacy beliefs lead to greater chances of maintaining behavior change, whereas individuals in the maintenance stage who lack self efficacy may be tempted to relapse through the stages. In the maintenance stage, tailoring interventions to focus on building self efficacy for the target behavior and resisting temptation become essential.

Based on the interrelationships between health beliefs and stages of change noted above by Prochaska et al. (1997), it is likely that increased attention to an individual's health beliefs regarding diet and exercise and risk for heart attack and stroke based on their SOC for diet and exercise would greatly assist their progression through stages of change toward the goal of remaining in the maintenance stage indefinitely. Thus, the integration of the HBM with SOC will provide important information for behavior change interventions. The HBM will offer insight regarding the beliefs and attitudes that determine adherence to healthy diet and physical activity behaviors, while the SOC will advise as to where the individual is in the change process in addition to their readiness for adopting healthy diet and physical activity behaviors. Theoretically-based interventions that simultaneously target health beliefs, promote self efficacy, and are matched to the individual's stage of change would be an important contribution to health protection and health promotion research and practice.

Despite the widespread problem of cardiovascular disease in patients with diabetes and the well known correlation of adherence to diet and exercise to decrease CVD risk, a comprehensive review of the literature has revealed a relative paucity of empirical research that addresses psychosocial determinants of adherence behaviors specifically related to cardiovascular disease complications in patients with diabetes. There is, however, a national effort to increase understanding of the increased CVD risk in adults with type 2 diabetes and to develop interventions focused on decreasing the risk of CVD morbidity and mortality in this population (ADA, 2002).

In the current study, combining the HBM and SOC model variables with the additional variables selected for their known influence on behavior will provide important information to the existing body of knowledge for behavior change in persons with diabetes. The current study proposes that the HBM affects stages of change, which dictate whether persons with diabetes will be adherent to recommended behaviors. Interventions must be directed toward the SOC while the HBM will direct how a clinician will address an individual's stage of change. This new model will also provide important information on the role of self efficacy as part of the HBM and on SOC.

PURPOSE AND SPECIFIC AIMS

In this study, a conceptual model integrating the Health Belief Model, including self efficacy, and Stages of Change with knowledge, depression, social support, socioeconomic status, comorbid disease, and duration of diabetes has been evaluated for its ability to explain diet and exercise behaviors in adults with type 2 diabetes. The design of this study is a cross-sectional descriptive co-relational study. Using convenience sampling techniques, a sample of 200 adults with type 2 diabetes was recruited from outpatient clinics and community settings in Southeast Texas and Central North Carolina.

If this model is able to explain a significant portion of the variance in diet and exercise behaviors, it would be an important contribution to our current understanding of health behaviors. Moreover, if the proposed strength of this model is supported, it would be appropriate to use in the development of interventions for behavior change. One of the strengths of the HBM and the SOC are their applicability for individualized interventions, which may be more effective in changing difficult behaviors such as diet and exercise. The design and implementation of interventions targeting individual health beliefs and matched to the individual's stage of change could lead to improvements in adherence to diet and exercise for some individuals. Intervention studies would be necessary to evaluate this hypothesis. Evaluating the strength of the model is an important first step toward that goal. The specific aims of this study are to:

1) Evaluate the psychometric properties of the Health Beliefs related to Cardiovascular Disease scale (HBCVD) in a population of persons with type 2 diabetes.
2) Explore the relationships among selected biological and psychosocial variables and diet and exercise behaviors in a population of persons with type 2 diabetes.
3) Evaluate the ability of a conceptual model integrating the Health Belief Model (HBM) and Stages of Change (SOC), with knowledge, social support, depression, socioeconomic status, comorbid disease, and duration of diabetes to predict or explain diet and exercise behaviors in a population of persons with type 2 diabetes.

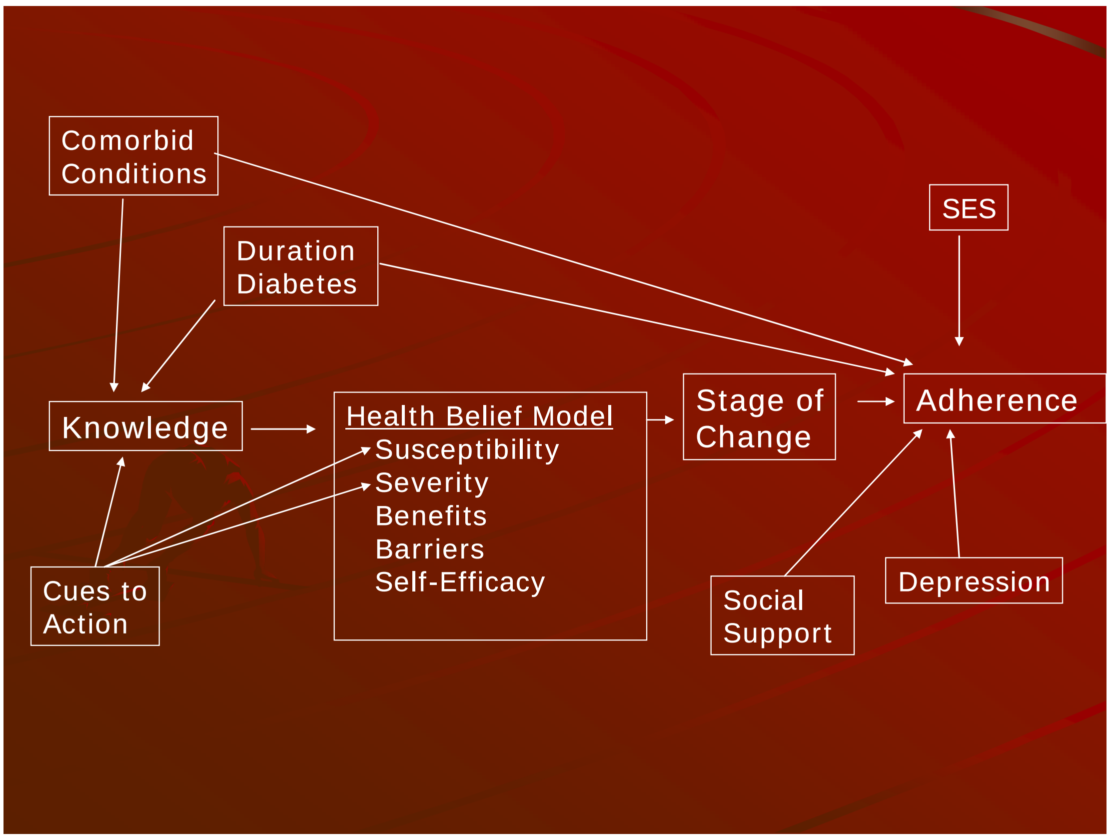
Research Questions and Hypotheses

Two research questions guided this study: 1) What are the relationships among biological and psychosocial variables and diet and exercise behaviors in a population of persons with type 2 diabetes; and 2) How well does the integrated model explain diet and exercise behaviors in a population of persons with type 2 diabetes? Multiple regression techniques were used to test the following research hypotheses:

1) *Cues to action* have a direct relationship with knowledge and perceived threat.
2) *Knowledge* has a direct relationship with the HBM (excluding cues to action).
3) *Self-efficacy* has a direct relationship with stage of change.
4) *Health beliefs* have a direct relationship with stage of change.
5) *Stage of change* has a direct relationship with diet and exercise behaviors.
6) *Depression* has a direct relationship with diet and exercise behaviors.
7) *Social support* has a direct relationship with diet and exercise behaviors.

8) *Socioeconomic status* has a direct relationship with diet and exercise behaviors.
9) *Comorbidity* and *length of disease* have a direct relationship with knowledge and diet and exercise behaviors.

Figure 1: Theoretical Model



Chapter 2: Review of the Literature

THEORETICAL FRAMEWORK

The two theoretical frameworks that guided this study are the expanded Health Belief Model (HBM), which includes self efficacy (Rosenstock et al., 1988), and the Stages of Change (SOC) component of the Transtheoretical Model (TTM) (Prochaska et al., 1997). In this chapter, each theory will be presented separately and evidence provided to support the application of the HBM and SOC to diet and exercise behaviors in diabetic patients. The discussion of each theory will begin with an explanation of how the theory has been conceptualized for this study and will be followed by a review of the relevant literature. Limitations of each theory and how these will be addressed in the current study will also be discussed. This section will conclude with a rationale for and the potential contribution of an integrated model combining the Health Belief Model with Stages of Change.

The Health Belief Model

According to the HBM, avoidance of a negative health outcome serves as the prime motivating force for adopting healthy behaviors (National Cancer Institute, 2005). In this study, the HBM has been applied to diet and exercise behaviors of diabetic patients and is conceptualized in the following way. For the diabetic individual to adopt and sustain a healthy diet and regular exercise to reduce their risk of CVD morbidity and mortality, one must perceive that one is susceptible to heart attack or stroke (perceived susceptibility to CVD), that the severity of having a heart attack or stroke is great (perceived severity of CVD), and that adopting a healthy diet and regular exercise will reduce the risks of a having a heart attack or stroke (perceived benefits) without excessive difficulty or negative side effects (perceived barriers). In addition, cues to action in the form of exposure to information about diabetes and CVD can be important triggers, as they may serve to increase knowledge of the significant risk of heart attack and stroke in diabetics, thereby influencing perceptions of susceptibility and severity of the condition. Additionally, adoption of healthy diet and regular exercise behaviors depends on the self efficacy beliefs concerning perceived barriers as well as competence in performing these behaviors.

Empirical Evidence for the Health Belief Model

Empirical evidence exists to support the use of the Health Belief Model to understand preventive behaviors in a number of populations, including diabetic patients (Aljasem et al., 2001), insulin-dependent diabetes patients (Coates & Boore, 1998), adolescents (Eisen et al., 1992), congestive heart failure patients (Bennett et al., 1997), and women in need of mammography (Champion & Scott, 1997; Wu & Yu, 2003). For example, in a study exploring the impact of barriers and self efficacy on self care behaviors of persons with type 2 diabetes, Aljasem et al. (2001) found that perceived barriers and self efficacy are associated with self care. Specifically, they found that greater perceived barriers regarding diabetes self care are associated with worsened adherence to diet and exercise behaviors, while greater self efficacy is associated with better diabetes self care behaviors. In addition, the researchers found that incorporating beliefs about barriers and self efficacy increases the explanatory power of the HBM, and that there seems to be a synergistic effect from the interaction between beliefs about barriers and self efficacy. The importance of self efficacy appears to be proportional to the difficulty level of the behavior increase: as the difficulty level increases, the importance of self efficacy also increases (Aljasem et al. 2001).

In a study measuring health beliefs and breast cancer screening practices in female patients, Champion and Scott (1997) correlated positive relationships between benefits with compliance; susceptibility, confidence (i.e., self efficacy), and benefits with proficiency; and confidence and benefits with behaviors. Inverse relationships between barriers with compliance and barriers with proficiency were also correlated. The variable of proficiency is related to self efficacy, which has been demonstrated to be an important factor in health behaviors, providing greater predictive validity to the revised HBM (Rosenstock et al., 1988).

Furthermore, Lewis et al. (1990) found that perceptions of greater barriers ($p<.05$) and fewer benefits of treatment ($p<.01$) were associated with being overweight. These researchers also found that greater perceived susceptibility to diabetes complications were associated with HgA1c levels ($p<.05$); higher HgA1c levels were associated with perceptions of greater vulnerability to complications.

In contrast, Hsieh and associates (2001), in a study exploring relationships between health beliefs related to osteoporosis and active behaviors to prevent osteoporosis (n=60 women; aged 40-95 years), found no significant relationship between health beliefs and preventive behaviors. However, there was a significant correlation between a single item ("I am worried about developing osteoporosis") and active behaviors to prevent osteoporosis (p = .03). Interestingly, only 40% of those studied were actively taking measures to prevent osteoporosis despite their belief that it is a serious condition. Pederson and associates (1984) also found a nonsignificant relationship between health beliefs and behavior with smoking status as the outcome variable of interest. But, when the effects of all variables combined were measured, the results were significant, indicating that the combined variables are related to smoking status. The researchers also found that the longer the smoking habit, the more susceptible the patient felt and that quitting would be beneficial.

In a review of HBM studies on certain cardiovascular risk reduction behaviors (exercising regularly, taking antihypertensive medications as prescribed, and smoking cessation), Janz (1988) found significant relationships between perceptions of susceptibility, severity, benefits, and perceived barriers, with perceived barriers being most strongly associated with behavior. In other studies, perceived benefits of a recommended treatment have been found to be the most strongly associated with adherence behaviors of all the health belief model variables (Becker & Janz, 1985; Harris et al., 1987).

Koch (2002) has identified a direct relationship between barriers and benefits and the desired health behaviors in a population of people with diabetes. Additionally, Koch found that participants who reported exercising three or more times per week had better metabolic control as evidenced by lower HgA1C levels. In a study exploring the relationships between health beliefs and prevention behaviors among Chinese persons with type 2 diabetes, Tan (2004) identified significant correlations between health behaviors and certain health beliefs (perceived severity, susceptibility, and barriers) as well as significant correlations between education level and perceived severity and susceptibility, in addition to health behaviors.

In summary, empirical evidence exists to support the use of the HBM to explain and predict health behaviors (Aljasem et al., 2001; Champion & Scott, 1997; Janz, 1988; Koch, 2002; Witte et al., 1993). In addition, there is evidence to support associations between health beliefs and knowledge (Meischke et al., 2000), associations between cues to action and perceived threat (Witte et al., 1993), and associations between health beliefs and metabolic control and diabetes complications (Lewis et al., 1990).

Discussion of Limitations and Gaps in Research Using the HBM

Although the HBM has received much attention in the literature and a significant amount of published research based on its theoretical framework supports the use of HBM, the HBM has also been criticized, with many researchers questioning its usefulness in interventions targeting behavior change. This section will address the most salient criticisms of the HBM and how these have been addressed in this study.

Perhaps the most commonly cited criticism is that the HBM lacks substantial power to explain or predict behavior. This criticism has been well addressed by Harrison et al. (1992), who published a meta-analysis of relationships between four dimensions of the HBM (susceptibility, severity, benefits, and barriers). They identified 16 studies that used the HBM with adults, measuring all four dimensions and a behavioral dependent variable with some measures of reliability, but ultimately demonstrating minimal validity criteria. The reviewers found that each of these variables is a significant predictor of health behavior; however, the amount of variance explained by each is small. Perceived barriers produced the largest effect size (r ±= -.21), followed by perceived susceptibility (r ±= .15), perceived benefits (r ±= .13) and perceived severity (r ±= .08). These findings support Janz and Becker's (1984) critical review of research that measured HBM variables, which found that of the HBM variables, perceived barriers were the best predictor of behavior followed by perceived susceptibility and perceived benefits, with the least powerful predictor being perceived severity. However, this issue of small effect sizes remains a valid point regarding the usefulness of the HBM in interventions targeting behavior change.

It is important to note that these analyses were conducted using studies of the HBM that did not incorporate the variable of self efficacy into the HBM. In 1988, Rosenstock et al. suggested that the failure to incorporate the construct of self efficacy in the model was a likely reason for the lower than expected findings of the variance accounted for by the model variables; they recommended that self efficacy be included in the HBM. Since 1988, self efficacy has been included as an additional variable in the HBM and a number of studies have demonstrated that the inclusion of self efficacy in behavioral models increases the explanatory power of that model (Aljasem et al., 2001; Garcia & Mann, 2003; Rosenstock, 2004; Rosenstock et al., 1988).

The concept of self efficacy is the key element of Social Cognitive Theory (SCT) (Bandura, 1986). According to SCT, self efficacy, defined by Bandura as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 391), provides the basis for human motivation. As such, there is general agreement that self efficacy is a critical component of an individual's acceptance and practice of a recommended health behavior (Bandura, 1986; Pederson et al., 1984; Strecher et al., 1986). The recent use of self efficacy as one of the variables in the HBM has demonstrated its important position in explaining the pathway leading to behavior change.

A recent study by Garcia and Mann (2003) provides compelling evidence to support the inclusion of self efficacy in the HBM, and counters previous claims that the HBM is not a strong framework to be used in interventions targeting behavior change. Garcia and Mann's study compared a number of health-protective behavior models to determine if self efficacy increases the ability of the model to predict intention to engage in health behaviors. They simultaneously compared the HBM with and without self-efficacy, the Theory of Reasoned Action (which does not include self efficacy), and the Theory of Planned Behavior and the Health Action Process Approach, both of which include self efficacy in their models. They demonstrated that, with the inclusion of self efficacy as a variable in the HBM, the HBM was more effective at predicting intention to engage in dieting than both the Theory of Reasoned Action and Theory of Planned Behavior (R^2 = 0.55, 0.22, 0.48, respectively), and that the HBM was more effective in predicting self breast exam behaviors than the Theory of Reasoned Action (R^2 = 0.30, 0.27, respectively) and was nearly as effective as the Theory of Planned Behavior (R^2 = 0.31). These findings support previous research suggesting that models that include self efficacy are better predictors of behaviors than models that do not include self efficacy, providing further empirical support for the use of self efficacy as a critical variable in the HBM.

A comprehensive discussion of the limitations of the HBM and suggestions for strengthening the model have been presented by Janz et al. (2002). They recommend that the following three features of the HBM be considered in future research: "components of the HBM, relationships between HBM components, and how to use the HBM to understand and change behaviors with public health significance" (p. 45). In addition, they evidence factors that limit the predictability of the HBM and suggest ways to improve these deficits. The following sections will investigate each of these points and demonstrate how the design and implementation of the current study attempts to address them.

Consideration of the Components of the HBM

The majority of studies that have been reviewed for the current study have not evaluated all HBM variables together in one study. Generally, cues to action and self efficacy are omitted and the most common variables studied have been perceived benefits and barriers. One strength of the current study is its measurement of all HBM variables and evaluation of both their individual and combined effects on adherence behaviors.

Consideration of the Relationships Between Components of the HBM

As noted above, all HBM variables will be measured in this study. According to Janz (Janz, 1988; Janz et al., 2002), testing of the entire model is necessary for the HBM to be most useful in predicting behaviors; breaking it into individual variables and ignoring how all variables work together undermines the explanatory and predictive ability of the HBM. Relationships between each of the variables will be evaluated in the current study.

Consideration of How to Use the HBM to Understand and Change Behaviors with Public Health Significance

One aim of this study is to evaluate the predictive power of the combined HBM and SOC models to explain diet and exercise behaviors. If this integrated model is able to explain a significant portion of the variance in these behaviors, it would be an important contribution to our current understanding of diet and exercise behaviors. Consequently, it would also be appropriate to use this model as a framework for the development of interventions for behavior change.

Deficits in the Research Using the HBM

Janz et al. (2002) have identified the existence of inconsistent measurements of HBM concepts and the failure to establish validity and reliability prior to model-testing as deficits in research when implementing the HBM. They suggest that it is essential for future research that uses the HBM to consider the following: using construct definitions consistent with HBM theory, using construct measurements that are specific to the behavior being addressed, developing multiple items for each scale to reduce measurement error, reexamining validity and reliability with each study, and analyzing not only the relationships between the individual HBM *components* on the target behavior but also the relationships between the HBM *constructs*,. Examination of the relationships between the HBM variables, in addition to their relationships with the outcome variable, has been addressed in the previous section. The remaining concerns are addressed in the following sections.

This study addresses these deficits in part by using a newly developed instrument, the Health Beliefs related to CardioVascular Disease scale (HBCVD), which was designed to measure perceived susceptibility and severity of heart attack or stroke (CVD) and perceived benefits and barriers for diet and exercise. A review of the literature did not yield an existing instrument to measure health beliefs related to CVD and diet and exercise specific to patients with type 2 diabetes. As a result, the HBCVD was developed, thus addressing the concern regarding construct measurement being specific to the behavior being investigated.

The HBCVD was developed using construct definitions consistent with the HBM and has demonstrated adequate validity and reliability, thus addressing the concerns expressed by Janz et al. (2002). A more detailed description of the development of the HBCVD can be found in Appendix M: Preliminary Instrument Development Study. For the purposes of this section, it is important to note that reliability and validity have been established in the pilot study for the HBCVD. The self efficacy scale used in this study has also demonstrated adequate validity and reliability (Talbot et al., 1997). The HBCVD scale consists of five to nine items per subscale that are consistent with the definitions of the model variables; content validity was established with extensive literature review, expert panel review, and a focus group session with diabetic patients during the instrument development phase. Construct validity has been demonstrated through Confirmatory Factor Analysis, with factor loadings supporting the presence of 4 factors labeled perceived susceptibility to CVD, perceived severity of CVD, perceived benefits of diet and exercise, and perceived barriers to diet and exercise.

One of the aims of the current study is to perform psychometric evaluation of the HBCVD with the study population in order to address the issue of reexamining validity and reliability with each study. Researchers who are evaluating health beliefs related to CVD and diet and exercise in diabetic patients should consider using the HBCVD in their studies to better resolve the deficit of inconsistent measurement of concepts among studies.

In summary, criticisms of the HBM generally focus on: its limited ability to explain behavior prior to the inclusion of self efficacy in the model, lack of published research exploring relationships between all model variables, lack of published research exploring relationships between all of the model variables and behaviors, inconsistent measurement of HBM concepts, and failure to establish validity and reliability prior to model testing. Each of these criticisms has been addressed in the development and design of the current study; therefore, this study will comply with two of the recommendations by Janz et al. (2002), which are to consider constructs of the HBM as they relate to behavior and the relationships between all HBM constructs. The final recommendation regarding how to use the HBM for improving public health has been addressed in the final chapters, which discuss data analysis and interpretation.

The Transtheoretical Model

According to the TransTheoretical Model (TTM), individuals will be in one of five levels of motivation, or readiness to change, for diet and exercise behaviors: precontemplation, contemplation, preparation, action, or maintenance (Prochaska et al., 1997). These levels are also called stages of change (SOC).

The conceptual definitions of the five stages of change as they have been measured in this study are as follows:

Diet Stages

- Stage 1) Precontemplation: I presently do not eat a healthy diet and do not plan to start eating better in the next 6 months.
- Stage 2) Contemplation: I presently do not eat a healthy diet, but have been thinking about starting to eat better within the next 6 months.
- Stage 3) Preparation: I presently eat a healthy diet sometimes, but not regularly.
- Stage 4) Action: I presently eat a healthy diet regularly, but I have only begun doing so within the past 6 months.
- Stage 5) Maintenance: I presently eat a healthy diet regularly and have been doing so for longer than 6 months.

Exercise Stages

- Stage 1) Precontemplation: I presently do not exercise and do not plan to start exercising in the next 6 months.
- Stage 2) Contemplation: I presently do not exercise, but have been thinking about starting to exercise within the next 6 months.
- Stage 3) Preparation: I presently get some exercise, but not regularly.
- Stage 4) Action: I presently exercise on a regular basis, but I have only begun doing so within the past 6 months.
- Stage 5) Maintenance: I presently exercise on a regular basis and have been doing so for longer than 6 months.

The TTM emphasizes the importance of designing interventions that target the individual's stage change to promote progression through the stages towards the ultimate goal of maintenance of a positive behavior. The stages are linear and cyclical due to the fact that successful changes in behavior often require repeated attempts; thus, recycling through the stages of change is likely to occur (Prochaska & DiClemente, 1992). Bridle et al. (2005) suggest that barriers to change will vary according to stages in the change process and in order to most effectively affect behavior, interventions need to be tailored to the individual's stage of change. It is this individualization that makes tailored interventions more effective than the "one size fits all" approach.

According to DiClemente (1995), there appears to be two distinct phases in which the five stages can be categorized: stages 1-3 are affected by cognitive processes and movement through these stages depends on motivation; stages 4 and 5 are affected by behavioral processes. Targeting health beliefs may be particularly important in the first three stages since cognitive processes influence motivation in these stages and health beliefs are indeed a function of cognition.

Prochaska and DiClemente (1992) assert that as individuals progress through stages, there is a shift in importance of health beliefs and self efficacy. The importance of self efficacy and its ability to predict behavior increases with the onset of some action and increases in its predictive ability as the individual progresses to the maintenance stage. The increasing importance of self efficacy as the individual progresses through change stages is supported by Grimley and associates (1995). In their study evaluating contraceptive behaviors among 550 college students, they found that self efficacy is lowest at the precontemplation stage and rises rapidly until the movement from action to maintenance. Glanz et al. (1994) have suggested that targeting self efficacy within the preparation, action, and maintenance stages is a more effective strategy in getting individuals to adopt a healthy diet than targeting self efficacy in the precontemplation and contemplation stages, at which points targeting health beliefs are likely to be more effective.

While the stages of change construct provides the foundation of the TTM and is the most common application of the model, processes of change have also received empirical support for explaining how shifts in attitudes, behaviors, and intentions occur (Prochaska & DiClemente, 1992; Prochaska et al., 1988). In these studies, ten processes of change have been identified, and each one varies among the different stages of change. The ten processes consist of five cognitive/experiential processes: consciousness raising, dramatic relief, environmental re-evaluation, self-reevaluation, and social liberation; and five behavioral processes of change: counterconditioning, helping relationships, reinforcement management, self-liberation, and stimulus control (Prochaska et al., 1992). Cognitive processes are more salient in earlier stages (precontemplation, contemplation, and preparation), while the behavioral processes increase in importance during the later stages (action and maintenance).

Of the processes, consciousness raising is the only process that appears to be related to the HBM constructs*.* This process includes exposure to and recall of information about the target behavior—similar to cues to action in the HBM. While we agree that processes of change are useful to consider among the myriad other factors that can affect motivation for behavior, the processes of change do not address the individual health beliefs that are accounted for in the HBM. It is the assumption of this study that health beliefs are critical for initiating any behavior change. In addition, the processes of change appear to focus on those which are initiated when an individual is trying to *change* a problem behavior, which is different from the focus of this study. This study instead aims to evaluate the variables that influence an individual's motivation to adopt the healthy behaviors of eating a healthy diet and engaging in regular physical activity.

We believe that the integration of the HBM with the SOC will provide a more comprehensive model to explain motivation for healthy diet and physical activity behaviors than the stages of change model with the processes of change alone. If the integrated model in this study is effective in explaining adherence to behavior, future studies could compare the integrated HBM and SOC model with the SOC and processes of change to evaluate concurrent and discriminate validity.

Empirical Evidence for Stages of Change

The Stages of Change (SOC) model has proven to be an effective framework for predicting a number of behaviors, including weight control, exercise, smoking, alcohol abuse, and psychological distress (Prochaska & DiClemente, 1992). The majority of the evidence to support the predictive validity of the TTM includes the use of stage matching and its application in smoking cessation interventions.

To evaluate the validity of the TTM constructs and the evidence to support the use of stage-matching for interventions designed to achieve smoking cessation, Spencer and associates (2002) conducted a comprehensive review of all peer reviewed research published before March 1, 2001 (N=148) that described original research on the TTM and tobacco cessation and prevention interventions. Using strict evaluation criteria, they reported strong but ultimately inconclusive evidence to support the use of TTM in studies of tobacco use. They concluded that acceptable evidence exists to support the use of stage matching interventions, and noted that when compared to non-tailored interventions, stage matched interventions for smokers were successful more often in achieving progression through stages.

Marcus et al. (1992) found that stage of change was significantly related to smoking cessation. Their findings revealed that after a six-week intervention, 30% of participants in the contemplation stage and over 60% of those in the preparation stage at baseline had progressed to the action stage. Greene et al. (1994) found significantly higher smoking cessation rates in the group who received individualized, self-help intervention materials based on the person's stage of change as compared with the group who received traditional, action-oriented self-help manuals. Similarly, Pallonen et al. (1994) found that after two years, participants who received stage-matched manuals to help with smoking cessation attempts had significantly higher rates of smoking cessation and made more attempts to quit than those in the usual care condition.

Campbell et al. (1994) found a significant two fold increase in reduction of dietary fat intake among participants who received stage matched messages versus participants that received non-tailored messages based solely on dietary guidelines. In a more recent study that aimed to increase mammography in women between the ages of 40 and 74, Rakowski et al. (1998) reported statistically significant differences in screening rates between a stage-matched intervention group and a control group, but no differences between the stage-matched group and standard intervention group. An adjusted logistic regression analysis revealed a significant difference in screening rates between the standard group and the stage-matched group, with the standard group reporting lower screening rates. Additional predictors of screening behaviors included decisional balance and commitment to screening process-of-change scores. The authors concluded that participants in the stage-matched interventions were more likely to have received a mammogram than those in the other two groups.

Clark et al. (2002) continued Rakowski's (1998) study to determine whether the effects of the stage-matched intervention on mammography were sustained for repeat screening rates after one year. The total sample consisted of 1,026 women between the ages of 50 and 74. Surveys conducted one year after baseline and seven to nine months later were used to classify participants into one of four intervention categories related to adherence to obtaining an initial mammogram and a second one within 14 months of the latter. Data analyses revealed that in all three groups, screening percentages for the second mammogram were lower than initial mammogram percentages. However, in both sets, the stage-matched and standard interventions had higher percentages of repeat screening than the control group, but there were no significant differences in screening rates between the stage-matched and standard intervention groups. It merits mention that the authors reported a slightly greater, but not significant, benefit for the stage-matched intervention in the second set of analyses. The authors concluded that the effects of the stage-matched intervention were no stronger than those of the standard intervention on screening behaviors one year after the intervention. They suggested that “booster” sessions may be necessary to sustain the effects found in the original study by Rakowski et al. (1998).

Discussion of Limitations and Gaps in Research Using TTM

There are a number of recent studies that have found evidence against the widespread use of the TTM. For example, Bridle et al. (2005) conducted a systematic review of health behavior interventions based on the TTM. Using strict inclusion criteria, a total of 37 randomized controlled trials that targeted seven health-related behaviors (physical activity, dietary change, multiple lifestyle changes, smoking cessation, screening mammography, adherence to treatment for mental illness, and prevention of unhealthy behaviors such as smoking and alcohol use) were evaluated for their effectiveness in promoting behavior change. Findings revealed that although the use of TTM is widespread and is one of the most popular current behavioral theories, there is actually limited evidence to support its application to develop interventions to affect behavior change.

The most popular explanations for lack of effectiveness of stage-based interventions are related to validity of published findings and the applicability of stage-based interventions to influence certain behaviors. Specifically, there have been limited randomized control trials (RCT), which are the gold standard for empirical evidence, and much of the research using stages of change has been cross-sectional and/or without a control group (Bridle et al., 2005). When evaluating intervention studies, researchers frequently make value judgments based on a variety of levels of evidence when they should be using only the best available evidence—ideally, RCTs. This variation in sources of evidence often leads to differences in outcomes, making it more challenging to determine the relative value of a given intervention. An example of the differences in outcomes depending on the caliber of the studies can be found in the conflicting findings between four recent systematic reviews of the research with stages of change (Bridle et al., 2005; Riemsma et al., 2003; Spencer et al., 2002; Whitelaw et al., 2000). Whitelaw et al. (2000) found a lack of strong evidence to support the use of stages of change in health promotion research. Riemsma et al. (2003) published a systematic review which also found limited evidence to support the use of stage based interventions to change smoking behaviors. In contrast, findings from a systematic review by Spencer et al. (2002) reported acceptable evidence to support the use of stage matched interventions for smoking cessation programs.

In a subsequent systematic review of health behavior interventions based on the stages of change model, the findings of Bridle et al. (2005) supported the findings of Whitelaw et al. (2000) as well as those of Riemsma et al. (2003) that there is a lack of evidence to support the effectiveness of stage-matched interventions. In Bridle's review, the authors suggested that the Spencer review did not use the best available evidence to support their claims. The Spencer review identified 22 trials, of which only six were RCTs, versus the Riemsma review, in which all 23 articles reviewed were RCTs. Because all of the evidence in the Riemsma was derived from RCTs, Bridle et al. (2005) deemed Riemsma's review the strongest and the one that should be used to make clinical decisions regarding the use of stage-based interventions. Although the reviews by Riemsma et al. (2003), Whitelaw et al. (2000), and Bridle et al. (2005) found a lack of evidence to support the use of SOC in health promotion research, Bridle et al. suggest that this lack of evidence could likely be due in part to a lack of model specification and/or poor application of the TTM.

Other popular explanations for the lack of effectiveness for stage-based interventions are related to the fundamental differences that exist between certain behaviors. The original focus of the stages of change model was addictive behaviors, but it has since been expanded to other behaviors such as physical activity and dietary behaviors. Because of the fundamental differences, it is likely that there could be a great deal of variability in the effectiveness of the model depending on the type of behavior being studied. Other explanations include the limitations imposed by measuring behavior change as the outcome variable of interest when increases in knowledge and/or stage progression are an important step toward behavior change (Bridle et al., 2005). Perhaps behavior change is an overly ambitious goal for certain interventions and certain behaviors. It is well known that behavior change is a process and that changes do not occur overnight. Therefore, the strength of the TTM is the recognition of the forward stage progression that is likely to be missed if the focus is on behavioral change only.

In summary, the evidence appears to be inconclusive regarding the effectiveness of SOC-based interventions in producing behavior change. The most common limitations identified are related to the validity of published findings and the variability in effectiveness of SOC when applied to different behaviors, particularly those outside the context of addictive behaviors. This study addresses these limitations in part by using a tool that demonstrates content validity and by evaluating construct and criterion-related validity in the results and discussion chapters. As part of this evaluation, inferences will be made regarding the applicability of stages of change to diet and exercise behaviors.

Due to the cross-sectional descriptive design of this study, longitudinal analyses using a control group are not warranted. However, future intervention studies using these methods would make an important contribution to existing SOC research. In addition, evaluating progression through stages as an outcome measure in intervention studies is another important consideration when designing intervention studies. In the present study, evaluation of the theoretically-sound integrated model incorporating stages of change will provide insight into the appropriateness of the stages construct for diet and exercise behaviors. If this model explains a significant portion of the variance in diet and exercise behaviors, it can be used as a guiding framework for interventions targeting these behaviors in persons with diabetes.

THE HEALTH BELIEF MODEL AND STAGES OF CHANGE: AN INTEGRATED MODEL

Empirical Evidence for the Integrated Model

Although an integrated model incorporating the HBM and SOC has not been evaluated for its ability to explain or predict diet and exercise behaviors in persons with type 2 diabetes, several research studies have demonstrated significant correlations between beliefs and stages of change when applied to other populations and behaviors (Champion, 1994; Champion & Menon, 1997; Champion & Skinner, 2003). In addition, interventions targeting certain health beliefs and stage of change have been found to be effective in facilitating appropriate behavior changes (Grimley et al., 1995; Strecher et al., 1994; Tseng, 2000).

In a recent study evaluating the ability of an integrated model composed of the HBM with self efficacy and SOC to explain Hepatitis A vaccination behaviors among men who have sex with men (MSM), Rhodes and Hergenrather (2003) found significant relationships between all variables included in the model. In their study, the precontemplation stage was associated with significantly higher perceived barriers and lower health care provider communications (exposure to cues to action), with exposure to these cues to action increasing the likelihood that MSM would be vaccinated. The preparation and action stages (readiness to take action) were significantly associated with higher perceived benefits of vaccination, higher perceived severity of HAV, and higher perceived general medical self efficacy and perceived personal self efficacy as compared to the previous stages of precontemplation and contemplation. Contemplation was associated with higher perceptions of susceptibility than the precontemplation stage.

Juniper and associates (2004) also found significant relationships between stages of change and HBM variables in a study assessing physical activity behaviors in a group of 233 African American college women. Findings revealed that participants in the precontemplation and contemplation stages (inactive group) reported high barriers to activity, low severity of negative health outcomes due to inactivity, less exposure to and influence of cues to action, and lower self efficacy for physical activity. Perceived benefits of exercise and perceived susceptibility to consequences of inactivity were not significantly associated with stages; however, there was a significant positive trend for perceived susceptibility, suggesting that these perceptions could eventually become more strongly associated with a stage.

In a recent cross sectional study exploring the influence of the threat of contracting hepatitis C (HCV) among injecting methamphetamine users, Davey et al. (2006) evaluated an application of the Health Belief Model and Stage of Change Model on motivation to quit injecting the drug. Results did not reveal statistically significant differences between stage of change and perceptions of susceptibility to or severity of HCV, nor between benefits or barriers of quitting injecting methamphetamine. However, results did reveal a significant difference between groups in regard to self efficacy: the participants in the action group reported significantly higher beliefs of self efficacy for ceasing injection.

Additional studies have found associations between some HBM variables and stages of change, although these studies did not include measurement of all HBM variables. Grimley et al. (1995) found significant differences between perceived benefits and barriers across stages of change for contraceptive behaviors. In a study targeting perceived benefits and perceived barriers of smoking cessation, Strecher et al. (1994) found that efforts were more effective when using tailored interventions (based on individuals' stage of readiness to change) than nontailored interventions. Skinner and associates (1994) found a relationship between cues to action and stage of change for mammography screening and follow-up behaviors. They believe that tailored letters are similar to cues to action in the HBM, and that the tailored letters may have motivated progression in change stage or targeted behavior change. This finding suggests that knowledge, attained from the tailored letters (i.e., the cues to action) for mammography screening, is a mediator in the relationship between cues to action and stage of change.

In a study evaluating relationships between health beliefs related to breast cancer and stage of change for mammography screening, Champion (1994) found significant differences in beliefs about susceptibility and severity of breast cancer and benefits and barriers to obtaining a mammogram between groups across mammography screening stages of change. Participants in the action/maintenance stage had higher susceptibility perceptions than participants in the precontemplation or contemplation stage; they also exhibited the highest severity perceptions of all groups. Participants in the action/maintenance and contemplation stages had significantly higher perceived benefits than those in the precontemplation stage, and participants in the action/maintenance stage also perceived fewer barriers than those in the precontemplation stage. This study also evaluated the relationships between health beliefs and mammography use and intention for mammography. Findings revealed that those participants who were classified as “mammography users” and those who intended to receive a mammography had significantly higher perceptions of severity of breast cancer as well as higher benefits of and lower barriers to mammography than the group who was classified as “nonusers” and those who did not intend to receive a mammogram.

Subsequent research by Champion and Skinner (2003) explored differences by stage of change in health beliefs related to breast cancer risk and benefits and barriers to mammography; their data support the findings mentioned in the previous paragraph. They identified significant differences between beliefs and stage of change, with the strongest relationships found between barriers and stage of change, followed by benefits, then susceptibility. Barriers were highest in the precontempation and contemplation stages and lowest in the action stage. Precontemplators had the lowest perceived benefits, and both contemplators and actors had higher perceptions of susceptibility than precontemplators.

Conceptualization of the Integrated Model

The current literature review provides evidence for the importance of examining relationships between health beliefs and stages of change related to a number of behaviors. What is missing in the literature is evaluation of the relationships between these variables as applied to diet and exercise behaviors in persons with diabetes. In addition, the HBM has not been sufficiently tested for its application to beliefs about cardiovascular disease and how these beliefs explain diet and exercise behaviors in adults with type 2 diabetes. Moreover, the stages of change for diet and exercise have not been sufficiently explored in the context of diabetes.

Surveys indicate that a majority of persons with diabetes have erroneous beliefs about their risk for cardiovascular disease and associated complications (ADA, 2002). The HBM provides a promising framework for interventions designed to influence inaccurate beliefs regarding susceptibility to and severity of CVD as well as benefits and barriers of diet and exercise to decrease CVD risk. In addition, individualized interventions that target an individual's stage of change for diet and exercise are likely to encourage forward stage progression.

This study contends that in the context of understanding behaviors related to the adoption of a healthy diet and regular physical activity, the HBM contributes to the understanding of stage progression in a different but equally important way than the processes of change in the TTM. Empirical evidence supports the influence of health beliefs on behaviors (Aljasem et al., 2001; Wu & Yu, 2003), but these health beliefs are not clearly recognized within the processes of change literature. We believe that a reliance solely on processes of change to understand stage progression provides an incomplete picture; thus, we propose that both the HBM and SOC models benefit from integration with one another by increasing the total explanatory power for diet and exercise behaviors in patients with type 2 diabetes. We also propose that health beliefs indirectly affect behavior through a direct effect on stage of change. Empirical evidence suggests that health beliefs will be most important in stages 1-3, while self efficacy will increase in importance as the individual progresses forward through the stages (Prochaska & DiClemente, 1992). If these relationships are supported, interventions should be directed toward the stage of change, while the HBM will direct how a clinician will address an individual's stage of change.

In addition to the HBM variables and stages of change, there are a number of other variables that can influence adherence behaviors. In accordance with the bio-psycho-social perspective approach to understanding adherence recommended by Peyrot et al. (1999), the integrated model includes some of these additional variables that have been shown to influence adherence. These variables include the biologic variables of comorbidity and duration of diabetes, and the psychosocial variables of knowledge, depression, social support, and socioeconomic status. The following section will address the conceptualization of adherence as it has been applied in the current study and the empirical evidence found in the literature that relates to adherence. Subsections will include empirical evidence that provides support for each variable included in the integrated model. This section will conclude with a comprehensive conceptualization of the integrated model and a summary of the empirical evidence to support the model links.

CONCEPTUALIZATION AND EMPIRICAL EVIDENCE OF ADHERENCE

Low rates of adherence to therapeutic regimens is not a new problem, especially in regard to preventive behaviors such as changes in eating habits and physical activity, smoking cessation, and adherence to prescribed pharmacological therapy (Fletcher & Lamendola, 2004; Rogers & Bullman, 1995; Sackett & Haynes, 1976). Self-care behaviors are complicated and unpredictable across other behaviors, since performance of one behavior does not necessarily predict performance on another. As a result, adherence variables should not be isolated as if they are occurring independently without interaction effects (Glasgow et al., 1985; Kurtz, 1990). This study attempts to address this issue by measuring relationships of multiple variables on diet and exercise behaviors as well as relationships between the variables.

Non-adherence in diabetic patients has a negative impact on health outcomes (ADA, 2004; Lin et al., 2004) and contributes to unnecessary health care costs to an already taxed health care system (Maldonado et al., 2003). Tan (2004) suggests that low adherence rates to treatment recommendations and the complex self-care behaviors necessary for long-term disease management contribute to the continuously high prevalence rates of diabetes. Diet and exercise are among the most difficult behaviors to change (Kurtz, 1990; Walker & Usher, 2003) and often have some of the lowest adherence rates of all self management behaviors. Thus, a greater understanding and identification of barriers to adopting the recommended lifestyle interventions, such as a healthy diet and regular physical activity, is an important component of addressing this public health problem on a national and international scale.

It is generally accepted that barriers to a behavior are highly related to compliance (Janz & Becker, 1984). Studies have identified a number of barriers that persons with diabetes face, including comorbidities and complex therapeutic regimens (DiMatteo, 2004), duration of disease (Cameron, 1996), demographic variables and socioeconomic status (Brown et al., 2004), which include financial constraints, underinsurance, and older age (Leichter, 2005), knowledge (Walker, 2001), incongruence between the patient's health belief model and therapeutic recommendations (Leichter, 2005), depression (Leichter, 2005; Lustman & Clouse, 2005), and lack of social support (Whittemore et al., 2005).

The following sections will provide conceptualization of and empirical evidence for each model variable. Hypothesized relationships have been identified by underlined statements, indicating the direction of the relationship.

Sociodemographic and Biologic Factors and Adherence

There is substantial empirical evidence to support the influence of sociodemographic and other psychological variables on behavior (Rosenstock, 2004). In addition, comorbidty and duration of illness have been associated with adherence behaviors (Cameron, 1996).

Socioeconomic status has a direct relationship with adherence. Empirical evidence from studies measuring the impact of socioeconomic status (SES) on health outcomes has been varied, but it is generally accepted that social and economic hardship are inversely related to health status (Brown et al., 2004.) Brown et al. (2004) conducted a comprehensive review of the literature regarding socioeconomic position (SEP) and health among persons with diabetes. Some of the salient findings from their review that are pertinent to the current study are summarized as follows: lower SES has been associated with worsened metabolic control, increased rates of CVD morbidity and mortality, lower rates of exercise, decreased access to care, and less use of preventive care services.

Rosenstock (2004) suggests that behavior is indirectly affected by education and other sociodemographic variables through their direct effects on perceptions of disease threat and benefits and barriers to a recommended health action. Aljasem et al. (2001) found that higher education was associated with greater frequency of testing blood glucose; however, this effect decreased to nonsignificance when self efficacy was included into the model. They also found that the presence of diabetes complications and race were associated with skipping medications ($p=.005$) and that age had some effect on whether or not participants followed a healthy diet ($p=.04$).

In this study, the following variables are being measured to represent SES: education, annual income, employment status, insurance status and type. In addition, gender, race, and age are also being measured as critical covariates that must be considered when evaluating the impact of SES on health outcomes (Brown et al., 2004).

Comorbidity and length of disease have a direct relationship with knowledge and adherence. Research supports the relationships between presence of comorbid conditions and duration of disease on health outcomes.

Presence of comorbid disease has been associated with decreased adherence (Hernández-Ronquillo et al., 2003), while longer duration of diabetes has been found to be positively associated with increased adherence to diet (Garay-Sevilla et al., 1995). Tan (2004) identified a significant positive relationship between knowledge and duration of diabetes, suggesting that knowledge could be an important mediator for the relationship between length of disease and adherence. Although the mechanism of action is not always clear, one possible explanation is that diabetes is not a single disease; rather, it consists of a number of other diseases including hypertension and hyperlipidemia. These comorbidities increase the complexity of the therapeutic regimen for diabetes care and adherence often decreases as the complexity of the regimen increases (Haynes et al., 1976).

One common comorbid disease among diabetics is depression (Anderson et al., 2001). Research has demonstrated significant associations between depression and comorbid diseases (Engum et al., 2005) and a number of diabetes complications (Katon et al., 2004) in patients with type 2 diabetes. Interestingly, in the previously mentioned Engum et al. study (2005), depression rates were significantly higher among diabetics with comorbid disease(s) when compared to other diabetics without comorbid disease, suggesting that the presence of comorbidities may be the mediating factor between depression and diabetes, rather than diabetes alone leading to depression or vice-versa. Brown, Majumdar, and associates' study (2006) support these findings: after controlling for comorbid diseases and the burden of diabetes complications, they found insubstantial evidence that type 2 diabetes increases the risk of depression. These findings provide evidence for the important influence of comorbid conditions and duration of diabetes in understanding health behaviors and health outcomes of patients with type 2 diabetes.

KNOWLEDGE AND THE HEALTH BELIEF MODEL

Low adherence among persons with diabetes could be due to deficient knowledge about effective interventions to decrease risk and/or lack of sufficient information or guidance for how to initiate and maintain the behavior. Other contributing factors to low adherence rates could be related to a lack of knowledge or erroneous beliefs about the increased risk of CVD morbidity and mortality among persons with diabetes (ADA, 2002). In a survey of approximately 2,000 persons with diabetes conducted by the ADA (2002), it was discovered that 68% did not consider cardiovascular disease to be a complication of diabetes; more than 50% did not feel at risk for heart conditions or stroke; 60% did not feel at risk for high blood pressure or cholesterol; and awareness was lowest among elderly and minority persons with diabetes.

Interventions that increase knowledge and awareness of CVD risk factors are important in strategies for reducing CVD in diabetics. For example, in a study of patients deemed at risk for cardiovascular disease, Nielsen et al. (2005) found that awareness of risk led to significant lifestyle changes unless the changes were associated with decreased quality of life. However, knowledge of diabetes management and risk for cardiovascular disease is a "necessary but not sufficient" component of successful diabetes self management (Arseneau et al., 1994). It is also important to understand the relationships between knowledge and other factors that can indirectly affect behavior, such as cues to action, perceptions of self efficacy and health beliefs.

Cues to action have a direct relationship with knowledge and perceived threat (perceived susceptibility and severity combined). In this study, the HBM variable *cues to action* is related to exposure to sources, providing information related to diabetes and cardiovascular disease; as such, it is considered a mechanism by which participants could have obtained knowledge. The cues were measured by asking the participants to respond with a "yes" or "no" to questions asking if they regularly attend DM or CVD support groups and if they have been exposed to information about DM or CVD from health care professionals, friends or family, electronic resources, or other media such as newspapers, commercial, or informational pamphlets.

Cues to action from health care professionals, social contacts, and media can directly affect knowledge, as they are common ways that patients learn about their health and disease. These cues can also affect health beliefs through their influence on knowledge. Rosenstock (2004) related the difficulty in measuring cues to action because they can be fleeting (e.g., a sneeze); as a result, these cues have not been systematically studied. For this reason, there is a lack of empirical evidence to support relationships between cues and behaviors.

One study was identified in the literature that found that a community event such as physician counseling (cue to action) significantly influences perceived threat (perceived susceptibility and severity combined), and that perceived threat predicted bicycle helmet purchasing behavior (Witte et al., 1993). Based on this finding and the logical relationship between cues to action as operationalized in this study, the relationships between cues to action and knowledge and cues to action and perceived threat will be explored in the integrated model.

Knowledge has a direct relationship with health beliefs. One possible explanation for the conflicting evidence regarding the effects of knowledge on behavior could be that knowledge may be a mediating variable for other factors known to influence behavior (Glasgow, 1999), factors which may include health beliefs. In this study, the effects of knowledge on adherence behaviors are thought to occur through a direct effect on health beliefs and subsequently through stage of change. Direct relationships between knowledge and health beliefs are supported in the literature (Dickerson et al., 2005; Meischke et al., 2000).

Dickerson et al. (2005) reported that diabetes knowledge is inversely associated with perceived barriers to diabetes care. Meischke et al. (2000) found a significant positive association between greater perceptions of myocardial infarction (MI) risk (susceptibility) and greater knowledge in women. As expected, women who incorrectly answered the question "heart disease is *not* the most common cause of death in the United States" reported significantly lower perceptions of risk than women who correctly answered the question, suggesting that knowledge is an important factor in health beliefs.

Associations between knowledge and health beliefs in the context of osteoporosis and cancer screening behaviors have also been identified. Ziccardi et al. (2004) found that senior nursing students were more knowledgeable about osteoporosis and were more confident about performing osteoporosis-preventing behaviors than sophomore students, thus suggesting a relationship between knowledge and self efficacy. Menon et al. (2003) found a positive association between colonoscopy use and provider recommendation, higher knowledge, lower barriers, higher benefits, and higher self efficacy, suggesting an association between knowledge and the HBM. In contrast, Eibner and associates (2006) found that breast cancer knowledge did not influence perceived susceptibility to breast cancer among women who did not have breast cancer or a family history of breast cancer. However, in a study measuring the effects of a breast self-exam teaching intervention with teenagers, Ludwick and Gaczkowski (2001) found a significant inverse relationship between knowledge and barriers and a significant positive relationship with benefits.

Although not included in conceptual links in the integrated model, it is interesting to note that there is some empirical evidence to support a positive relationship between knowledge and stages of change. For example, in a study exploring osteoporosis prevention behaviors in 113 older adults, Popa (2005) found a significant relationship between stage of change and level of knowledge about osteoporosis in addition to relationships between age, gender, and level of education. Further, Kelaher et al. (1999) found a significant positive relationship between higher knowledge scores and women who intended to be screened in the future (contemplation, action, and maintenance stages). We propose that the effects of knowledge on stage of change actually occur through its effect on health beliefs; it is the influence of health beliefs that moves a person forward in the cognitive stages of change, which leads to actual behavior practices.

HEALTH BELIEF MODEL AND STAGE OF CHANGE

Empirical evidence demonstrating the relationships between the effects of the HBM variables and stages of change was first presented in the theoretical framework section of this chapter, providing support for the use of the combined HBM and SOC model in the current study. In this section, a summary of the most relevant findings as well as additional evidence will be presented to emphasize support for the hypothesized relationships that are being tested in this study.

Health beliefs have a direct relationship with stages of change. Health beliefs influence stage of change (Champion, 1994; Champion & Skinner, 2003; Juniper et al., 2004; Rhodes & Hergenrather, 2003). We purport that health beliefs regarding perceived susceptibility, severity, benefits and barriers affect behavior change through their influence on the cognitive processes of behavior change, which are the major influences in the first three stages of change in the TTM. In fact, it could be that the inconsistent support for the HBM effects on behavior can be attributed, in part, to the lack of consideration of other factors affecting behavior in the context of health beliefs, such as stages of change. The interrelationships between the HBM and SOC are the focus of this study. Empirical evidence to support the hypothesized relationships between SOC and the health beliefs of perceived susceptibility, severity, benefits, and barriers, followed by self efficacy, is summarized below.

Perceived susceptibility has a direct relationship with stages of change. Rhodes and Hergenrather (2003) found that the contemplation stage is associated with higher perceived susceptibility to HAV than the precontemplation stage. Champion (1994) found higher perceptions of susceptibility to breast cancer in the combined action/maintenance stage than in the precontemplation and contemplation stages. Champion and Skinner (2003) found that perceptions of susceptibility to breast cancer were higher in contemplators and actors than in precontemplators.

Perceived severity has a direct relationship with stages of change. Champion (1994) found that participants in the action/maintenance stage had the highest perceived severity of breast cancer of all groups. Precontemplation and contemplation stages are associated with low severity of negative outcomes related to inactivity (Juniper et al., 2004). Preparation and action stages are associated with higher perceived severity of HAV (Rhodes & Hergenrather, 2003).

Perceived benefits have a direct relationship with stages of change. Grimley et al. (1995) found significant differences between benefits of contraceptive behaviors across stages of change. Preparation and action stages are associated with higher perceived benefits of HAV vaccination (Rhodes & Hergenrather, 2003). Champion (1994) found that participants in the action/maintenance and contemplation stages had significantly higher perceived benefits of mammography screening than participants in the precontemplation stage. Champion and Skinner (2003) found that precontemplators reported the lowest perceived benefits of mammography.

Perceived barriers have a direct relationship with stages of change. The precontemplation stage is associated with higher perceived barriers to HAV prevention behaviors (Rhodes & Hergenrather, 2003). Precontemplation and contemplation stages are associated with high barriers to physical activity (Juniper et al., 2004). Grimley et al. (1995) found significant differences between barriers to contraceptive behaviors across stages of change. Champion (1994) found that participants in the action/maintenance stage perceived fewer barriers to mammography screening than participants in the precontemplation stage.

Champion and Skinner (2003) found barriers to mammography were lowest in the action stage and highest in precontemplation and contemplation stages.

Self efficacy has a direct relationship with stages of change. Grimley et al. (1995) found significant relationships between self efficacy and contraceptive behaviors. Moreover, they noted that self efficacy climbs from its lowest point in the precontemplation stage to a peak in action or maintenance stage. Tseng (2000) found that self efficacy was the most important variable in influencing stage of change, noting that self efficacy combined with cognitive processes, behavioral processes, and pros & cons accounted for 74% of the variance in stages of change.

In Rhodes and Hergenrather's study (2003), participants in the preparation and action stages for HAV prevention behaviors reported significantly higher self efficacy than participants in the precontemplation and contemplation stages. This is similar to the study by Davey et al. (2006), which found that participants in the action group reported significantly higher self efficacy beliefs for quitting injection of methamphetamine. However, the converse has also been reported by Juniper et al. (2004), who found that participants in the precontemplation and contemplation stages reported lower self efficacy for physical activity.

STAGES OF CHANGE AND ADHERENCE

Stages of change provide information about where a person is regarding their decision to engage in a given behavior, ranging from precontemplators, who are not even considering adopting a given behavior, to persons in the maintenance stage, who have maintained a given behavior for a period of six months or longer. As such, it is logical that stage of change would be associated with behavior. In the integrated model, behavior is believed to be indirectly affected by influencing expectations regarding a situation rather than by a direct influence on behaviors (Rosenstock, 2004). The authors hypothesize that the indirect effect occurs through the direct effect of the HBM on SOC, with SOC acting as a mediator in the relationship between HBM and diet and exercise behavior.

Empirical evidence demonstrating the affects of SOC on behavior was first presented in the theoretical framework section of this chapter, which served to provide support for the use of the SOC in the current study. In the following section, a summary of the most relevant findings as well as additional evidence will be presented to emphasize support for the hypothesized relationships that are being tested in this study.

Stage of change has a direct relationship with adherence behaviors. Empirical evidence provides support for the relationships between stages of change and behavior and the benefits of stage matched interventions for influencing behavior. In a recent systematic review of the literature evaluating published TTM interventions to affect exercise behaviors, Spencer and associates (2006) found that stage-based interventions can affect forward stage progression and/or increase exercise behaviors. Although Fahrenwald et al. (2005) did not support the hypothesis that the TTM constructs mediated increases in physical activity, they did find large effect sizes for improvements in physical activity and changes in TTM constructs. Auslander et al. (2002) found that using individually tailored interventions based on the participants' change stage for individual dietary patterns resulted in statistically significant reductions in fat intake compared to the control group.

DEPRESSION AND ADHERENCE

Depression is common in patients with type 2 diabetes and is a significant risk factor for the development of diabetes (Freedland, 2004) and diabetes related complications, particularly coronary heart disease (CHD) (Lustman & Clouse, 2004). Diabetes is associated with a two fold increase in risk of developing depression compared to people without diabetes; further, approximately 30% of persons with diabetes have depressive symptoms (Anderson et al., 2001). As a result, it is generally recommended that practitioners aggressively evaluate and manage depression in diabetic patients in efforts to improve health outcomes and quality of life (DiMatteo, 2004; McKellar et al., 2004; Williams et al., 2006).

There is a great deal of evidence to support an association between depression and adherence, with one group of researchers surmising that as many as 64% of nonadherent patients will meet the criteria for depression (DiMatteo et al., 2000; Kalsekar et al., 2006). There is also considerable evidence supporting the notion that nonadherence has negative and consistent effects on treatment outcomes (DiMatteo et al., 2000), and that depression is associated with diabetes complications (de Groot et al., 2001).

McKellar et al. (2004) found that depression affects diabetic patients' ability to adhere to a prescribed treatment regimen, which, in turn, leads to poorer health outcomes. The mechanisms through which depression affects adherence and health outcomes among diabetic patients are unclear (Sacco et al., 2005); however, it is likely that there are many variables that mediate the relationships between adherence and depression. For example, self efficacy has been found to mediate the relationship between adherence and depression (Sacco et al., 2005). Wells (1995) posits that depression has an indirect effect on health outcomes through patient adherence. This position is supported by recent studies that have found adherence to be a mediating variable between depression and health outcomes (Salmon, 2001; Wing et al., 2002). In addition, DiMatteo (2004) suggests the possibility of a "feedback loop" in which depression causes nonadherence, which, in turn, exacerbates depression.

There is also empirical evidence to support the associations between depression and metabolic control. For example, Lustman and Clouse (2005) found a significant association between depression and decreased metabolic control, which they suggested led to worsening of depression (Lustman & Clouse, 2005). Katon et al. (2004) found a significant association between HGA1c levels $\geq$ 8.0% and major depression, but not minor depression. In contrast, Engum et al. (2005) did not find a significant association between depression and HGA1c levels in type 2 diabetics. However, they did find significant differences between groups when comparing diabetic patients with and without comorbid disease.

Depression is also associated with increased mortality rates. Egede and associates (2005) found that coexistence of diabetes and depression is associated with significant increases in mortality from any cause, and that patients with diabetes were up to two and a half times more likely to die from coronary heart disease than patients without diabetes or depressive symptoms. Women are particularly vulnerable to the interaction between depression and mortality because diabetic women have higher rates of depression than diabetic men (Anderson et al., 2001). In fact, major depression has been found to be an independent risk factor for CHD in diabetic women, and the development of CHD is accelerated in diabetic women with depression compared to diabetic women who are not depressed (Clouse et al., 2003).

Zhang et al. (2005) also identified a significant relationship between depression and mortality in diabetic patients with no significant relationship in nondiabetic patients, indicating that diabetes is a modifier in the relationship between depression and mortality. These findings are supported by Katon et al. (2005), who found that type 2 diabetic patients diagnosed with major and minor depression had a significant increase in mortality rates compared to persons with diabetes without a diagnosis of depression.

Depression has a direct relationship with adherence behaviors. Depression in diabetic patients is associated with poorer health behaviors and physiological measures, reduced quality of life, and increased health care costs (Lustman & Clouse, 2005). These associations are likely to be related, at least to some degree, to the significant relationships that have been found between depression and decreased adherence to treatment recommendations and/or diabetes self-management activities. In a meta-analysis of the effects of anxiety and depression on patient adherence, DiMatteo et al. (2000) found a significant relationship between depression and non-adherence, with depressed patients three times more likely to be non-adherent with medical treatment recommendations than non-depressed patients. While in the general population, depression occurs in at least 25% of patients undergoing medical treatment (DiMatteo et al., 2004), DiMatteo et al. (2000) concluded from their meta-analysis that in a population of non-adherent patients, one can expect an average of 63.5% to be depressed.

Lin et al. (2004) found an association between major depression and the following patient-initiated health behaviors: unhealthy diet, lessened physical activity, and decreased medication adherence. Ciechanowski and associates (2000) also found that depression decreases adherence to diet and prescribed medications. In persons with diabetes, depression is significantly associated with poorer diet and exercise (Fenton & Stover, 2006) as well as decreased adherence to medication (Kalsekar et al., 2006) and poorer glycemic control (Lustman et al., 2000). Furthermore, higher depression scores are associated with more barriers to treatment ($p<.001$), greater severity of diabetes ($p<.01$) and greater susceptibility to diabetes complications ($p<.001$) (Lewis et al., 1990).

SOCIAL SUPPORT AND ADHERENCE

Social support has been defined as the tangible and intangible "assistance and protection given to others, especially to individuals" (Langford et al., 1997, p. 95). To add clarification to the concept, Finfgeld-Connett (2005) offers the following explanation:

> Social support is composed of emotional and instrumental support. It is an advocative interpersonal process that involves the reciprocal exchange of information, is context specific, and results in improved mental health. Antecedents of emotional and instrumental support include a perceived need plus a social network and climate conducive to the exchange of social support. (p. 8)

Social support has a direct relationship with adherence behaviors. In diabetic patients, adherence to diet is strongly associated with social support (Garay-Sevilla et al., 1995). Glasgow and Toobert (1988) have found that family support is the most important type of social support for adherence. The relationships between family support and adherence behaviors in diabetic patients has also been demonstrated by Lo (1999) and Tillotson and Smith (1996). Toljamo and Hentinen (2001) have also underscored the importance of family support in their research on adherence to self care behaviors with insulin treated diabetes; they found better adherence to self care among participants that reported better support from family and friends. In addition, Toljamo and Hentinen (2001) found that although living alone was a predictor of neglect of self-care (i.e., nonadherence), in the presence of support from family and friends, the relationship between living status and adherence was no longer significant. More recently, in a study exploring factors associated with diet and exercise behavior, support from family, friends, and health care professionals and self efficacy, beliefs regarding diabetes self-management were the most consistent predictors of diabetes self management behaviors (Whittemore et al., 2005).

De Bacquer et al. (2005) identified a substantial relationship between social support and coronary heart disease independent of other risk factors. Piano (1997) found a significant positive relationship between health promotion behavior and perceived social support. Zabalegui (1997) found that high psychological distress occurred when patients perceived their social support to be low. Toljamo and Hentinen (2001) found that neglect of self-care was predicted by poor metabolic control, smoking and living alone. Talbot et al. (1996) found that women reported lower levels of social support and that lower levels of social support were significantly related to lower levels of adherence to exercise recommendations. In a study evaluating the HBM with self efficacy, social support, and locus of control, Aalto and Uutela (1997) found that the model incorporating self efficacy explained 14% of the variance in adherence to diet, and identified social support as the strongest predictor of diet adherence.

CHAPTER SUMMARY

In this chapter, the theoretical frameworks that guided this study were described and empirical evidence to support the use of these models was provided. The rationale and support for a model integrating the Health Belief Model and Stages of Change Model was presented. In addition, the concept of adherence was discussed and a review of adherence literature was presented. Selected variables that have been shown to influence adherence behaviors were described and a focused review of the literature was provided for each variable. The selected variables that have been evaluated in this study are knowledge, cues to action, health beliefs, self-efficacy, stage of change, comorbid diseases, length of diabetes, depression, social support, and socioeconomic status.

CONCLUSION

The integrated model that was tested in this study was derived from an extensive review of the literature on psychosocial factors influencing illness prevention and/or adherence behaviors. From this information, the integrated model that guides this study was developed to explain diet and exercise behaviors. Support for the hypothesized relationships among model variables was obtained from the literature. Of note, there is support for individual relationships, but no research was identified that evaluated all model variables at one time. Thus the significance of the present study is the evaluation of the relationships among multiple variables known to influence behavior tested together in one model. The ability to evaluate and control for the influence of multiple variables on diet and exercise behaviors will provide a more comprehensive understanding of the complex nature of adherence to diet and exercise in persons with diabetes.

Chapter 3: Methodology

INTRODUCTION

This chapter describes the research design and methods used in this study to explore the relationships between the variables included in the conceptual model. These variables include the following predictor variables: Health Belief Model (HBM) including self-efficacy, stages of change, knowledge, depression, social support, socioeconomic status, comorbid disease, and duration of diabetes as well as the following outcome variables: diet and exercise adherence. First, an overview of the design is presented, followed by a description of the sample, setting, recruitment and data collection methods, and ethical considerations applied in this study. Next, a description of the measurement methods is provided. Finally, this chapter concludes with a description of the data analysis and procedures employed in this study.

DESIGN

A descriptive correlational cross-sectional design was used to explore relationships among the model variables. The conceptual model depicting the hypothesized relationships between the model variables has been presented in Figure 1. The predictor variables measured in this study include: comorbidity, duration of illness, cues to action related to diabetes and cardiovascular disease (CVD), knowledge related to risk for heart disease in diabetic patients, the HBM including self efficacy for self management of diabetes, stage of change for diet and exercise, social support for diabetes management, depression, and socioeconomic status (e.g., education level, income, employment status, and health insurance status). The main outcome variables that have been measured in this study are diet and exercise adherence.

A descriptive correlational design was chosen for this study because this model has not been previously tested and therefore the purpose of this study was to describe the relationships between the variables and evaluate the model's viability for predicting diet and exercise behaviors. According to Tabachnick & Fidell (2001), descriptive correlational studies describe the relationships among variables rather than infer cause-and-effect relationships. Further, they can provide support for specific theoretical linkages that can be used as the foundation for more rigorous research. Correlational analyses were used to describe the size and direction of the relationships between the variables, while multiple regression techniques were used to test the adequacy of the proposed model to predict adherence to diet and exercise behaviors.

SAMPLE AND SETTING

This study utilized a convenience sample of 212 adults with type 2 diabetes recruited from eight different clinical and community settings in southeastern Texas and central North Carolina. Non-random sampling techniques were chosen based on considerations of feasibility and economic constraints. According to Pedhauzer and Schmelkin (1991), nonprobability sampling is commonly used and is acceptable in sociobehavioral research; however, it must be noted that one can not make inferences to a population based on findings from nonrandom samples. In this study, the intent was not to make inferences outside of the sample, but to explore the characteristics of the sample and the relationships among the model variables within this sample as the basis for future research.

The sample size for the multiple regression analyses that tested individual predictors in this study was calculated based on recommendations by Tabachnick and Fidell (2001). They provided the following *rule of thumb* equation for calculating required sample-size based on the number of predictors and assuming “a medium-size relationship between the IVs and the DV, $\alpha = .05$, and $\beta = .20$“ (p.117): $N \geq 104 + m$ (where m is the number of IVs). There are 24 predicted relationships in the model tested in this study; therefore, a total of 128 participants was the minimum number of participants required. Additional sample size considerations were included for examination of reliability of the HBCVD scale. As suggested by Nunnally and Bernstein (1994), a minimum of 5 participants per scale item is required. The HBCVD contains 25 items; thus, 125 participants is the minimally acceptable sample size to address this aim. The final sample of 212 participants satisfies the minimum criteria identified.

All participants in this study met the following inclusion criteria: 1) self-reported clinical diagnosis of type 2 diabetes, 2) age 18 years or older, and 3) ability to speak, read and understand English. In an attempt to increase sample size and to recruit a variety of adults with type 2 diabetes, multiple recruitment sites in community and clinical settings were chosen. Descriptions of each site and patient population are as follows:

- *Site 1* (n=103): The majority of the study participants were recruited from an outpatient cardiovascular and diabetes prevention (CVDP) clinic affiliated with a large university hospital in southeast Texas. Each year, the clinic treats an average of 526 adult diabetes patients who are referred to the clinic for diabetes education and management.
- *Site 2* (n=42): Participants were recruited from a volunteer registry obtained from a Center for Aging in southeast Texas. This registry consists of approximately 800 people 55 years and older in the local community that volunteered to be invited to participate in research studies in the area. A total of 83 recruitment packets were mailed and 43 completed questionnaires were returned with a response rate of approximately 50%.
- *Site 3* (n=8): Participants were recruited from a diabetes support group meeting in southeast Texas. The support group consists of persons of any age with diabetes in addition to their family and friends; the meetings are held on a monthly basis.
- *Site 4* (n=7): Participants were recruited from an outpatient family practice clinic in southeast Texas. This clinic is a Federally Qualified Health Center that serves all ages in the surrounding community. Each month the clinic

treats approximately 400 patients, the majority of whom are economically disadvantaged.

- *Site 5* (n=36): Participants were recruited from a pre-admit testing center in the Rio Grande Valley that sees patients with diabetes and CVD on a daily basis. The majority of this population is Spanish-speaking only; however, participants were limited to those who were able to read, write and speak English.
- *Site 6* (n=3): One participant from an outpatient family practice clinic in southeast Texas, one family member and one friend of the recruiter from this clinical site returned completed questionnaires.
- *Site 7* (n=6): Employees from a large academic medical center in southeast Texas were recruited by a recruitment announcement posted via the institutional list serve that posts daily announcements. Of approximately 12,300 full time equivalent (FTE) employees, 11 responded to the announcement and six returned completed questionnaires.
- *Site 8* (n=7): Participants were recruited from an outpatient family practice clinic and through a list serve of employees affiliated with a regional 457-bed, not-for-profit medical center in North Carolina. The family practice clinic sponsors a diabetes self-management program for adult, pediatric, and gestational clients with diabetes who are referred to the clinic by practitioners in the community and surrounding areas. Two patients from the clinic and 17 employees returned completed questionnaires.

DATA COLLECTION AND PROCEDURES

This section will describe the recruitment efforts and procedures of data collection for each of the eight recruitment sites used in this study. A brief description of the recruiters from each site is provided, followed by a description of the recruitment procedures at each sight and the participant compensation offerings.

Recruitment and Procedure

Recruitment of adults with type 2 diabetes occurred in community and outpatient clinical settings and through family and friends of the volunteer recruiters from April 24, 2006 to March 16, 2007. The principal investigator contacted professional nurse colleagues involved with care for diabetic patients for assistance with recruitment at their clinical sites. From this query, six clinicians agreed to assist with recruitment in sites 2, 3, 4, 5, 6, and 8. Permission for recruitment at these sites was obtained from the Institutional Review Boards associated with the medical centers in southeast Texas and central North Carolina and from the clinic directors and/or volunteer recruiters at each site.

All recruiters were trained in study purpose and protocol by the principal investigator. A detailed participant recruitment letter (Appendix B) was provided on the first page of each questionnaire packet to limit the amount of explanation the recruiters had to provide and to maintain consistency among recruitment efforts. Characteristics of the volunteer recruiters and recruitment procedures at each site are described below.

Recruiter characteristics. This section describes the characteristics of the individuals who assisted with recruitment of participants for this study. The relevant characteristics of each recruiter from each recruitment site is described below.

- Site 1: Recruiters consisted of seven clinic staff members composed of two secretaries, three medical assistants, and two diabetes educators.
- Site 2: Recruiters consisted of two masters prepared Clinical Gerontology Recruitment Coordinators and one assistant clinical research coordinator.
- Site 3: One recruiter, who is a certified diabetes educator that served as facilitator of the monthly diabetes support group meetings.
- Site 4: Recruiters consisted of five clinic staff composed of two nurse practitioners, one secretary, and two medical assistants.
- Site 5: One recruiter, who is a family nurse practitioner.

- Site 6: One recruiter, who is a family nurse practitioner, was able to recruit one patient, one nurse colleague with diabetes, and one family member with diabetes.
- Site 7: One recruiter, who is a family nurse practitioner.
- Site 8: Recruiters consisted of eight staff members composed of the primary recruiter, who is a registered nurse, and the coordinator of the diabetes self management program at the clinic, three other nurses, two dietitians, and two secretaries.

Recruitment procedures. All recruitment efforts included provision of questionnaire packets, which contained a recruitment letter on the first page that explained the study and purpose, what would be required of participants, participants' rights, compensation methods, and contact information for the principal investigator and research assistant (Appendix B). The questionnaire packets consisted of the recruitment letter, contact information sheet (Appendix C), a demographic and biographic questionnaire (Appendix D) and eight scales measuring psychosocial variables included in the integrated model (Appendices E-L).

Prior to recruitment for the current study, four volunteers were asked to complete the questionnaires to obtain an estimate of the amount of time it would take study participants to complete them. It took the four volunteers approximately 30 minutes each and as a result, participants were informed that the estimated time for completion is 30-45 minutes.

By way of the recruitment letter and reinforcement by recruiters, participants were assured that all information would remain confidential, would be used for descriptive and inferential purposes only, and would only be available to the research team. The recruitment letter served as the primary method of imparting information about the study and the participants' role. Volunteer recruiters were responsible for notifying eligible participants of the opportunity to participate in the study and for providing the questionnaire packets. Participants were given the option of returning their completed packets to the recruiters or mailing them to the principal investigator in a self addressed, postage-paid envelope.

Recruiters were available to introduce and explain the study and to answer questions of the participants. All recruiters reported that the only questions they received were about compensation offerings, and none about the study purpose or protocol. In addition, no participants contacted the principal investigator or research assistant about the study purpose or protocol.

Beginning in the sixth month of recruitment, test-retest methods were included in the study protocol. In the first questionnaire packet, participants were instructed to complete the contact information sheet and return it with their completed questionnaires. Within two to four weeks after their first set of completed questionnaires were received, the research assistant mailed participants the retest questionnaires, which included all previous questionnaires minus the demographic and biographic questionnaire. In addition, a letter composed by the principal investigator thanking them for their participation and providing instructions for completing and returning the retest packet was included in the mailing. Participants were instructed to return completed packets via U.S. mail in a self addressed stamped envelope.

Recruitment efforts were generally consistent among the different sites, with variations only among the individual target populations, such as the outpatient clinics, diabetes support group meeting attendees, and the employees from the two medical centers. Specific recruitment efforts for the individual sites are described below.

Sites 1, 4, 5, and 8: Flyers were posted in clinic waiting rooms (Appendix A). Upon checking-in for a scheduled clinic visit, clinic personnel explained the purpose of the study to eligible patients and offered them the opportunity to participate. Study packets were given to interested patients. Study packets included a recruitment letter (Appendix B), contact information form (Appendix

C), a demographic and biographic questionnaire (Appendix C), and eight instruments (Appendices E-L).

Participants who expressed an interest in participating in the study were given the questionnaire packet and were instructed to complete the questionnaire in the waiting area of the clinic and return them to clinic personnel or to complete it at a time of their convenience and return it to the principal investigator via U.S. Mail in a self addressed postage paid envelope provided.

Site 2: The center staff identified 84 volunteers in the volunteer registry with a self reported diagnosis of type 2 diabetes and mailed out questionnaire packets with the recruitment letter. The volunteers were instructed to return their completed questionnaires if they consented to participate in the study. Of the 84 questionnaires distributed, one volunteer was deceased and a total of 43 participants returned completed questionnaires, for a response rate of approximately 50%.

Site 3: The facilitator of the support group meeting introduced the study to attendees at one of their regularly scheduled monthly meetings. Attendees who were interested were given a questionnaire packet and were instructed to return completed packets in the mail. At the one evening meeting where recruitment took place, approximately ten people with diabetes were present and eight of the ten returned completed questionnaires.

Site 4: In addition to recruiting patients from her clinic site (site 8), the recruiter at this site also composed a recruitment announcement (Appendix A), which was distributed to all employees of the institution. Interested employees contacted the recruiter and questionnaire packets were distributed when requested via campus mail. Participants were instructed to return completed questionnaires to the principal investigator via U. S. mail with a self addressed postage paid envelope provided.

Site 6: The recruiter informed one family member and several of her patients and nurse colleagues of the opportunity to participate in the study. She provided participants with the questionnaire packet and instructed them to return completed questionnaires to the principal investigator via U. S. mail with a self addressed postage paid envelope provided.

Site 7: The recruiter composed a recruitment announcement (Appendix A) to be posted in the daily announcements distributed by the institution to all employees. Interested employees contacted the recruiter and questionnaire packets were distributed when requested via campus mail. Participants were given the option of returning questionnaires via campus mail (no postage required) or through U.S. mail with a self addressed postage paid envelope provided.

Participant compensation. Compensation for participants occurred in three phases, with all phases including the choice of a healthy snack and/or cloth tape measure. In phase one, the names of all participants during this phase were entered into a lottery drawing for a $100 gift card to Wal-Mart. In phase two, all participants were given the choice of a healthy snack and/or cloth tape measure only and in phase three, all participants received a $5 gift card to Wal-Mart.

Changes in compensation methods occurred as a result of decisions made by the Institutional Review Board (IRB) of the medical center in southeast Texas. The original study protocol that was submitted to the IRB for expedited review and was approved by the first reviewer included the lottery drawing as compensation for participants. However, when an amendment was submitted to include the test-retest procedures and the institutional electronic recruitment announcement, a different IRB reviewer reviewed the protocol and felt that the lottery compensation could be perceived as coercive and stipulated that it must be removed. As a result, compensation was altered to include the healthy snack and cloth tape measure only. Not surprisingly, participation rates dropped dramatically: only 20 completed questionnaires were returned for this compensation group in a four month time period compared to the 96 that were returned during the preceding four months. As of January 17, 2007 the principal investigator was able to obtain funding to provide $5 gift cards to Wal-Mart to participants, which resulted in a dramatic increase in participants, with 100 questionnaires returned in a ten week time period.

As a result of the development of recruitment efforts and subsequent recruitment sites, certain sites were only offered certain compensation (see table 3.1). Phase one included the lottery and was offered to all participants from sites 2 (n=42) and 8 (n=7) and approximately half of the participants recruited from site 1 (n=44). The healthy snack and tape measure only offering in phase two was the only compensation offered for sites 4 (n=7) and 7 (n=6) and for the first two participants from site 5 (n=2) and the majority of participants from site 6 (n=2). This relatively insignificant compensation offering could have contributed the low numbers of participants recruited from these sites. Phase three compensation was offered to the next half of participants from site 1 (n=56), the remaining participants from sites 5 (n=34) and 6 (n=1), and all the participants from site 3 (n=8). To evaluate differences between groups across recruitment site and compensation methods, one-way analyses of variance were conducted and the results are presented in chapter four.

Ethical Considerations

Protection of Human Subjects

This was a noninvasive study with no anticipated risks associated with participation in this study. No adverse events were reported by the study participants or the research team. There were no anticipated benefits to the participants. Possible societal benefits include a greater understanding of the relationships between selected psychosocial factors and diet and exercise behaviors of this population, which could lead to more effective interventions to improve health outcomes. There was no monetary cost associated with participation in this study. Both males and females are represented in this study and there were no exclusions regarding race or ethnicity. Children were excluded from this study because the population of focus in this study was adults with type 2 diabetes.

Table 3.1: Number of Participants by Compensation Phase and Recruitment Site (Cross tabulations)

Recruitment Site (n)	Compensation Phase (n)			Total (n)
	$100 Lottery	Tape Measure, snack	$5 gift card	
Site 1	44	3	56	103
Site 2	42	0	0	42
Site 3	0	0	8	8
Site 4	0	7	0	7
Site 5	0	2	34	36
Site 6	0	2	1	3
Site 7	0	6	0	6
Site 8	7	0	0	7
Total	93	20	99	212

Data Safety Monitoring

The Principal Investigator served as Data Safety Monitor for this study and assumed primary responsibility for all aspects of the study, including maintaining participant confidentiality, recruitment and retention, data collection and entry, and data analysis. Upon receipt, all data were handled only by members of the research team and when not in use, were kept in a locked drawer in the Principle Investigator’s locked private office. All data will remain locked in the Principle Investigator’s office until they are destroyed three years after completion of the study. All information has been used for statistical and descriptive purposes only and will be kept strictly confidential. Once completed questionnaires were received, each participant’s contact information sheet was coded as per the code on the questionnaire, then immediately separated from their questionnaires so that unique identifiers were not associated with their questionnaire responses.

Measurement Methods

This section includes a description of the methods used to measure the study variables. The reader is reminded to review Figure 1 for a diagram of the conceptual model that guided this study, which depicts the predictor and outcome variables measured. The predictor variables in this study include: comorbidity, duration of illness, cues to action related to diabetes and CVD, knowledge related to risk for heart disease in diabetic patients, the HBM, including self efficacy for self management of diabetes, stage of change for diet and exercise, social support for diabetes management, depression, and socioeconomic status (education level, income, employment status, and health insurance status). The main outcome variables that have been measured in this study are diet and exercise adherence.

Each measure is described and, when available, evidence of reliability and validity of the measure is provided. Decisions regarding coding and scoring, changes in group membership and procedures for handling missing data are also described as they apply to the individual measurement.

Sample Characteristics

To evaluate sample characteristics and measure study variables, the author developed a questionnaire to measure self report of demographic and health status information. In addition, seven previously validated scales and three scales developed by the author were used to measure remaining study variables. Scoring of the model variables included construction of total scores, subscale scores, and reversed item scoring syntax formulas under the guidance of the biostatistician that served on the dissertation committee. A description of the method of measurement for each study variable is provided below.

- *Recruitment site and compensation phase.* To allow for comparisons between recruitment sites and compensation phases, each site and each phase was given an arbitrary code. Recruitment sites were coded as 1-8, which corresponds to the previously described site numbers.

Compensation type was coded as “1” for the lottery, “2” for the healthy snack and tape measure only, and “3” for the $5 gift card.

- *Demographic data.* This section of the study packet included questions designed to measure demographic characteristics of the sample (Appendix D). Participants responded to nine categorical items and one continuous item regarding their age (continuous), gender, race, marital status and living arrangements. Measurement of socioeconomic status consisted of responses to questions regarding education level, gross annual income, employment status, health insurance status and insurance type. Specific categories provided as response options for each variable can be found by reviewing the actual questionnaire in Appendix D. Evaluation of group characteristics revealed some groups with small sizes, which necessitated changes in group membership for analytical purposes. A description of these changes is provided below.
- *Changes in group membership.* Analysis of descriptive statistics for study variables revealed four demographic variables with small group size in one or more levels of the variable, making inferences related to group membership unreliable. The variables in which small group membership occurred were age, race, marital status, and employment status. As a result, the levels or groupings within each variable were re-evaluated and some individual groups were combined in an equally meaningful manner.
- *Age:* Age was originally divided into five categories: 18-30 (n=6), 31-50 (n=53), 51-65 (n=83), 66-80 (n=68), and 81+ (n=6). Due to the small sample size in the 18-30 and 81+ age groups, these groupings were revised to create three new age groupings: 1) 19-39, 2) 40-59, and 3) 60+. These age groupings are consistent with the Centers for Disease Control (2005) groupings presented in their *National Diabetes Fact Sheet* publication.

- *Race:* In this study, only two Asian/Pacific Islanders and only four Native Americans participated, whereas there were a total of 36 African American (AA) participants, 135 Caucasians (C), and 39 Hispanics (H). Because of the small group sizes, the decision was made to combine Asian/Pacific Islanders and Native Americans into one group (other; n=6) and compare the diet and exercise adherence scale means between the new grouping and the other race groups (see table 2) to determine the most meaningful way to combine this group with one of the larger groups. Mean scores of the "other" group were most similar to the African American group; therefore the decision was made to combine the Asian/Pacific Islanders and Native Americans with the African American group (n=40). The final groupings consisted of three groups for race: 1) African American, Asian/Pacific Islander, and Native American; 2) Caucasian; and 3) Hispanic.

Table 3.2: Mean Diet and Exercise Scores by Race

		N	**Mean**
Diet and Weight Subscale	AA	34	5.5882
	Other	6	5.5000
	C	129	5.8295
	H	39	6.0256
	Total	208	5.8173
Exercise Subscale	AA	34	8.2647
	Other	6	8.5000
	C	123	7.4146
	H	38	7.8421
	Total	201	7.6716

- *Marital status:* Originally, there were 6 different marital status response options: Single, never married (n=11); Divorced (n=26); Separated (n=3); Married or with Life Partner (n=82); Widowed (n=29); and Member of an Unmarried Couple (n=4). The separated and member of an unmarried couple groups had few members. Upon further consideration, the author recognized that conceptual differences between certain groups were insignificant for the purposes of this study and thus combined the following two groups: Divorced or Separated and Married or with Life Partner or Member of an Unmarried Couple. The following four marital status groups were used in data analysis: 1) Single, never married, 2) Divorced/Separated, 3) Widowed and 4) Married/with Life Partner/Member of an Unmarried Couple.
- *Employment status:* Eight categories were originally selected to describe employment status: Employed for wages full-time (n=35), Employed for wages part-time or less (n=14), Out of work for more than 1 year (n=2), Out of work for less than 1 year (n=1), Unable to work (n=22), Homemaker (n=8), Student (n=2), and Retired (n=69). Due to small sample size in some groups, the categories were condensed into three different but meaningful groupings: 1) Employed for wages full-time and Employed for wages part-time or less which was labeled as "Employed"; 2) Out of work for more than 1 year, Out of work for less than 1 year, and Unable to work which was labeled as "Disabled/Unable to find work"; and 3) Retired, Homemaker, and Student which was labeled as "Retired/Student/Homemaker".

Health Status Data

This section of the study packet included questions about the participants' health history and exposure to health information (Appendix D). Measurement of duration of diabetes, comorbidities, and cues to action for diabetes and CVD were included in this section.

Duration of diabetes was measured as a single open-ended item asking "for how many years have you been diagnosed with diabetes". A list of comorbid conditions commonly seen in diabetics, including hypertension, CVD, and high cholesterol, was presented in a table for participants to respond with a "yes," "no," or "I don't know" regarding whether or not they had been diagnosed with each condition. "Yes" responses were weighted as "1" and "no" or "I don't know" responses were weighted as "0". The weighted scores for this scale were summed, with higher scores indicating higher numbers of comorbid conditions.

Two redundant items were included in the comorbid disease list. One item, "diabetes," was included as a validity check to compare participants' responses regarding the presence of diabetes and duration of diabetes and to identify individuals who were not diabetic, but submitted questionnaires. Four participants who reported that they had not been told that they were diabetic listed their duration of diabetes as "0", and reported that they were not being treated for diabetes; as a result, these participants were not included in the data analysis. The second item, "depression," was included as a means of capturing participants who have been diagnosed with depression but whose depression scores do not indicate depression, perhaps because it is being controlled with medication. Comparisons between self-reported diagnosis of depression, self-reported treatment for depression, and total scores on the CESD depression scale were evaluated in the data analysis.

Although not included in the hypothesized model, additional questions were included to glean more descriptive information about the participants' health status that could provide further insight into the health of the study population. These self-report items included duration of hypertension, smoking status, height, weight, and the following lab values: blood glucose, hemoglobin A1C, LDL, HDL, blood pressure, triglycerides, and total cholesterol. Body mass index (BMI) was calculated for each individual and the participants were then categorized according to their BMI as follows: *Normal weight* if BMI <25, *Overweight* if BMI ranged from 25-29, and *Obese* if BMI was 30 or greater. In addition, participants were asked to indicate whether or not they were taking insulin, oral hypoglycemics, aspirin, or plavix, and to respond to the question “are you currently being treated with medication for any of the conditions for which you answered 'yes' " by choosing “yes,” “no,” or “I don’t know” in the list of comorbid diseases.

One item, “have you been admitted to the hospital for any reason within the last six-months,” was included to identify participants who may have recently experienced an acute or chronic illness that required hospital admission. This item was included because a recent stressful event such as a hospitalization could significantly affect responses on the questionnaire items. A total of 57 participants indicated that they had been admitted to the hospital in the past six months; however, there was no item that inquired about reason for admission. Analyses of variance results revealed no significant differences between hospitalized and non-hospitalized groups across diet and exercise adherence scores; therefore, no statistical control was necessary for differences in hospitalization groups.

Cues to Action

Cues to action related to diabetes were measured by six items developed by the researcher, inquiring about exposure to information about diabetes from a variety of resources including health care professionals, social contacts, and media (Appendix D). A nearly identical scale was created for exposure to information about CVD, with the only change being replacement of the word “diabetes” with “cardiovascular disease.” Participants responded either “yes” or “no” to each question. Scores were weighted, with yes=1 and no=0, and were summed. Scores ranged from 0-6, with higher scores indicating more exposure to cues to action.

Instrumentation

Knowledge: Knowledge of heart disease risk in people with diabetes was measured by the Heart Disease Fact Questionnaire (HDFQ) (Wagner et al., 2005). The HDFQ (Appendix E) is a 25 item self-report questionnaire. In the original scale, two response options were provided: “True” or “False.” The original scale was tested in a population of 524 patients with diabetes, 74% of whom had type 2 diabetes (Wagner et al., 2005). Internal consistency was demonstrated with Kuder Richardson-20 internal consistency coefficient of .77, with good inter-item correlations ranging from .18 to .41. Content validity was achieved by extensive literature review and evaluation of items by an expert panel. Criterion-related validity was established by discriminant function analyses which demonstrated that scale scores differentiated respondents by group membership.

For this study, the author chose to include “I don’t know” as a third response option in an effort to decrease the possibility of participants being able to guess correctly, which would falsely raise the knowledge score, in an attempt to obtain the most accurate assessment of CVD risk knowledge. Correct responses were weighted as “1” and incorrect or “I don’t know” responses were weighted as “0”. Responses were summed to create a total score ranging from 0-25, with higher scores indicating higher knowledge.

Health Beliefs: Perceived susceptibility to and severity of heart attack or stroke and benefits of and barriers to diet and exercise were measured by the Health Beliefs related to Cardiovascular Disease scale (HBCVD) (Gressle, 2005). The HBCVD (Appendix F) is a 25 item self-report scale that consists of four subscales, measuring perceptions of susceptibility, severity, benefits, and barriers. Each subscale has four response options ranging from strongly agree to strongly disagree. Item responses received weighted scores ranging from 1 (strongly disagree) to 4 (strongly agree), so that higher scores indicated higher levels of the perception. Two items in the barriers subscale, “I have access to exercise facilities and/or equipment" and "I have someone who will exercise with me," were reverse coded so that the higher the score, the less the participant agreed with the statement. Mean scores for each subscale were calculated and used in data analysis; each subscale score ranged from 1-4.

The HBCVD has been tested with a population of 95 patients with type 2 diabetes (see Appendix M). The standardized item alpha was .78 with good inter-item correlations. Standardized item alphas for susceptibility, severity, benefits, and barriers subscale scores were .87, .64, .91, and .68 respectively. Content validity was demonstrated by extensive review of the literature, expert panel review and feedback on items from a focus group of adults with type 2 diabetes.

Handling of missing data: For each HBCVD subscale, if the participant missed only one item, mean scores for the individual subscale were used to replace missing data in that subscale. If missing more than one item, subscale scores were not calculated or used in statistical analysis.

Depression: Depression was measured by the Center for Epidemiologic Studies Depression Scale: (CES-D) (Hann et al., 1999). The CES-D (Appendix G) is a 20-item self report depression scale with questions pertaining to frequency of depressive symptoms experienced during the previous week (Radloff, 1977). Response options range from 0 (rarely) to 3 (most or all of the time), with the total score being the sum of total item weights ranging from 0-60. A score of 16 or higher indicates depression. Reliability has been demonstrated with reported item alphas > .85 (Hann et al., 1999).

Handling of missing data: Mean scores were used to replace missing data for CESD scores if the total number of missing items was not greater than four; this decision was made based on scoring guidelines for the CESD (Hann et al., 1999). If missing more than four items, CESD scores were not calculated or used in statistical analysis.

Self Efficacy: Self efficacy for diabetes self-care was measured by the Multidimensional Diabetes Questionnaire - Self-Efficacy subscale (MDQ-SE) (Talbot et al., 1997). The MDQ-SE (Appendix H) consists of 7 self-report items related to self-efficacy for adhering to diet recommendations, checking blood sugars, exercising, weight control, and prescribed medication regimen. This instrument was originally designed with response options ranging from 0-100 on a visual analog scale, with 0 indicating “not at all confident” and 100 indicating “very confident.” However, to maintain consistency among the format of this scale with the remainder of the scales in the questionnaire packet, responses options were altered to include a Likert scale, with four response options ranging from “not at all confident” to “very confident.” Scores were weighted and summed, producing a possible range of 7-28, with higher scores indicating higher self efficacy.

The MDQ-SE was tested in a population of 249 non-insulin independent diabetic patients and the self efficacy subscale showed good internal consistency, with an alpha of .89. Construct validity was supported through confirmatory factor analysis supporting the factor structure for the self efficacy subscale.

Social Support: Perceived social support related to diabetes from significant others, family, friends and health care professionals was measured by the Multidimensional Diabetes Questionnaire – Social Support subscale (MDQ-SS) (Talbot et al., 1997). The MDQ-SS (Appendix I) consists of four self-report items with four response options on a 1-4 rating scale. Total scores were used for data analysis and scores ranged from 4-16, with higher scores indicating higher levels of social support.

The instrument was tested in a population of 249 non-insulin independent diabetic patients. The social support subscale showed good internal consistency with an alpha of .77. Construct validity was supported through confirmatory factor analysis supporting factor structure for the social support subscale.

Changes in group membership: Because two of the four questions in the MDQ-Social Support subscale ask about the extent of support received from a spouse/significant other and because almost half of the participants in this study indicated that they were not in a relationship with a significant other, it was necessary to evaluate differences between marital status groups and perceived social support. Social support can come from a variety of sources, and the term "significant other" may mean different things to different people. To prevent unnecessary exclusion based on relationship status, the MDQ-SS was also divided into two subscales: Diabetes Support from Friends and Healthcare Team and Diabetes Support from Spouse/Significant Other. Marital status between group differences across social support total scores and subscale scores were evaluated using One-Way ANOVA. No significant differences were found in diet or exercise adherence scores between groups. As a result, data analysis included the MDQ-SS total score.

Exercise Stage: Stage of exercise was measured by the Stage of Exercise Scale (SOES) (Cardinal, 1995). The SOES (Appendix J) consists of a five-point, ordered categorical scale in which participants select the one category that best describes their current exercise behaviors. The following definition was provided for participants in the instructions paragraph at the top of the page: “Regular exercise” equals three or more days per week for 20 minutes or more each day (for example, swimming or walking). Response options are listed in hierarchical order with “4” (maintenance stage) at the top and “0” at the bottom. Stages were categorized as follows: 0 is precontemplation, 1 is contemplation, 2 is preparation, 3 is action, and 4 is maintenance. Each participant received one score per stage item ranging from 0-4.

Spearman Rho test-retest reliability in a sample of 12 subjects was 1.00 ($p<.001$). Content validity for the SOES in this study has been confirmed by expert panel review.

Diet Stage: Stage of diet was measured by the Stage of Diet Scale (SODS) (Appendix K). This scale was adapted from the SOES by the author and applied to diet behaviors. The SODS consists of a five-point ordered categorical scale in which participants select the one category that best describes their current diet behaviors. The following definition was provided for participants in the instructions paragraph at the top of the page: "Healthy diet" is one that includes fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products; lean meats, poultry, fish, beans, eggs, and nuts; and is low in saturated fats, *trans* fats, cholesterol, salt (sodium), and added sugars. Response options are listed in hierarchical order with "4" (maintenance stage) at the top and "0" at the bottom. Stages were categorized as follows: 0 is precontemplation, 1 is contemplation, 2 is preparation, 3 is action, and 4 is maintenance. Each participant received one score per stage item, ranging from 0-4.

While there are various algorithms that exist to measure stages of change, there is no "gold standard" with which to compare the different algorithms (Brug et al., 2005). As a newly developed scale, the SODS has no baseline reliability data. However, test re-test reliability was evaluated in the current study. Content validity for the SODS has been confirmed by expert panel review.

Changes in stage group membership: In this study, only seven participants indicated that they were in the precontemplation stage of change for the SOES and only three participants indicated that they were in the precontemplation stage for the SODS. Cross tabulations between SOES and the three items on the TDAQ exercise subscale identified that all seven responses occurred in either the "never" or "rarely" categories for questions 4 and 5. Question 3 responses were five "never," one for "rarely," and one for "sometimes." Cross tabulations between SODS and the two items on the TDAQ diet subscale identified two responses for "never" and one for "sometimes" for question 1; question 2 responses were two "never," and one for "rarely." Cross tabulation of stages by participant number identified that participants in the exercise precontemplation stage were not the same participants that were in the diet precontemplation stage. The decision was made to try to combine the precontemplation group with the contemplation group to create a new larger group to represent participants who indicated that they do not participate in any diet or exercise activity at all (inaction group), while retaining the other three groups that involve some degree of action by the participants (preparation, action, maintenance).

To justify decisions regarding combination of groups, analyses of variance tests were conducted to determine if there were significant differences between precontemplation and contemplation stage groups on the outcome variables of diet and exercise adherence; due to the small group sizes, $p<.001$ was selected as criteria for statistical significance in this particular analysis. One-way analyses of variance showed no significant differences in exercise adherence subscale scores between the two groups ($p=.443$) or between groups on the diet adherence subscale scores ($p=.004$). Thus, exercise precontemplators and contemplators were combined into one group, for a total of four exercise stage groups; diet precontemplators and contemplators were also combined into one group for a total of four diet stage groups.

Diet and Exercise Adherence: Self-reported adherence to diet and exercise behaviors was measured by The Diabetes Activity Questionnaire: (TDAQ) (Hernandez, 1997). The TDAQ (Appendix L) consists of 13 items measuring adherence to recommended diet, exercise, prescribed medication regimen, self monitoring of blood glucose, management of abnormal glucose levels, and daily foot inspection. In the original scale, response options consisted of a 100 mm long VAS ranging from “never” to “always,” with higher scores indicating higher self reported adherence. Pilot test results in a sample of 153 diabetic patients demonstrated test-retest reliability of .78 and Cronbach’s alpha of .82. Content validity was supported by a literature review and expert panel review. Construct validity was demonstrated through principal component analysis which resulted in two factors: changes in client lifestyle and necessary treatments for diabetes. The changes in lifestyle factor included items assessing diet and exercise behaviors as well as self monitoring of blood glucose.

For this study, response options were altered to maintain consistency among the format of this scale with the remainder of the scales in the questionnaire packet to decrease the likelihood of participant confusion due to multiple response options. The revised response options included a Likert scale with four options ranging from "always" to "never." Scores were weighted so that higher scores indicated greater self reported adherence.

For the purposes of this study, which focus specifically on diet and exercise behaviors, two subscales scores were created for diet and exercise and these subscale scores were the only items from the TDAQ that were evaluated in the current study. Two items were retained for the diet subscale: "I follow my meal plan exactly as suggested by my educator" and "I try to keep my weight within the range suggested by my educator." Three items were retained for the exercise subscale: "I exercise as often as my educator advised me to," "I only do exercises/activities recommended by my educator" and "I exercise at the times suggested by my educator." Responses on the diet and exercise subscales received weighted scores and were summed to provide a total diet adherence score ranging from 2-8 and a total exercise adherence score ranging from 3-12, with higher scores indicating higher adherence.

IDENTIFICATION OF LIMITATIONS AND ASSUMPTIONS

Possible limitations of the current study include the use of nonrandom sampling techniques and the unintentional effect that the differences in participant compensation offerings may have had on participation rates and sample characteristics. Each potential limitation will be discussed in the following sections.

Convenience sampling methods were chosen for their feasibility and due to economical restraints. Use of nonrandom sampling methods precludes the possibility of being able to generalize study findings outside of the study population (Pedhauzer & Schmelkin, 1991). Since one of the aims of this study was to simply describe the relationships among the model variables in the study population as a first step in evaluating the integrated model, a convenience sampling method was sufficient to address this aim.

Differences in participant compensation offerings may have contributed to differences in participation rates at the different recruitment sites. It is also likely that the differences in compensation offerings resulted in variations in participant characteristics, which perhaps affected the outcome variables in this study. For example, participants who were motivated to participate in the study because of the possibility of having their name drawn in the $100 gift card lottery may be economically disadvantaged or poorer and were driven to participate by this monetary incentive, which, in turn could affect diet and exercise behaviors because of their economic barriers. Or, perhaps these participants are inherent risk takers, which could affect diet and exercise behaviors in that they may be less likely to engage in these recommended behaviors and instead play against the odds that they will not develop diabetes complications, including CVD morbidity and mortality.

Participants who were motivated by the healthy snack and/or cloth tape measure only may be inherently more altruistic or self-motivated, which could influence behavior by making them more likely to adhere to recommended diet and exercise behaviors. Additionally, the time of year may have been a factor during this compensation phase since three major holidays occurred during this time: Thanksgiving, Christmas/Hanukah/Kwanza, and the New Year; all of which are very busy times for many individuals and the addition of another responsibility (completing the questionnaires) may have been undesirable. Finally, participants during the $5 gift card compensation phase may have also been economically disadvantaged and the gift card could have provided monetary incentive, or perhaps they were motivated by New Year's resolutions, which could have encouraged them to be more involved in their self management of diabetes.

These differences in recruitment rates between the three recruitment phases suggest that people were more likely to participate when they were offered a better compensation. When the only compensation was a cloth tape measure and healthy snack, participation decreased dramatically while the $100 lottery and $5.00 gift card phases yielded much higher rates of participation. Differences between group characteristics across compensation offerings were explored to identify significant differences in study variables associated with group membership, which could have an effect on the outcome variables of interest.

DATA ANALYSIS AND PROCEDURES

In this section, descriptions of the data analysis and procedures are provided. First a description of the procedures used for data management and preparation for data analysis is provided, then statistical analyses for evaluating sample characteristics are described. Finally, the statistical analyses that were used to answer the research questions and post hoc analyses are described.

Data Management and Preparation for Analysis

Prior to setting up the dataset, variable name and coding decisions were made by the Principal Investigator (PI) and written on a hard copy of the questionnaire to be used as the code sheet. Next, the dataset was composed using SPSS version 14.0 program software. Participant responses were entered into this database by either a research assistant (RA) trained in SPSS data entry and study procedures or by the principal investigator. To ensure consistent techniques, the first ten data entries by the RA were observed by the PI; no variations in entry were identified. The RA was instructed to consult with the PI for any and all questions concerning the data entry.

The first step in data analysis included cleaning and checking the quality of the data by evaluating descriptive statistics of all study variables. As recommended by Munro (2001), each variable was checked by evaluating frequency distributions, measures of central tendency, variability, skewness, and kurtosis (Munro, 2001). Additionally, data were evaluated for the presence of outliers and missing data.

First, frequency distributions and minimum and maximum scores were visually evaluated by the PI to identify small group membership and any unexpected and/or extreme values or outliers among the data. Several variables had groups with very few participants, and groups were combined when theoretically possible; specific changes have been described previously in the *Method of Measurement* section. When additional unexpected findings were identified, the source of the questionable variable result was identified and scores entered into the dataset were compared to the actual response on the original questionnaire. If an entry error occurred, it was then corrected. Throughout the cleaning and screening process, only two cases of error entry were identified. To ensure reliability of the dataset and participant responses, a random sampling of all original completed questionnaires was selected and a total of 20 questionnaires were cross validated for correct data entry; this step revealed no additional entry errors, and thus data analysis continued.

Measures of central tendency included mean, median, and mode. Determination of the most meaningful measure to report was based on the distribution of values, except for nominal level variables in which the mode is the only acceptable measure of central tendency (Munro, 2001). After determining the distribution of scores, variability, or homogeneity of groups, was assessed by measuring the standard deviation, range, and/or interpercentile measures of all scores for each ordinal and interval variable. Currently, there are no acceptable measures of variability for nominal data (Munro, 2001).

Next, the data were screened for additional outliers, or extreme values relative to the distribution (Munro, 2001). Potential sources of outliers include data entry error, data collection failure, or an actual extreme value. Subjective identification of outliers was completed in the first phase of the cleaning and screening process through evaluation of frequency distributions previously described. An objective assessment was also employed by evaluating box plots constructed by the SPSS program software.

Following the screening for outliers, evaluation of missing data began according to procedures recommended by Munro (2001). The number of missing data entries was provided in each variable’s frequency table. Regarding missing data, the data were evaluated for patterns that could explain why missing data occurred. First, the original questionnaire was reviewed to ensure correct data entry and to subjectively evaluate whether or not there was an obvious pattern of missing data throughout the questionnaire. The majority of the missing items occurred at random, and mean scores were substituted for the missing items in the HDFQ, HBCVD, and CESD scales. Specific procedures for handling missing data for each variable have been described in the preceding *Measurement Methods* section.

Evaluation of Assumptions for Parametric Statistical Tests

Each parametric statistical procedure has certain assumptions that must be met in order to have confidence in the results. Decisions regarding appropriate statistical tests to answer the research questions were based on whether or not the data from the current study meet the assumptions for the procedure. In the case of violations of assumptions, nonparametric statistics and other statistical techniques will be considered.

Summary of Data Management and Preparation for Analysis

In summary, cleaning and screening of the data was completed as the first step in data analysis. All data were evaluated for measures of central tendency, variability, and symmetry. Measures were taken to correct any violations of assumptions in the data. Outliers and missing data were identified and handled according to recommendations by Tabchnick and Fidell (2001) and Munro

(2001). Descriptions of changes in group membership to improve interpretability of the data and the procedure for handling missing data are provided.

Upon completion of the data screening and cleaning process, statistical analyses were conducted to describe sample characteristics and to answer the research questions using two statistical software programs: SPSS version 14.0 and AMOS version 6.0.

Data Analysis Plan

Description of the Sample

Frequencies with measures of central tendency, dispersion, and distribution were calculated for demographic data, each model variable, recruitment site, compensation phase and additional health status indicators not included in the conceptual model (see Figure 1). Demographic variables included age, gender, race, marital status, living arrangements, education level, gross annual income, employment status, health insurance status and insurance type. Health status indicators included in the model were duration of diabetes and comorbid conditions. Additional health status characteristics measured by the self-report questionnaire included: hospital admission in the previous six months, duration of hypertension; smoking status; height and weight with BMI calculated by author; lab values for blood glucose, hemoglobin A1C, LDL, HDL, blood pressure, triglycerides, and total cholesterol; whether or not the participants were taking insulin, oral hypoglycemics, aspirin, and plavix; and whether or not they were being treated with medication for each of the comorbid conditions they identified having.

Statistical Analyses for Research Questions

Aim One

The research question for aim one of this study was: "What are the psychometric properties of The Health Beliefs related to Cardiovascular Disease scale (HBCVD) tested in a population of persons with type 2 diabetes?" To address aim 1, reliability and validity indices were evaluated using SPSS version 14.0 and AMOS 6.0.

Reliability. Initial evaluation included calculation of frequencies for each response option for each item to determine adequate range and variability among responses. Inter-item correlations between all scale items were evaluated using DeVellis' (2003) criteria, which suggested that items with an alpha <.30 are insufficiently related to the other items in the scale, and those with an alpha >.70 may be redundant. Items that did not fall within the recommended alpha range were carefully evaluated based on their theoretical significance and their inter-item correlations within their associated subscale to determine whether to retain the item or delete it.

Next, determination of the internal consistency of each of the four subscales within the HBCVD was achieved by evaluating Cronbach's alpha calculations for each subscale using the following criteria suggested by DeVellis (2003): "below .60, unacceptable; between .60 and .65, undesirable; between .65 and .70, minimally acceptable; between .70 and .80, respectable; between .80 and .90, very good; much above .90, one should consider shortening the scale…" (pp. 95-96). Individual items in each subscale were also evaluated according to the above criteria to guide decisions regarding item deletion or revision. Corrected item-total correlation and alpha if-item-deleted were also evaluated for the items in each scale to further evaluate items that need to be deleted or modified. Assessment for high item variance and item means close to the center range of possible scores was also included in the evaluation of scale items.

Next, scale intercorrelations were evaluated. High scale intercorrelations suggest multicolinearity and would decrease the likelihood of obtaining separate factors through factor analysis (DeVellis, 2003). The goal is to have low scale intercorrelations, i.e., 0.1 to 0.2, which would indicate that the scales are independent enough to capture different aspects of the general construct while keeping high inter-item correlations. Moreover, this relationship indicates that the items are measuring the specific latent variable the scale aims to capture (R. P. Lederman, personal communication, September 14, 2004).

Finally, results for total scale reliability were evaluated by applying DeVellis' (2003) criteria to the standardized item alpha. While this value will provide valuable information about the internal consistency of the overall scale, each subscale and each item within the subscale must also be carefully evaluated and the theoretical value or importance of the individual items must be considered when determining whether to retain, delete, or modify an item.

Test-retest reliability was evaluated for the 25 participants who completed the HBCVD scale two to three weeks after completion of the first questionnaire packet. These measures provided information about the temporal stability of the HBCVD over time.

Validity. Validity of the Health Beliefs Related to Disease Risk scale was evaluated by examining content validity, construct validity, criterion-related validity, and discriminant validity indices (DeVellis, 2003). A description of each plan for evaluation is described below. Assessment of concurrent validity was not an aim in the current study. However, if the HBCVD proves to be an acceptably reliable scale, concurrent validation would be a necessary next-step in the instrument development and evaluation process.

Content validity. Content validity was evaluated by consultation with an expert panel with expertise in the areas of diabetes, cardiovascular disease, and/or instrument development. Evaluation of the other types of validity is described below.

Construct validity. Forced factor analysis (FFA) with oblique rotation was used to determine factor structure. Four factors were identified from the pilot study and, as a result, FFA selecting 4 factors was used in the current study. Factor structure was evaluated based on primary and secondary loadings. Upon examination of the resulting factor structure matrix, items were retained if they had primary loadings of ≥ .3 and secondary loadings of ≤ .4, which are the minimally acceptable criteria suggested by Norman and Streiner (2000).

Non-rotated factor solutions and factor rotation with orthogonal and oblique rotation were evaluated for determination of the constructs that corresponded to the factor based on the items identified within each factor. The rotation with the most meaningful item groupings and strong, unambiguous loadings was sought to determine the number of items to retain.

Criterion-related validity. Criterion-related or predictive validity was evaluated by hypothesis-testing through multiple regression and path analysis procedures and interpretation of the extent to which the HBCVD predicted stage of change and/or diet and exercise behavior in this population of type 2 diabetics. In essence, the greater the strength of this empirical relationship, the greater the predictive validity of the scale.

Discriminant validity. Using a Multitrait-Multimethod matrix (Campbell & Fisk, as cited in DeVellis, 2003) is one way to measure construct validity of an instrument. In the current study, evaluation of discriminant validity provided partial evidence for construct validity for the HBCVD. Discriminant validity was examined by evaluating inter-scale correlations between the HBCVD and the other scales used to measure remaining model variables. Ideally, correlations between the HBCVD and the other instruments will be low, since the HBCVD aims to measure health beliefs specifically rather than the remaining model variables.

Aim Two

The research question for aim two was "What are the relationships among biological and psychosocial variables and diet and exercise behaviors in a population of persons with type 2 diabetes?" Before relationships among model variables were examined, each instrument (i.e., HDFQ, HBCVD, CES-D, MDQ-SS, MDQ-SE, SOES, SODS, and TDAQ) was evaluated to ensure reliable measurement of the model variables. Once reliability of the measures for the model variables was established, descriptive statistics were used to examine bivariate relationships between selected variables and mean differences associated with group membership.

Psychometrics for study measures. The first step to address aim two was to evaluate the measurement model in the study population. Scale reliabilities for the instruments measuring the core variables in this study (i.e., HDFQ, HBCVD, CES-D, MDQ-SS, MDQ-SE, and TDAQ) were calculated and compared to findings from previously published instrument evaluation studies. Alpha coefficients for each scale were deemed acceptable according to DeVellis' (2003) criteria. Acceptable internal consistency of each scale indicates reliable measurement of the latent variables in this specific study population; thus, the model variables were adequately measured and could be subjected to statistical analyses with confidence in the results.

Bivariate analyses. To evaluate the relationships among the model variables and diet and exercise behaviors, for comparisons between groups, and to identify critical covariates that could impact the error variance in the outcome measure, analysis of variance tests were performed. Using diet and exercise as dependent variables, the remaining model variables were entered as independent variables. The following secondary research questions were included the analysis:

1. Do diet and exercise differ by any of the following demographic and/or health status groups: age, gender, race, marital status, insurance, education, income, employment, BMI group, or insulin use? Analysis consisted of parallel sets of ANOVAs for each variable with diet and exercise as the dependent variables.
2. How do health beliefs vary across stage of change? Analysis consisted of two sets of four one-way ANOVAs. The first set of ANOVAs included stage of change for diet (SODS, four levels) as the independent variable for all four measures. The five dependent variables were the

four health belief model subscale total scores (susceptibility, severity, benefits, and barriers) and the MDQ self-efficacy total scores. The second set of ANOVAs was identical to the first set, only the independent variable was changed to stage of change for exercise (SOES, four levels).

Hypothesis testing. Analysis of the relationships among the model variables was conducted using simple and multiple regression procedures. First, simple regression equations were used to evaluate each hypothesis statement. Each hypothesis statement, with identification of the predictor and outcome variables specified in the regression equation, is listed below with the outcome variable listed to the left of the equal sign (=) and the predictor variable listed to the right:

1) <u>Cues to action have a direct relationship with knowledge and perceived threat.</u>

   Four regression equations were calculated: 1) threat = DM cues to action; 2) threat = CVD cues to action; 3) knowledge = DM cues to action; and 4) knowledge = CVD cues to action.

2) <u>Knowledge has a direct relationship with the HBM (excluding cues to action).</u>

   Five regression equations were calculated: 1) susceptibility = knowledge; 2) severity = knowledge; 3) benefits = knowledge; 4) barriers = knowledge; and 5) self efficacy = knowledge.

3) <u>Self-efficacy has a direct relationship with stage of change.</u>

   Two regression equations were calculated: 1) diet stage = self efficacy; and 2) exercise stage = self efficacy.

4) <u>Health beliefs have a direct relationship with stage of change.</u>

   Four regression equations were calculated for diet stage: 1) diet stage = susceptibility; 2) diet stage = severity; 3) diet stage = benefits; and 4) diet stage = barriers. Four regression equations were calculated for exercise stage: 1) exercise stage = susceptibility; 2) exercise stage = severity; 3) exercise stage = benefits; and 4) exercise stage = barriers.

5) <u>Stage of change has a direct relationship with diet and exercise behaviors.</u>

   Two regression equations were calculated: 1) diet adherence = diet stage; and 2) exercise adherence = exercise stage.

6) <u>Depression has a direct relationship with diet and exercise behaviors.</u>

   Two regression equations were calculated: 1) diet adherence = depression; and 2) exercise adherence = depression.

7) <u>Social support has a direct relationship with diet and exercise behaviors.</u>

   Two regression equations were calculated: 1) diet adherence = social support; and 2) exercise adherence = social support.

8) <u>Socioeconomic Status has a direct relationship with diet and exercise behaviors.</u>

   Two regression equations were calculated for each indicator: 1) diet adherence = income; 2) exercise adherence = income; 3) diet adherence = employment status; 4) exercise adherence = employment status; 5) diet adherence = insurance status; 6) exercise adherence = insurance status; 7) diet adherence = education level; and 8) exercise adherence = education level.

9) <u>Comorbidity and duration of disease have a direct relationship with knowledge and diet and exercise behaviors.</u>

   Six regression equations were calculated: 1) diet adherence = total comorbid conditions; 2) exercise adherence = total comorbid conditions; 3) knowledge = total comorbid conditions; 4) diet adherence = duration of diabetes; 5) exercise adherence = duration of diabetes; and 6) knowledge = duration of diabetes.

Aim Three

The research question to address aim three was "How well does the integrated model explain diet and exercise behaviors in a population of persons with type 2 diabetes?" The development of the conceptual model depicted in Figure 1 was driven by theory and provided a framework to guide this study. This model guided the researcher's decisions regarding which variables and relationships should be evaluated for their influence on diet and exercise behaviors in the current study based on their empirical support in the literature. However, the empirical model that was tested in this study was not driven by theory, but instead was developed based on the analysis of bivariate associations identified through regression analysis of the model variables identified in the conceptual model. The empirical models are presented in Figure 4.1. To evaluate the structure of the conceptual and empirical models, and to evaluate the empirical model's ability to predict or explain diet and exercise adherence behaviors, multiple regression and path analysis techniques were used.

Each pathway in the conceptual model was evaluated separately using simple and multiple regression techniques that have been described in the previous data analysis plan for the hypothesis statements. All but one path were evaluated through the hypothesis testing; the path that remained to be tested was the path through which the complete HBM predicts stage of change. This path was evaluated by placing all HBM variables into two regression equations, with diet stage (SODS) as one outcome variable and exercise stage (SOES) as the other.

The first step in analysis of the conceptual model was to explore the structure of the conceptual model through path analysis. Next, the empirical model was explored with path analysis to further evaluate the relationships between the predictor variables and the outcome variables. Model estimations and post hoc model modifications were performed in search of a model that provided a good fit for the data. Finally, the empirical models were evaluated using multiple regression techniques to further explore relationships among the significant variables identified through hypothesis testing.

Post Hoc Analyses

To add to the practical significance of the current study, several post hoc data analyses were conducted. Of particular interest to the author were additional exploration of knowledge and depression scores in the study population and evaluation of how these scores differed among groups. These additional analyses yielded important information that will be applied in future intervention studies conducted by the author that will aim to decrease CVD morbidity and mortality in adults with type 2 diabetes.

Knowledge. Evaluation of individual items within the Heart Disease Fact Questionnaire (HDFQ) (Wagner et al., 2005) was completed to identify knowledge deficits among the participants in this study. Group differences in knowledge scores were also evaluated as a necessary step to inform behavior change intervention strategies guided by this study. Each question in the HDFQ was evaluated for the percentage of participants who answered each item correctly. Group differences in heart disease knowledge scores were identified through one-way analysis of variance tests across each demographic group. Finally, the frequency of exposure to each cue to action listed in the study questionnaire was evaluated to identify the most common sources of diabetes and CVD related information reported by the participants.

Depression and adherence to diet and exercise. Depression in persons with diabetes has received a great deal of attention in the literature. Higher rates of depression have been found among diabetics compared to the general population (Anderson et al., 2001) and lower rates of adherence to recommended health behaviors have been identified when diabetic patients are also depressed (DiMatteo, 2004; DiMatteo et al., 2000). In addition, several researchers have found that depression is often under-identified and under-treated in patients with diabetes (Lustman & Clouse, 2005). As a result, exploration of descriptive statistics for CESD scores and self report of diagnosis and/or treatment for depression was undertaken. Additionally, between group differences among study measures were evaluated using analysis of variance tests. Scores on the CESD were used to categorize participants into one of two groups: participants who scored 16 or higher were considered "depressed" (Hann et al., 1999), and those whose scores were less than 16 were considered "not depressed".

CHAPTER SUMMARY

This chapter described the research design and methods used in this study to explore the relationships between the variables included in the integrated model. A description of and rationale for the design was presented. Descriptions of the sample, setting, recruitment and data collection methods, and ethical considerations applied in this study were also provided. Measurement methods were described and potential limitations of the study design and procedures were discussed. This chapter concluded with a description of the data analysis procedures employed in this study.

Chapter 4: Results

INTRODUCTION

In this chapter, results of the data analysis are reported. The specific aims of this study were to 1) evaluate the psychometric properties of the Health Beliefs related to Cardiovascular Disease scale (HBCVD) in a population of persons with type 2 diabetes, 2) to explore the relationships among selected biological and psychosocial variables and diet and exercise behaviors in a population of persons with type 2 diabetes, and 3) to evaluate the ability of a conceptual model integrating the Health Belief Model (HBM) and Stages of Change (SOC) with knowledge, social support, depression, socioeconomic status, comorbid disease, and duration of diabetes to predict or explain diet and exercise behaviors in a population of persons with type 2 diabetes. This chapter is organized as follows: a description of the sample is provided, psychometric evaluation of the HBCVDS is described, the results of each hypothesis are presented, followed by the results of the path analysis for model testing, and finally post hoc analyses are presented.

DESCRIPTION OF THE SAMPLE

A convenience sample of 212 adults with type 2 diabetes participated in this study. Participants' ages ranged from 25 to 85 with a mean age of 58 years. The mean duration of diabetes was 12 years with 40% of the participants having diabetes for longer than 10 years. Table 4.1 shows the distribution of the demographic variables measured in this study with group mean scores for the diet and exercise adherence scales, Heart Disease Fact Questionnaire, CESD, Social Support Scale, Self-Efficacy Scale, and the HBCVD subscales. Minimum and maximum scores for each scale are provided in the column headings of the table. Findings revealed that the majority of this sample was female (67%) and Caucasian (62%). Age groups were fairly equal with the largest group of participants between the ages of 51 and 65 years (39%), followed by the older than 65 years group (34%) and the 50 years or less group (27%). Sixty percent of the participants were married or a member of an unmarried couple, almost half of the participants were retired (43%), and nearly 40% of the participants reported an annual income of less than $20,000.

The sample in this study was drawn from outpatient clinics and community settings in southeast Texas and central North Carolina. The majority of the participants (n = 103, 49%) were recruited from site one, which was an outpatient cardiovascular and diabetes prevention (CVDP) clinic affiliated with a large university hospital in southeast Texas. The second largest recruitment group came from site two and consisted of 42 participants (20%) aged 55 years and older who were recruited from a volunteer registry obtained from a Center for Aging in southeast Texas. The third largest recruitment group (n = 36, 17%) was recruited from a pre-admit testing center in the Rio Grande Valley that evaluates patients with diabetes and CVD on a daily basis. The remainder of the sites yielded less than 10 participants per site.

Evaluation of the health status indicators measured in this study (see Table 4.2) revealed that the majority of the participants were obese (59%) as indicated by body mass index (BMI) calculations greater than or equal to 30, 27% were overweight (BMI 25-29.9), and only 14% had normal weight BMI (18.5-24.9). Evaluation of diet and exercise adherence scores across age, gender, and race indicate that although the majority of the sample scored above the median range score for diet (4.5) and exercise (6.5) adherence, the sample adhered to recommended diet and exercise behaviors only rarely to some of the time. Other discouraging health indicators identified were random blood glucose levels greater than 120 mg/dL for 56% of the participants, triglyceride levels greater than 150 mg/dL for 54% of the participants, and systolic blood pressure greater than 130 mm/Hg for 56% of the participants. Positive health indicators include HgA1c levels less than 7 mg/dL for 51% of participants, diastolic blood pressure less than or equal to 80 mm/Hg for 80% of participants, LDL less than

100 mg/dL in 58%, HDL greater than 40 mg/dL in 85%, and total cholesterol levels less than or equal to 200 mg/dL for 81% of participants.

The majority of participants had multiple comorbid conditions with 49% reporting five to nine comorbidities, 42% had at least one but less than five, and only 9% reported greater than 10 comorbid conditions. A few of these comorbidities that are particularly relevant to this study and the percentage of participants reporting that they have been diagnosed with them include hypertension (73%), high cholesterol (63%), depression (35%), CVD (20%), history of heart attack (12%) and history of stroke (10%).

The majority of the participants were taking oral antidiabetic medications (73%), antihypertensives (76%), anticholestrol medications (58%) and aspirin (59%). Forty seven percent of the participants reported taking insulin and 11% reported taking Plavix.

AIM ONE: PSYCHOMETRIC PROPERTIES OF THE HBCVD

To address the first specific aim, reliability and factor structure of the HBCVD scale were evaluated. Evaluation of frequencies for each response option for each item revealed adequate range and variability among responses.

Reliability

The HBCVD has four mean subscale scores with higher scores indicating stronger beliefs. For each subscale, if a participant missed one item, mean scores for the individual subscale were used to replace missing data in that subscale. If missing more than one item, subscale scores were not calculated or used in statistical analysis. Total subscale mean scores were used for data analysis and interpretation; the possible range of scores was 1-4. The individual HBCVD scale items with item numbers are provided in Table 4.3.

Table 4.1: One-Way Analyses of Variance for Participant Groups and Ten Dependent Variables

			Diet Adherence (Minimum = 2; Maximum = 8)				Exercise Adherence (Minimum = 3; Maximum = 12)			
	N	%	Mean	SD	F	Sig.	Mean	SD	F	Sig.
Gender										
Male	69	33	5.97	1.40	1.06	NS	8.0	2.56	1.55	NS
Female	142	67	5.76	1.30			7.5	2.51		
Age										
≤50	58	27	5.39	1.41	5.73	.004	7.0	2.34	2.91	NS
51-65	83	39	5.83	1.31			7.7	2.64		
>60	71	34	6.18	1.19			8.2	2.54		
Race										
Black, Asian, Pac. Isl., Native American	41	19	5.58	1.48	1.16	NS	8.3	2.67	2.09	NS
Hispanic	39	18	6.03	1.33			7.8	2.60		
Caucasian	132	62	5.84	1.28			7.4	2.46		
Marital Status										
Single, Never Married	15	7	5.6	1.30	.25	NS	6.9	2.61	.782	NS
Divorced, Separated	40	19	5.8	1.64			8.0	2.98		
Widowed	30	14	6.0	.84			7.4	2.32		
Married, Member of Unmarried Couple	127	60	5.8	1.33			7.7	2.46		
Education Level										
Less than high school	13	6	4.9	1.66	4.29	.002	5.6	2.47	2.71	.031
High school graduate	49	23	6.1	1.40			7.9	2.47		
Some college/trade school	78	37	5.5	1.25			7.8	2.38		
College graduate	47	22	6.2	1.09			7.8	2.61		
Post-graduate education	20	9	6.1	1.37			8.4	2.57		
Employment Status										
Employed	67	32	5.7	1.27	3.97	.020	7.5	2.59	1.52	NS
Out of work	39	18	5.4	1.55			7.1	2.74		
Retired/ student/ homemaker	104	49	6.1	1.24			7.9	2.44		
Income										
<$20K	81	38	5.7	1.32	1.12	NS	7.7	2.60	.038	NS
$21K-$40K	46	22	5.7	1.54			7.6	2.73		
$41K-$60K	34	16	5.8	1.22			7.8	2.25		
$61K-$80K	18	9	6.4	1.06			7.6	2.58		
>$80K	16	8	6.1	1.02			7.6	2.45		
Health Insurance										
Yes	182	87	5.9	1.31	.73	NS	7.7	2.47	.573	NS
No	26	12	5.5	1.50			7.4	3.15		

Table 4.1: One-Way Analyses of Variance for Participant Groups and Ten Dependent Variables (continued)

			Diet Adherence (Minimum = 2; Maximum = 8)				Exercise Adherence (Minimum = 3; Maximum = 12)			
	N	%	Mean	SD	F	Sig.	Mean	SD	F	Sig.
Hospital Admission previous 6 mos.										
Yes	57	29	5.9	1.57	.60	NS	7.8	2.81	.064	NS
No	139	71	5.8	1.24			7.6	2.45		
Recruitment site										
1	103	49	5.7	1.41	1.078	NS	7.9	2.52	.383	NS
2	42	20	5.8	1.26			7.7	2.70		
3	8	4	6.4	1.41			7.7	1.38		
4	7	3	5.4	1.62			6.9	3.34		
5	36	17	6.2	1.07			7.4	2.55		
6	3	1	5.0	1.73			7.7	3.21		
7	6	3	5.5	1.22			6.7	2.73		
8	7	3	6.0	1.15			7.3	2.65		
Compensation phase										
$100 lottery	93	44	5.8	1.27	1.42	NS	8.0	2.58	1.682	NS
Tape measure & healthy snack only	20	9	5.5	1.54			7.0	2.94		
$5 gift card	99	47	6.0	1.33			7.5	2.41		
CESD score										
<16	128	62	6.0	1.24	6.295	.013	8.0	2.5	3.867	.049
≥16	79	38	5.5	1.44			7.2	2.6		
Insulin Use										
Yes	91	47	5.7	1.295	1.28	NS	7.4	2.46	1.61	NS
No	101	53	5.9	1.427			7.9	2.56		
BMI										
Normal weight ≤25	25	14	6.4	1.248	2.634	NS	8.3	2.171	.644	NS
Overweight 25-29	49	27	5.8	1.320			7.7	2.755		
Obese ≥30	107	59	5.7	1.350			7.6	2.543		

Table 4.1 Continued

	CVD Knowledge Total (Min. = 0; Max. = 25)				CESD Total (Minimum = 0; Maximum = 60)				Social Support Total (Minimum = 4; Maximum = 16)			
	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Gender												
Male	20.6	3.47	3.66	NS	13.0	9.74	.903	NS	14.3	2.5	5.71	.018
Female	21.4	2.42			14.5	11.41			13.3	2.9		
Age												
≤50	21.1	3.02	.029	NS	18.2	11.90	6.24	.002	13.1	2.99	2.37	NS
51-65	21.0	2.96			12.1	10.76			14.2	2.56		
>65	21.2	2.51			12.8	9.25			13.6	2.89		
Race												
Black, Asian, Pac. Isl., Nat. Am.	20.6	3.18	3.93	.021	16.4	10.26	1.551	NS	13.1	3.38	1.711	NS
Hispanic	20.2	3.11			14.9	11.76			14.3	2.65		
Caucasian	21.6	2.54			13.1	10.78			13.6	2.70		
Education level												
Less than high school	19.3	4.20	2.49	.045	19.1	13.8	1.165	NS	11.9	4.38	1.164	NS
High school graduate	20.7	3.20			12.6	9.4			13.7	3.16		
Part college/trade school	20.9	2.76			15.2	11.0			13.9	2.85		
College graduate	21.9	2.27			13.4	11.3			13.4	2.36		
Post graduate education	22.1	1.81			12.5	11.5			13.9	1.93		
Employment Status												
Employed	21.4	2.66	.38	NS	12.4	10.25	12.63	.000	13.8	2.33	1.12	NS
Out of work	21.1	2.65			21.7	13.27			13.0	3.51		
Retired/student/homemaker	21.0	3.00			12.3	9.09			13.8	2.80		
Income												
<$20K	20.9	3.00	1.03	NS	16.2	10.98	1.965	NS	13.5	3.14	.590	NS
$21K-40K	21.5	2.48			14.8	12.06			13.6	2.61		
$41K–60K	20.6	3.04			11.0	9.70			14.0	2.09		
$61K–80K	22.0	2.12			11.1	9.60			14.3	1.90		
>$80K	21.5	2.88			11.8	8.38			13.1	3.85		
Health Insurance												
Yes	21.3	2.66	1.76	NS	13.4	10.75	2.893	NS	13.8	2.76	2.431	NS
No	20.1	3.86			18.6	11.37			12.8	3.19		
Hospital Admission past 6 mos.												
Yes	20.8	3.35	.967	NS	16.7	13.27	4.483	.036	13.8	2.70	.123	NS
No	21.2	2.65			13.0	9.76			13.7	2.80		
Recruitment site												
1	21.3	2.84	1.45	NS	15.3	11.18	1.418	NS	13.69	2.91	.652	NS
2	21.5	2.72			12.1	9.74			12.9	3.34		
3	20.9	3.94			9.1	6.66			13.7	2.29		
4	19	3.90			19.3	10.26			14.0	2.38		
5	20.5	2.08			14.5	11.17			14.1	2.49		
6	18.3	4.62			14	12.49			13.0	3.00		
7	22.2	2.14			5.3	2.34			13.2	2.49		
8	22.0	2.35			13.3	16.0			14.8	1.30		

Table 4.1: Continued

	CVD Knowledge Total (Min. = 0; Max. = 25)				CESD Total (Minimum = 0; Maximum = 60)				Social Support Total (Minimum = 4; Maximum = 16)			
	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Compensation Phase												
$100 Lottery	21.1	2.94	.672	NS	14.5	11.35	.178	NS	13.3	2.92	1.432	NS
Tape measure & healthy snack	20.4	3.54			13.4	9.78			13.4	2.29		
$5 Gift card	21.3	2.83			13.7	10.73			14.0	2.83		
CESD Total Score (Depression)												
<16	21.2	2.74	.005	NS	7.0	4.66	439.2	.000	14.4	2.21	23.26	.000
≥16	21.1	3.00			25.4	8.01			12.4	3.30		

Table 4.1: Continued

	Self Efficacy Total (Min. = 7; Max. = 28)				Susceptibility Mean (Min. = 1; Max. = 4)				Severity Mean (Min. = 1; Max. = 4)			
	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Gender												
Male	20.9	5.15	.032	NS	2.6	.56	.351	NS	2.3	.52	.249	NS
Female	20.7	6.99			2.5	.69			2.2	.56		
Age												
≤50	18.1	5.06			2.5	.81			2.24	.63		
51-65	21.8	8.02	7.122	.001	2.5	.63	.413	NS	2.25	.46	.061	NS
>65	21.7	4.59			2.6	.53			2.21	.56		
Race												
Black, Asian, Pac. Isl., Nat. Am.	20.2	5.68	.351	NS	2.4	.74	1.185	NS	2.3	.57	2.585	NS
Hispanic	21.4	4.79			2.5	.70			2.4	.66		
Caucasian	20.7	7.05			2.6	.61			2.2	.48		
Education level												
Less than high school	19.6	5.88			2.8	.63			2.6	.70		
High school graduate	21.8	4.55			2.5	.61			2.2	.48		
Part college/trade school	19.8	5.43	.956	NS	2.6	.74	.895	NS	2.2	.54	2.65	.035
College graduate	21.3	9.88			2.5	.59			2.1	.51		
Post graduate education	21.5	3.52			2.5	.47			2.4	.55		
Employment Status												
Employed	20.2	8.68			2.4	.62			2.2	.53		
Out of work	19.4	5.63	1.893	NS	2.7	.85	1.915	NS	2.3	.64	.625	NS
Retired/student/ homemaker	21.6	4.70			2.6	.59			2.2	.50		
Income												
<$20K	20.1	7.47			2.5	.75			2.3	.59		
$21K-40K	20.0	5.35			2.6	.63			2.3	.40		
$41K–60K	20.2	4.90	.590	NS	2.6	.61	.358	NS	2.1	.57	.925	NS
$61K–80K	22.7	8.94			2.5	.32			2.2	.59		
>$80K	22.3	3.70			2.5	.66			2.4	.45		
Health Insurance												
Yes	21.0	6.48	.789	NS	2.5	.63	6.548	.011	2.2	.50	4.737	.010
No	19.2	6.20			2.9	.79			2.5	.69		
Hospital Admission past 6 mos.												
Yes	20.4	5.37	.151	NS	2.6	.67	1.093	NS	2.2	.60	.668	NS
No	20.8	6.98			2.5	.65			2.3	.53		
Recruitment site												
1	20.9	7.67			2.6	.69			2.3	.58		
2	20.6	5.01			2.6	.59			2.2	.49		
3	19.9	5.91			2.5	.54			2.0	.49		
4	19.5	6.47	.473	NS	2.8	.85	.518	NS	2.6	.39	1.88	NS
5	21.9	5.03			2.4	.62			2.2	.58		
6	18.0	5.29			2.7	.81			2.5	.46		
7	18.8	2.3			2.3	.70			2.1	.45		
8	18.7	4.72			2.6	.53			2.0	.14		

Table 4.1: Continued

	Self Efficacy Total (Min. = 7; Max. = 28)				Susceptibility Mean (Min. = 1; Max. = 4)				Severity Mean (Min. = 1; Max. = 4)			
	Mean	SD	F	p	Mean	SD	F	p	Mean	SD	F	p
Compensation Phase												
$100 Lottery	19.6	5.19			2.6	.66			2.3	.58		
Tape measure & healthy snack	19.2	4.74	4.83	.009	2.7	.76	.504	NS	2.4	.46	1.959	NS
$5 Gift card	22.2	7.45			2.5	.63			2.2	.52		
CESD Total Score (Depression)												
<16	22.0	5.50	13.57	.000	2.5	.62	3.350	NS	2.1	.50	10.93	.001
≥16	18.6	7.31			2.7	.71			2.4	.58		

Table 4.1: Continued

	Benefits Mean Minimum = 1; Maximum = 4)				Barriers Mean (Minimum = 1; Maximum = 4)			
	Mean	SD	F	p	Mean	SD	F	p
Gender								
Male	3.2	.55	4.164	.043	2.3	.34	2.887	NS
Female	3.4	.55			2.2	.35		
Age								
≤50	3.4	.58	2.713	NS	2.2	.38	.291	NS
51-65	3.3	.60			2.2	.33		
>65	3.2	.45			2.2	.35		
Race								
Black, Asian, Pac. Isl., Nat. Am.	3.4	.61	3.069	.049	2.2	.36	1.103	NS
Hispanic	3.1	.61			2.3	.35		
Caucasian	3.3	.50			2.2	.34		
Education level								
Less than high school	3.1	.50	1.829	NS	2.2	.38	.105	NS
High school graduate	3.2	.45			2.2	.32		
Part college/trade school	3.3	.66			2.2	.39		
College graduate	3.4	.51			2.2	.37		
Post graduate education	3.4	.39			2.2	.25		
Employment Status								
Employed	3.4	.48	5.966	.003	2.2	.34	.290	NS
Out of work	3.4	.60			2.2	.43		
Retired/student/homemaker	3.2	.55			2.2	.33		
Income								
<$20K	3.3	.59	.687	NS	2.2	.38	.321	NS
$21K-40K	3.2	.44			2.3	.28		
$41K–60K	3.3	.66			2.2	.30		
$61K–80K	3.4	.43			2.2	.28		
>$80K	3.4	.42			2.2	.46		
Health Insurance								
Yes	3.3	.56	.976	NS	2.2	.33	.217	NS
No	3.2	.50			2.2	.50		
Hospital Admission past 6 mos.								
Yes	3.4	.55	.560	NS	2.3	.35	2.141	NS
No	3.3	.57			2.2	.36		
Recruitment site								
1	3.4	.56	.883	NS	2.2	.36	.594	NS
2	3.3	.45			2.2	.34		
3	3.5	.47			2.2	.18		
4	3.1	.51			2.4	.44		
5	3.2	.70			2.2	.36		
6	3.6	.10			2.0	.19		
7	3.5	.43			2.2	.34		
8	3.4	.40			2.3	.27		
Compensation Phase								
$100 Lottery	3.4	.45	1.039	NS	2.2	.35	2.845	NS
Tape measure & healthy snack	3.3	.43			2.3	.35		
$5 Gift card	3.2	.66			2.2	.35		
CESD Total Score (Depression)								
<16	3.3	.55	1.382	NS	2.2	.34	2.289	NS
≥16	3.4	.56			2.3	.36		

Table 4.2: Health Characteristics of Participants (N=212)

Characteristic	N	%	Characteristic	N	%
Duration of Diabetes (mean = 12 yr)			**Self-report High Cholesterol**		
≤ 1 year	21	10	Yes	131	63
1-6 years	52	26	No	77	37
6-10 years	49	24	**Self-report Cardiovascular Disease**		
>10 years	79	40	Yes	41	20
BMI			No	167	80
Normal Weight: 18.5-24.9	25	14	**Self-report Depression**		
Overweight: 25-29.9	49	27	Yes	73	35
Obesity: ≥30	107	59	No	136	65
Blood Glucose (random)			**Self-report history of Heart Attack**		
≤120	54	44	Yes	25	12
120-200	43	36	No	183	88
>200	24	20	**Self-report history of Stroke**		
Hemoglobin A1c			Yes	20	10
<7	34	51	No	188	90
≥7	33	49	**Taking Insulin**		
LDL			Yes	91	47
<100	15	58	No	101	53
≥100	11	42	**Taking Oral Antidiabetic Medicine**		
HDL			Yes	147	73
≤40	6	15	No	53	27
>40	20	85	**Taking Medication for Hypertension**		
Total cholesterol			Yes	157	76
Desirable: ≤200	25	81	No	50	24
Borderline high risk: 201-239	6	19	**Taking Medicine for High Cholesterol**		
High risk: ≥240	0	0	Yes	119	58
Triglycerides			No	87	42
<150	11	46	**Taking Asprin**		
≥150	13	54	Yes	116	59
Systolic Blood Pressure			No	81	41
≤130	40	44	**Taking Plavix**		
>130	52	56	Yes	19	11
Diastolic Blood Pressure			No	148	89
≤80	75	82	**Taking Medication for Depression**		
>80	17	18	Yes	55	27
Comorbid Conditions Total			No	147	73
<5	80	42	**Self-report Hypertension**		
5-9	95	49	Yes	153	73
≥10	18	9	No	56	27

Table 4.3: Health Beliefs related to Cardiovascular Disease (HBCVD) Scale Items

Susceptibility Items
hb01. It is likely that I will suffer from a heart attack or stroke in the future.
hb02. My chances of suffering from a heart attack or stroke in the next few years are great.
hb03. I feel I will have a heart attack or stroke sometime during my life.
hb04. Having a heart attack or stroke is currently a possibility for me.
hb05. I am concerned about the likelihood of having a heart attack or stroke in the near future.
Severity Items
hb06. Having a heart attack or stroke is always fatal.
hb07. Having a heart attack or stroke will threaten my relationship with my significant other.
hb08. My whole life would change if I had a heart attack or stroke.
hb09. Having a heart attack or stroke would have a very bad effect on my sex life.
hb10. If I have a heart attack or stroke I will die within 10 years.
Benefits Items
hb11. Increasing my exercise will decrease my chances of having a heart attack or stroke.
hb12. Eating a healthy diet will decrease my chance of having a heart attack or stroke.
hb13. Eating a healthy diet and exercising for 30 minutes most days of the week is the best way for me to prevent a heart attack or stroke.
hb14. When I exercise I am doing something good for myself.
hb15. When I eat healthy I am doing something good for myself.
hb16. Eating a healthy diet will decrease my chances of dying from cardiovascular disease.
Barriers Items
hb17. I do not know the appropriate exercises to perform to reduce my risk of developing cardiovascular disease.
hb18. It is painful for me to walk for more than 5 minutes.
hb19r. I have access to exercise facilities and/or equipment
hb20r. I have someone who will exercise with me
hb21. I do not have time to exercise for 30 minutes a day on most days of the week.

Table 4.3: HBCVD Scale Items (continued)

Barriers Items
hb22. I do not know what is considered a healthy diet that would prevent me from developing cardiovascular disease.
hb23. I do not have time to cook meals for myself.
hb24. I cannot afford to buy healthy foods.
hb25. I have other problems more important than worrying about diet and exercise.

Assessment of item variance and item means close to the center range of possible scores for each subscale and determination of the internal consistency of each subscale scale was achieved by evaluating Cronbach alpha calculations for the four subscales using DeVellis' criteria (2003). Evaluation of each subscale is presented separately in the following sections. Cronbach's alpha calculations for each subscale and the HBCVD total scale are presented in Table 4.4. Reliability estimates were .91 for the susceptibility subscale, .72 for the severity subscale, .90 for the benefits subscale, .61 for the barriers subscale, and .75 for the HBCVD total scale.

Table 4.4: Reliability of HBCVD and Subscales

Subscale	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Susceptibility	.908	.910	5
Severity	.722	.722	5
Benefits	.904	.903	6
Barriers	.608	.612	9
HBCVD Total	.744	.749	25

Individual items in each subscale were also evaluated according to Devellis' (2003) criteria to guide decisions regarding item deletion or revision. In addition, corrected item-total correlation and alpha if item deleted were evaluated for the items in each scale to further evaluate items that need to be deleted or modified. Results for each subscale are provided in the following sections.

Susceptibility Subscale

This subscale contains five items that measure a person's beliefs about their susceptibility to heart attack or stroke, with higher scores indicating stronger beliefs that one is susceptible to heart attack or stroke. Descriptive statistics for the susceptibility subscale revealed adequate item means and sufficient item variance for the five items in this subscale (see Table 4.5). The inter-item correlations ranged from .58 to .76 with 80% falling between .30-.70 (see Table 4.6) which shows that they are related but not redundant. The susceptibility subscale shows very good internal consistency with Cronbach's alpha of .91; alpha did not improve when any of the items were deleted (see Table 4.7).

Table 4.5: Descriptive Statistics for Susceptibility Subscale Items

ITEM		hb01.	hb02.	hb03.	hb04.	hb05.
N	Valid	208	209	209	210	208
	Missing	4	3	3	2	4
Mean		2.56	2.46	2.61	2.63	2.51
Std. Deviation		.733	.740	.740	.742	.862
Variance		.537	.548	.547	.550	.744
Skewness		-.367	-.110	-.305	-.628	-.022
Std. Error of Skewness		.169	.168	.168	.168	.169
Range		3	3	3	3	3
Minimum		1	1	1	1	1
Maximum		4	4	4	4	4

Table 4.6: Susceptibility Subscale Inter-Item Correlation Matrix

ITEM	hb01.	hb02.	hb03.	hb04.	hb05.
hb01.	1.000	---	---	---	---
hb02.	.737	1.000	---	---	---
hb03.	.760	.705	1.000	---	---
hb04.	.652	.664	.706	1.000	---
hb05.	.578	.646	.638	.617	1.000

Table 4.7: Susceptibility Subscale Item-Total Statistics

ITEM	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
hb01.	10.20	7.158	.785	.664	.884
hb02.	10.31	7.082	.797	.646	.882
hb03.	10.17	7.017	.816	.684	.878
hb04.	10.14	7.195	.757	.580	.890
hb05.	10.25	6.853	.703	.507	.905

Severity Subscale

This subscale also contains five items and measures a person's beliefs about the severity of heart attack or stroke, with higher scores indicating stronger beliefs that having a heart attack or stroke is severe. Descriptive statistics for the severity subscale revealed adequate item means and sufficient item variance for the five items in this subscale (see Table 4.8). The inter-item correlations ranged from .18 to .48 with 80% falling between .30-.70 (see Table 4.9) which shows that they are related but not redundant. The severity subscale shows respectable internal consistency with Cronbach's alpha of .72; alpha did not improve when any of the items were deleted (see Table 4.10).

Table 4.8: Descriptive Statistics for Severity Subscale Items

ITEM		hb06.	hb07.	hb08.	hb09.	hb10.
N	Valid	210	201	210	201	209
	Missing	2	11	2	11	3
Mean		1.79	2.06	2.81	2.46	2.05
Std. Deviation		.762	.852	.796	.812	.722
Variance		.581	.726	.633	.660	.521
Skewness		1.038	.473	-.219	.037	.772
Std. Error of Skewness		.168	.172	.168	.172	.168
Range		3	3	3	3	3
Minimum		1	1	1	1	1
Maximum		4	4	4	4	4

Table 4.9: Severity Subscale Inter-Item Correlation Matrix

ITEM	hb06.	hb07.	hb08.	hb09.	hb10.
hb06.	1.000	---	---	---	---
hb07.	.306	1.000	---	---	---
hb08.	.188	.336	1.000	---	---
hb09.	.245	.483	.424	1.000	---
hb10.	.329	.402	.303	.400	1.000

Table 4.10: Severity Subscale Item-Total Statistics

ITEM	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
hb06.	9.35	5.436	.360	.148	.720
hb07.	9.10	4.619	.548	.315	.647
hb08.	8.35	5.133	.435	.215	.693
hb09.	8.71	4.695	.562	.343	.641
hb10.	9.12	5.169	.509	.263	.666

Benefits Subscale

This subscale contains six items that measure a person's beliefs about the benefits of diet and exercise for reducing risk for heart attack and stroke, with higher scores indicating stronger beliefs that diet and exercise are beneficial. Descriptive statistics for the benefits subscale revealed high item means (3.21-3.25) in this scale with 4 as the maximum score for each item. Item variance was also a bit lower in this scale than the susceptibility and severity subscales, ranging from .34-.52 (see Table 4.11). This suggests that most participants agreed that exercise and diet are good for them and can decrease their risk for heart attack or stroke.

Table 4.11: Descriptive Statistics for Benefits Subscale Items

ITEM		hb11.	hb12.	hb13.	hb14.	hb15.	hb16.
N	Valid	208	210	209	210	210	209
	Missing	4	2	3	2	2	3
Mean		3.21	3.24	3.30	3.42	3.45	3.22
Std. Deviation		.718	.699	.643	.668	.670	.586
Variance		.515	.488	.414	.446	.449	.343
Skewness		-.892	-1.213	-.922	-1.322	-1.394	-.802
Std. Error of Skewness		.169	.168	.168	.168	.168	.168
Range		3	3	3	3	3	3
Minimum		1	1	1	1	1	1
Maximum		4	4	4	4	4	4

The inter-item correlations in the benefits subscale ranged from .40 to .75 with 78% falling between .30-.70 (see Table 4.12), which shows that they are related but not redundant. The benefits subscale shows very good internal consistency with Cronbach's alpha of .90. Review of item total statistics among the benefits items (see Table 4.13) revealed that Cronbach's alpha did not improve when any of the items were deleted for all items except for hb16: *Eating* *a healthy diet will decrease my chances of dying from cardiovascular disease*. Alpha would increase to .917 if hb16 were deleted. Inter-item correlations between this item and the others in the benefits subscale ranged from .398-.501. Interestingly, the highest inter-item correlation was between hb16 and hb12: *Eating a healthy diet will decrease my chances of having a heart attack or stroke.* Item hb12 is very similar to hb16 which consists of the more extreme word “dying” rather than “having” in hb12 and also uses the term “cardiovascular disease” rather than “heart attack or stroke” in hb12. Both of these differences in the hb16 item compared to other items in the scale could have contributed to the increase in scale alpha if item hb16 was deleted. However, because this item provided important and somewhat different information about the participants and because the improvement in alpha was minimal, the author chose to retain this item in the final HBCVD scale.

Table 4.12: Benefits Subscale Inter-Item Correlation Matrix

ITEM	hb11.	hb12.	hb13.	hb14.	hb15.	hb16.
hb11.	1.000	---	---	---	---	---
hb12.	.799	1.000	---	---	---	---
hb13.	.673	.747	1.000	---	---	---
hb14.	.563	.614	.689	1.000	---	---
hb15.	.549	.620	.681	.960	1.000	---
hb16.	.434	.501	.476	.398	.421	1.000

Table 4.13: Benefits Subscale Item-Total Statistics

ITEM	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
hb11.	16.69	7.269	.731	.657	.889
hb12.	16.66	7.112	.807	.735	.877
hb13.	16.61	7.323	.801	.656	.878
hb14.	16.48	7.354	.786	.926	.880
hb15.	16.45	7.342	.787	.925	.880
hb16.	16.70	8.439	.515	.287	.917

Barriers Subscale

This subscale contains nine items that measure a person's beliefs about specific barriers to diet and exercise with higher scores indicating higher perceived barriers. Descriptive statistics for the barriers subscale revealed item means close to the center range and sufficient item variance for the nine items in this subscale (see Table 4.14). The inter-item correlations ranged from .00 to .47 with only 7% falling between .30-.70 (see Table 4.15). Items that were correlated greater than .28 include: hb21 and hb23 ($r = .38$) with both items pertaining to having *time* to engage in health behaviors; hb17 and hb22 ($r = .47$) both items of which pertain to *knowledge* about healthy diet or exercise; and items hb19r and hb20r ($r = .29$), which are related in that they both pertain to exercise and external factors that could be potential barriers. These low inter-item correlations certainly contribute to the low alpha for this subscale ($\alpha = .61$) which is considered undesirable, but not unacceptable, per Devellis' (2003) criteria. Although the inter-item correlations were low, item total statistics (see Table 4.16) revealed that Cronbach's alpha did not improve when any of the items were deleted. Because barriers can be very unique to a given individual and may even vary within the individual depending on other factors, it is not surprising that the inter-item correlations were low.

Responses on the HBCVD from the pilot study were combined with the current study responses to yield a total sample of 279. With this larger sample, Cronbach's alpha for the barriers subscale was .75, which is respectable according to DeVellis (2003). Based on these findings and because an alpha of .61 is adequate for a new instrument, although not ideal, data analysis proceeded with the inclusion of the barriers subscale. The author acknowledges that some improvements in the instrument can be realized in future developmental efforts.

Table 4.14: Descriptive Statistics for Barriers Subscale Items

ITEM		hb17.	hb18.	hb19r.	hb20r.	hb21.	hb22.	hb23.	hb24.	hb25.
N	Valid	209	208	208	207	207	208	207	205	209
	Missing	3	4	4	5	5	4	5	7	3
Mean		2.34	2.12	2.34	2.48	2.03	2.13	1.99	2.13	1.96
Std. Deviation		.775	.956	.914	.852	.740	.747	.724	.825	.792
Variance		.600	.914	.835	.726	.547	.558	.524	.680	.628
Skewness		.141	.570	.267	-.098	.455	.416	.557	.608	.721
Std. Error of Skewness		.168	.169	.169	.169	.169	.169	.169	.170	.168
Range		3	3	3	3	3	3	3	3	3
Minimum		1	1	1	1	1	1	1	1	1
Maximum		4	4	4	4	4	4	4	4	4

Table 4.15: Barriers Subscale Inter-Item Correlation Matrix

ITEM	hb17.	hb18.	hb19r.	hb20r.	hb21.	hb22.	hb23.	hb24.	hb25
hb17.	1.000	---	---	---	-	---	---	---	---
hb18.	.112	1.000	---	---	---	---	---	---	---
hb19r	.176	.245	1.000	---	---	---	---	---	---
hb20r	.109	.150	.289	1.000	---	---	---	---	---
hb21.	.080	.241	.075	.140	1.000	---	---	---	---
hb22.	.468	.113	.000	-.078	.120	1.000	---	---	---
hb23.	.024	.009	-.194	.066	.377	.077	1.000	---	---
hb24.	.194	.193	.049	.175	.174	.299	.197	1.000	---
hb25.	.264	.180	.082	.103	.298	.186	.220	.160	1.00 0

Table 4.16: Barriers Subscale Item-Total Statistics

ITEM	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
hb17.	17.15	10.691	.355	.287	.564
hb18.	17.39	10.330	.316	.146	.573
hb19r	17.12	11.123	.191	.197	.609
hb20r	17.00	11.020	.245	.153	.592
hb21.	17.45	10.744	.372	.243	.561
hb22.	17.35	11.138	.284	.301	.582
hb23.	17.49	11.776	.170	.232	.607
hb24.	17.36	10.524	.354	.174	.563
hb25.	17.52	10.594	.366	.174	.560

The factor structure of the barriers subscale items was also evaluated and has been described in the following section. However, it is helpful to note at this time that the presence of four separate factors within the barriers subscale was identified after exploratory factor analysis was conducted on the total HBCVD scale. As a result, adding additional items pertaining to the four barriers sub factors that are present in this subscale may improve the internal consistency of this scale in future studies.

Subscale Intercorrelations

The high inter-item correlations within the susceptibility, severity, and benefits subscales indicate that the items within each subscale are in fact measuring the specific latent variable that the subscale aims to capture. The barriers subscale also demonstrates internal consistency; however, adding additional items to the sub-factors identified in the barriers subscale will likely improve the overall internal consistency of this scale.

Interscale correlations were also evaluated and are presented in Table 4.17. All interscale correlations among the HBCVD subscales were between .10 and .30 which indicates that each scale is independent enough to capture different aspects of the health beliefs as measured in this scale.

Total Scale Reliability

Finally, results for total scale reliability were evaluated by applying DeVellis' (2003) criteria to the standardized item alpha. Cronbach's alpha for the total scale was .75 (see table 4.4), which is considered respectable.

Test-Retest Reliability

Test-retest reliability was evaluated for the 40 participants who completed the HBCVD scale again two to three weeks after completion of the first questionnaire packet. Results are presented in Table 4.18 Test-retest reliability for the susceptibility subscale was $r = .665$; severity subscale $r = .449$; benefits subscale $r = .508$; and barriers $r = .444$. The reliability between the test and retest measures provide acceptable support for the temporal stability of the HBCVD over time.

Table 4.17: HBCVD Inter-scale Correlations

		Susceptibility	Severity	Benefits	Barriers
	N	197	191	198	196
Susceptibility	Pearson Correlation	1	.277(**)	.172(*)	.299(**)
	Sig. (2-tailed)		.000	.013	.000
	N	209	202	209	204
Severity	Pearson Correlation	.277(**)	1	.099	.155(*)
	Sig. (2-tailed)	.000		.158	.029
	N	202	203	203	199
Benefits	Pearson Correlation	.172(*)	.099	1	-.192(**)
	Sig. (2-tailed)	.013	.158		.006
	N	209	203	210	205
Barriers	Pearson Correlation	.299(**)	.155(*)	-.192(**)	1
	Sig. (2-tailed)	.000	.029	.006	
	N	204	199	205	207

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Validity

The validity of the HBCVD was evaluated by content, construct, criterion-related, and discriminant validity indices. Support for validity is described in the following sections.

Content Validity

Support for content validity of the HBCVD was supported by expert panel review and feedback from focus group participants. Several items were revised slightly to improve clarity based on feedback from the expert panel and focus group participants. The final version of the HBCVD reflected feedback from both groups.

Table 4.18: HBCVD Test-retest Reliability

		Retest Susceptibility Subscale	Retest Severity Subscale	Retest Benefits Subscale	Retest Barriers Subscale
Susceptibility	Pearson Correlation	.665(**)	.034	.003	.152
	Sig. (2-tailed)	.000	.839	.984	.355
	N	38	38	39	39
Severity	Pearson Correlation	.012	.449(**)	-.299	.229
	Sig. (2-tailed)	.945	.005	.068	.166
	N	37	37	38	38
Benefits	Pearson Correlation	-.092	-.309	.508(**)	-.418(**)
	Sig. (2-tailed)	.581	.059	.001	.008
	N	38	38	39	39
Barriers	Pearson Correlation	.056	-.076	-.188	.444(**)
	Sig. (2-tailed)	.740	.651	.252	.005
	N	38	38	39	39

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Construct Validity

Based on the preliminary findings for the HBCVD (see Appendix M), four factors were selected for the forced factor analysis (FFA) to confirm the presence of factor structures supporting the four subscales intended in the HBCVD: susceptibility, severity, benefits and barriers. Non-rotated factor solutions and factor rotation with orthogonal and oblique rotation were evaluated for determination of the constructs that corresponded to the factor based on the items identified within each factor. No difference was found between the factor structure using orthogonal or oblique rotations. Because approximately 13% of the items in the HBCVD had Pearson correlation coefficients greater than .30, the factor structure using oblique rotation was used for evaluation of construct validity. This decision was based on the recommendations by Tabachnick and Fiddell (2001) to use oblique rotation when underlying latent variables correlate with each other. Results of the FFA with oblique rotation are presented in Table 4.19.

Upon examination of the resulting factor structure matrix, items were retained if they had primary loadings of ≥ .3 and secondary loadings of ≤ .4, which are the minimally acceptable criteria suggested by Norman and Streiner (2000). For the susceptibility, severity, and benefits subscales, all expected items had primary loadings greater than .60 on the expected factor and no secondary loadings greater than .40. These findings support the susceptibility, severity, and benefits subscales.

Six of the items in the barriers subscale were supported while three of the items intended for this subscale did not have primary loadings as predicted. The barriers subscale factor identified only six of the nine items with primary loadings greater than .30. Two items from the intended barriers subscale had primary loadings on the susceptibility subscale (items hb21 and hb23) and one item (hb20) loaded strongest on the barriers subscale at .284, but did not quite meet the .30 criteria for primary loading values; none of the barriers items had secondary loadings. Because these items did not load as predicted, post hoc analyses were conducted to evaluate the HBCVD items again through exploratory factor analysis (EFA), which would not force the data into four factors as in the forced approach. The EFA revealed the presence of 7 factors with eigen values greater than 1.0. Evaluation of the structure matrix identified the same primary loadings for the susceptibility, severity, and benefits subscales with no secondary loadings among the first three factors, thus providing further support for the presence of these distinct subscales within the HBCVD.

Table 4.19: Summary of Factor Loadings for Forced Factor Analysis with Oblique Rotation for the Health Beliefs related to Cardiovascular Disease Scale

	Component					**Component**			
	1 Benefits	2 Suscept	3 Severity	4 Barriers		1 Benefits	2 Suscep	3 Sever.	4 Barriers
hb01.	.043	**.861**	125	.184	**hb14.**	**.873**	.063	.110	-.153
hb02.	.004	**.870**	.130	.277	**hb15.**	**.873**	.041	.103	-.191
hb03.	.097	**.892**	.053	.146	**hb16.**	**.631**	.111	.067	-.142
hb04.	.095	**.829**	.061	.145	**hb17.**	-.004	.148	.062	**.756**
hb05.	.162	**.749**	.321	.230	**hb18.**	-.128	.339	.038	**.393**
hb06.	-.038	-.094	**.568**	.066	**hb19r**	-.092	.081	-.083	**.361**
hb07.	.048	.207	**.709**	.060	**hb20r**	-.235	.053	-.278	.284
hb08.	.284	.026	**.623**	.031	**hb21.**	**-.365**	.301	-.004	.307
hb09.	.069	.172	**.769**	-.057	**hb22.**	-.163	.212	.176	**.706**
hb10.	-.045	.382	**.627**	-.070	**hb23.**	**-.357**	.190	-.086	.112
hb11.	**.795**	.068	.069	-.218	**hb24.**	-.196	.166	.088	**.541**
hb12.	**.851**	.134	.075	-.195	**hb25.**	-.314	.052	-.239	**.546**
hb13.	**.862**	.120	.099	-.219	**Note: Primary loading values indicated in bold font**				

Not surprisingly, the remaining 4 factors included items from the barriers subscale. Two items had primary loadings on factor 4: hb17: I do not *know* the appropriate exercises to perform to reduce my risk of developing CVD (loading = .811) and hb22: I do not *know* what is considered a healthy diet that would prevent me from developing CVD (loading = .812). For descriptive purposes, this factor was labeled "Knowledge." Factor five had three items with primary loadings: hb21: I do not have *time* to exercise for 30 minutes a day on most days of the week (loading = .791); hb23: I do not have *time* to cook meals for myself (loading = .748); and hb25: I have *other problems* more important than worrying about diet and exercise (loading = .568). This factor was labeled “Time and Other Problems”. The sixth factor contained three items with primary loadings: hb18, It is *painful* for me to walk for more than five minutes (loading = .552); hb19r, I have *access* to exercise facilities and equipment (loading = .810); and 20r, I have someone who will exercise with me (loading = .561). This factor was labeled “External Forces/Factors.” Finally, the last barrier item loaded on factor 7: hb24, I can not afford to buy healthy foods (loading = -.680). This factor was labeled “Financial.” The four potential sub-factors identified within the barriers subscale warrant further exploration in future studies and the author recommends the inclusion of additional items to measure each additional sub-factor to improve internal consistency if this subscale.

Criterion-related Validity

Criterion-related or predictive validity was evaluated by testing the ability of the HBCVD to predict stage of change for diet (SODS) and exercise (SOES) as well as for adherence to diet and exercise as measured by the TDAQ diet and exercise subscales. The explanatory power of the HBCVD was evaluated by entering a regression model using mean subscale scores for the susceptibility, severity, benefits, and barriers scales as the predictor variables. It is important to note that self efficacy was not included in this particular analysis since self efficacy was not measured in the HBCVD. Each subscale mean score was entered into the regression equation, which was then regressed across each of the outcome variables of interest: SODS, SOES, TDAQ diet subscale, and TDAQ exercise subscale. Results are presented in Tables 4.20-4.23. The HBCVD explained 5% of the variance for diet stage of change ($R = .22$; $R^2 = .05$; $p = .049$), although no individual subscale contributed significantly to the overall model (see Table 4.20). The HBCVD also explained 8% of the variance in stage of change for exercise ($R = .289$; $R^2 = .084$; $p = .003$), with the susceptibility subscale as the only significant contributor ($p = .016$) to the model (see Table 4.21).

Table 4.20: Regression Analysis Summary for HBCVD Variables Predicting Stage of Change for Diet

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.706	.713		6.599	.000
	Susceptibility	-.088	.120	-.058	-.737	.462
	Severity	-.166	.138	-.090	-1.203	.231
	Benefits	-.126	.133	-.071	-.944	.346
	Barriers	-.434	.230	-.148	-1.886	.061

a Dependent Variable: Diet Stage

Table 4.21: Regression Analysis Summary for HBCVD Variables Predicting Stage of Change for Exercise

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.584	.763		6.010	.000
	Susceptibility	-.303	.125	-.189	-2.424	.016
	Severity	.183	.146	.093	1.260	.209
	Benefits	-.249	.143	-.129	-1.735	.084
	Barriers	-.460	.240	-.148	-1.916	.057

a Dependent Variable: Exercise Stage

Similarly, the HBCVD was also able to explain a significant portion of the variance for both the TDAQ diet ($R = .278$, $R^2 = .08$, $p = .005$; see table 4.22) and exercise ($R = .255$, $R^2 = .07$, $p = .015$; see table 4.23) adherence subscales. The amount of variance explained by the HBCVD was equally low for the adherence measures as they were for the stages of change. The HBCVD explained 8% of the variance in diet adherence ($R = .278$; $R^2 = .08$) and 7% of the variance in exercise adherence ($R = .255$; $R^2 = .07$). In both models, susceptibility was the only predictor that contributed significantly to the overall model.

Table 4.22: Regression Analysis Summary for HBCVD Variables Predicting Diet Adherence

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	7.257	.944		7.690	.000
	Susceptibility	-.466	.154	-.237	-3.020	.003
	Severity	-.208	.180	-.085	-1.155	.250
	Benefits	.138	.176	.058	.780	.437
	Barriers	-.087	.299	-.022	-.291	.772

a Dependent Variable: Diet adherence

These findings provide limited support for the predictive validity of the overall HBCVD as measured in this study. While each model containing all four HBCVD variables were found to be significant predictors of stage and adherence, the susceptibility subscale was found to be the only significant individual contributor among all four variables when predicting exercise stage and diet adherence.

Table 4.23: Regression Analysis Summary for HBCVD Variables Predicting Exercise Adherence

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.221	1.876		5.980	.000
	Susceptibility	-.735	.297	-.196	-2.475	.014
	Severity	.489	.348	.105	1.404	.162
	Benefits	-.227	.351	-.049	-.646	.519
	Barriers	-.893	.580	-.121	-1.540	.125

a Dependent Variable: Exercise adherence

Discriminant Validity

Discriminant validity was examined by evaluating inter-scale correlations between the HBCVD and the other scales used to measure the remaining core model variables in this study; results are presented in Table 4.24. All interscale correlations were less than .52. These correlations suggest that although the majority of the scale correlations were statistically significant at the $p < .05$ level, none of the scales were capturing the same construct, thus supporting discriminant validity.

AIM TWO: RELATIONSHIPS AMONG MODEL VARIABLES

For this aim, relationships among biological and psychosocial variables and diet and exercise behaviors in a population of persons with type 2 diabetes were evaluated. Prior to conducting statistical analyses, psychometric evaluation of the study measures was conducted.

Psychometrics for Study Measures

Prior to evaluation of the relationships among the model variables, Cronbach's alpha calculations for the HDFQ, HBCVD, CES-D, MDQ-SS, MDQ-SE, and TDAQ diet and exercise subscales were evaluated to ensure reliable measurement of the core model variables. Cronbach's alpha for standardized items for all scales ranged from .65 to .90 and were deemed acceptable or better per DeVellis' (2003) criteria (see Table 4.25). In addition, test-retest reliability was obtained for the SODS and SOES to establish some form of reliability for these one item scales. Both scales were significantly correlated with their retest scores ($p = .00$) and Pearson correlation coefficients were .611 for the SODS and .737 for the SOES (see Table 4.26). After reliability of the measures for the model variables was established, descriptive statistics were used to examine bivariate relationships between selected variables and mean differences associated with group membership.

Bivariate Analyses

Analysis of Variance: Demographic and Biological Variables

To evaluate group differences in diet and exercise adherence scores across selected model variables, analysis of variance tests were performed. Using diet and exercise as dependent variables, the remaining model variables were entered as independent variables to answer one of the secondary research questions: Do diet and exercise adherence scores differ by age, gender, race, marital status, insurance, education, income, employment, BMI group, or insulin use?

Results of this analysis are presented in Table 4.1 which shows the mean scores, F-statistic, and statistical significance for diet and exercise adherence scores across the selected variables. The reader is reminded that higher scores on the diet and exercise scales indicate better adherence. Significant differences between age, education and employment groups were identified. Exercise adherence scores differed significantly only across education level ($p = .03$). Tukey's post hoc analysis revealed that participants with less than high school education had significantly lower exercise scores compared to all other education level groups.

Table 4.24: Discriminant Validity of HBCVD – Inter-scale Correlations between Scales Measuring Model Variables

		HDFQ Knowledge	HBCVD Suscep-tibility	HBCVD Severity	HBCVD Benefits	HBCVD Barriers	CESD Depression	MDQ-SE Self Efficacy Total Score	MDQ-SS Social Support Total Score	TDAQ Adherence Total Score
HDFQ Know-ledge	Pearson Correla-tion	1	-.079	-.106	.161*	-.169*	-.019	.040	-.024	.171*
	Sig. (2-tailed)		.267	.146	.024	.018	.790	.574	.757	.025
	N	198	197	191	198	196	196	196	166	170
HBCVD Suscepti-bility	Pearson Correla-tion	-.079	1	.277**	.172*	.299**	.238**	-.259**	-.300**	-.296**
	Sig. (2-tailed)	.267		.000	.013	.000	.001	.000	.000	.000
	N	197	209	202	209	204	204	205	176	176
HBCVD Severity	Pearson Correla-tion	-.106	.277**	1	.099	.155*	.302**	-.063	-.191*	-.080
	Sig. (2-tailed)	.146	.000		.158	.029	.000	.375	.012	.291
	N	191	202	203	203	199	198	199	175	175
HBCVD Benefits	Pearson Correla-tion	.161*	.172*	.099	1	-.192**	.047	.009	-.094	.021
	Sig. (2-tailed)	.024	.013	.158		.006	.503	.902	.215	.786
	N	198	209	203	210	205	205	206	176	177
HBCVD Barriers	Pearson Correla-tion	-.169*	.299**	.155*	-.192**	1	.167*	-.160*	-.054	-.216**
	Sig. (2-tailed)	.018	.000	.029	.006		.018	.022	.480	.004
	N	196	204	199	205	207	202	205	175	174
CESD Depres-sion	Pearson Correla-tion	-.019	.238**	.302**	.047	.167*	1	-.303**	-.405**	-.273**
	Sig. (2-tailed)	.790	.001	.000	.503	.018		.000	.000	.000
	N	196	204	198	205	202	207	203	174	175
MDQ-SE Self Efficacy Total Score	Pearson Correla-tion	.040	-.259**	-.063	.009	-.160*	-.303**	1	.362**	.522**
	Sig. (2-tailed)	.574	.000	.375	.902	.022	.000		.000	.000
	N	196	205	199	206	205	203	208	176	175
MDQ-SS Social Support Total Score	Pearson Correla-tion	-.024	-.300**	-.191*	-.094	-.054	-.405**	.362**	1	.417**
	Sig. (2-tailed)	.757	.000	.012	.215	.480	.000	.000		.000
	N	166	176	175	176	175	174	176	178	155

Table 4.24: Continued

		HDFQ Knowledge	HBCVD Suscep-tibility	HBCVD Severity	HBCVD Benefits	HBCVD Barriers	CESD Depression	MDQ-SE Self Efficacy Total Score	MDQ-SS Social Support Total Score	TDAQ Adherence Total Score
TDAQ Adher-ence Total Score	Pearson Correla-tion	.171*	-.296**	-.080	.021	-.216**	-.273**	.522**	.417**	1
	Sig. (2-tailed)	.025	.000	.291	.786	.004	.000	.000	.000	
	N	170	176	175	177	174	175	175	155	178

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 4.25: Reliability and Scale Statistics for Scales Measuring Model Variables

Scale	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Mean	Variance	Std. Deviation	N of Items
HDFQ	.727	.760	21.14	8.0	2.83	25
MDQ-SE	.780	.867	20.57	31.106	5.58	7
MDQ-SS	.811	.804	13.66	7.99	2.83	4
CESD	.896	.904	14.11	121.944	11.04	20
TDAQ Total	.826	.828	41.71	35.867	5.989	13
TDAQ Diet	.634	.646	5.82	1.773	1.332	2
TDAQ Exercise	.865	.864	7.66	6.491	2.548	3

Table 4.26: Test Re-test Reliability for Stages of Change Diet and Exercise Scales

		SOES Exercise Stage	SODS Diet Stage	Retest SOES Exercise Stage	Retest SODS Diet Stage
SOES Exercise Stage	Pearson Correlation	1	.428(**)	.737(**)	.533(**)
	Sig. (2-tailed)		.000	.000	.000
	N	202	202	38	39
SODS Diet Stage	Pearson Correlation		1	.426(**)	.611(**)
	Sig. (2-tailed)			.008	.000
	N			38	39
Retest SOES Exercise Stage	Pearson Correlation			1	.601(**)
	Sig. (2-tailed)				.000
	N				38
Retest SODS Diet Stage	Pearson Correlation				
	Sig. (2-tailed)				
	N				

** Correlation is significant at the 0.01 level (2-tailed).

Diet scores differed significantly across education (p = .002), age (p = .004), and employment (p = .020) groups. Tukey's post hoc analyses were evaluated for each significant finding. Participants in the less than high school education group differed significantly from the high school graduates (p = .024) and college graduates (p = .020). Evaluation of mean scores revealed that the group that did not graduate from high school had the lowest diet adherence scores while the high school and college graduates had the highest adherence scores. Significant age group differences were found between the youngest age group (less than 50 years) and the oldest age group (greater than 65 years; p= .002). The youngest participants had significantly lower diet scores than the oldest participants, while participants in the middle age group (51-65 years) did not differ significantly from either group. Finally, diet scores were significantly different between participants who were out of work and those participants who were not working because they were a retiree, student, or homemaker (p = .019). Evaluation of mean scores revealed that that the retired/student/homemaker group had the highest diet scores while participants who were out of work had the lowest diet scores.

Evaluation of differences between marital groups across types of social support was necessary to determine whether or not marital group would need to be included as a covariate in statistical analyses. Since two types of support were measured as part of the Social Support total scale, i.e., support from family or health care provider and support from significant other, participants not involved in a romantic relationship could have been excluded from the significant other type of support and this could have lowered their social support total scores.

Results revealed that participants who were married or a member of an unmarried couple had the highest mean scores for total social support and support from significant other than the other groups. Statistically significant differences were found between the single, never married group and the married or member of an unmarried couple group between social support total (p = .017) and support from significant other (p = .007). To determine the effect of marital status on the outcome variables of interest in this study, diet and exercise adherence scores, one-way analysis of variance tests were conducted to determine if there were between group differences across marital group in diet and exercise adherence scores. No significant differences were found for diet (p = .816) or exercise (p = .136).

Analysis of Variance: Health Beliefs and Stages of Change

The second secondary research question was: How do health beliefs vary across stage of change? Results of the ANOVA for HBM including self efficacy across stage of change for exercise (SOES) are presented in Table 4.27. Results identified no significant differences between groups across stage of change for exercise among perceived severity or benefits. Perceived susceptibility (p = .007), barriers (p = .011), and self efficacy (p = .000) were found to differ significantly across stages of change for exercise (SOES). Tukey's post hoc analysis revealed that the significant differences across susceptibility beliefs occurred between groups 1 (the inactive group) and group 4 (the maintenance group; p = .003). Evaluation of trends across group means revealed that as exercise stage increases, susceptibility to heart attack or stroke beliefs decrease. Tukey's post hoc analysis also revealed that group 1 (the inactive group) was significantly different from groups 2 (the preparation group; .005) and 4 (the maintenance group; p = .023) across barriers beliefs. Evaluation of trends across group means revealed that as exercise stage increases, perceived barriers to diet and exercise decrease until you get to the maintenance stage, which revealed a slight increase in perceived barriers compared to the action stage. However, barriers scores of participants in the maintenance stage were still lower than for those in the inactive and preparation stages. Finally, Tukey's post hoc analysis revealed that the inactive group (stage 1) also had significantly different self efficacy total scores across all other exercise stage groups (stages 2, p = .024; 3, p = .004; and 4, p = .000). Evaluation of trends across group means identified that as self efficacy scores increase, exercise stage also increases.

Similar findings were also found for differences between groups across perceived barriers and self efficacy and stage of change for diet (SODS); however susceptibility beliefs did not differ significantly across stages for diet although trends in group means revealed a similar pattern with susceptibility decreasing as stage increased. No significant differences were found between stage groups across perceived severity and benefits scores. Results of the ANOVA for the HBM including self efficacy across stage of change for diet (SODS) are presented in Table 4.28. Tukey's post hoc analysis revealed that perceived barriers differed significantly across stages for diet: group 3 (the action group) differed significantly from group 1 (inactive group; p = .001) and group 2 (preparation group; p = .003). Evaluation of trends across group means revealed nearly identical findings form the exercise stage analysis in that as diet stage increases, perceived barriers to diet and exercise decrease until you get to the maintenance stage in which there is a slight increase in barriers perceptions compared to the action stage participants. Participants in the action stage (group 3) had the lowest mean barriers score across all groups, followed by group 4 (maintenance stage), group 2 (preparation stage) and finally group 1 (inactive stage).

Self efficacy beliefs also differed significantly across stages of change for diet. Tukey's post hoc analyses revealed that Group 1 (inactive stage) was significantly different from all other groups: group 2 (preparation group; $p = .012$), group 3 (action group; $p = .000$), and group 4 (maintenance group; $p = .000$). Group 2 was also significantly different from group 3 ($p = .029$) and group 4 ($p = .001$). Groups 3 and 4 did not differ significantly. Evaluation of trends across group means for self-efficacy scores revealed that as self efficacy increases, diet stage also increases.

Hypothesis Testing

Analysis of the relationships among the model variables was conducted using simple and multiple regression procedures. First, simple regression equations were used to evaluate each hypothesis statement. The results for the analyses of each hypothesis statement are provided below.

<u>H1) Cues to action have a direct relationship with knowledge and perceived threat.</u>

The regression equations for this hypothesis were nonsignificant (see Table 4.29); thus H1 was not supported. The reader is reminded that higher cues to action scores indicate exposure to more sources of information about diabetes or cardiovascular disease and higher knowledge scores indicate greater knowledge of heart disease risk factors in persons with diabetes.

<u>H2) Knowledge has a direct relationship with the HBM (excluding cues to action).</u>

Regression equations revealed partial support for H2 (see Table 4.30). Knowledge was not a significant predictor of perceived susceptibility ($p = .289$), severity ($p = .115$), or self efficacy ($p = .692$). Knowledge was a significant predictor for perceived benefits ($p = .033$) and barriers ($p = .000$). The reader is reminded that higher HBM scores indicate stronger beliefs held for the corresponding construct. For example, a high susceptibility score indicates that the participant feels highly susceptible to heart attack or stroke and a high barriers score indicates that the participant perceives a high amount of barriers to diet and exercise.

<u>H3) Self-efficacy has a direct relationship with stage of change.</u>

Hypothesis three was fully supported (see Table 4.31). Self efficacy was predictive of diet stage ($p = .000$) and exercise stage ($p = .000$). The reader is reminded that stage scores indicate the following: 1 = precontemplation and contemplation/inactive stage; 2 = preparation stage; 3 = action (maintained for less than six months); and 4 = maintenance (maintained for longer than six months).

<u>H4) Health beliefs have a direct relationship with stage of change.</u>

Hypothesis four was partially supported. Table 4.32 shows the results of each regression. Significant predictors of diet stage were susceptibility ($p = .039$) and barriers ($p = .015$). These HBM variables were also significant predictors of exercise stage: susceptibility ($p = .001$) and barriers ($p = .011$).

<u>H5) Stage of change has a direct relationship with diet and exercise behaviors.</u>

This hypothesis was fully supported (see Table 4.33). Diet stage significantly predicted diet adherence ($R = .47$, $R^2 = .22$, $p = .00$) and exercise stage significantly predicted exercise adherence ($R = .61$, $R^2 = .37$, $p = .00$).

Table 4.27: One-Way Analysis of Variance for Exercise Stage Groups and Health Belief Model Variables

		N	Mean	Std. Deviation	F	Significance
Susceptibility	1.00	43	2.8047	.77887	4.136	.007
	2.00	85	2.5418	.59716		
	3.00	23	2.5130	.74303		
	4.00	48	2.3396	.46574		
	Total	199	2.5465	.64637		
Severity	1.00	41	2.18780	.546898	.092	.964
	2.00	84	2.24048	.558800		
	3.00	23	2.23478	.469631		
	4.00	45	2.21778	.537371		
	Total	193	2.22332	.537743		
Benefits	1.00	43	3.3721	.54535	1.026	.382
	2.00	86	3.3554	.54294		
	3.00	23	3.2348	.69096		
	4.00	48	3.2153	.44953		
	Total	200	3.3115	.54197		
Barriers	1.00	42	2.3681	.38044	3.824	.011
	2.00	84	2.1847	.33586		
	3.00	23	2.1401	.29379		
	4.00	48	2.1606	.33259		
	Total	197	2.2127	.34792		
Self Efficacy	1.00	44	17.4091	5.39732	8.229	.000
	2.00	84	20.6429	6.51161		
	3.00	22	22.9091	8.05877		
	4.00	48	23.3333	4.71455		
	Total	198	20.8283	6.40992		

*** p<.05**

**** p<.01**

Table 4.28: One-Way Analysis of Variance for Diet Stage Groups and Health Belief Model Variables

		N	Mean	Std. Deviation	F	Significance
Susceptibility	1.00	15	2.7467	.87983	2.582	.055
	2.00	92	2.6332	.69521		
	3.00	30	2.3200	.49158		
	4.00	64	2.4734	.54663		
	Total	201	2.5440	.64739		
Severity	1.00	14	2.34286	.432727	1.552	.202
	2.00	89	2.29494	.562666		
	3.00	30	2.09500	.439112		
	4.00	62	2.16452	.573198		
	Total	195	2.22615	.543431		
Benefits	1.00	15	3.3889	.42570	.299	.826
	2.00	93	3.3215	.59250		
	3.00	30	3.2744	.68775		
	4.00	64	3.2604	.46469		
	Total	202	3.3002	.55734		
Barriers	1.00	15	2.4296	.26516	6.411	.000
	2.00	90	2.2580	.37350		
	3.00	30	2.0111	.29807		
	4.00	64	2.1936	.29953		
	Total	199	2.2130	.34643		
Self Efficacy	1.00	15	14.4000	4.99714	12.676	.000
	2.00	91	19.4945	6.76818		
	3.00	30	22.9667	6.90069		
	4.00	64	23.3438	3.92072		
	Total	200	20.8650	6.39777		

*** p<.05**

**** p<.01**

Table 4.29: Simple Regression Analysis Summary for Hypothesis 1

	Knowledge					Threat (Susceptibility + Severity)				
Predictor	(Constant)	β Unstandard Coefficients	β Standard Coefficients	T	Sig	(Constant)	β Unstandard Coefficients	β Standard Coefficients	T	Sig
Cues DM	21.389	-.076	-.036	-.480	.632	24.361	-.205	-.058	-.787	.432
Cues CVD	20.617	.227	.127	1.707	.089	23.575	.110	.038	.518	.605

* p<.05
**p<.01

Table 4.30: Simple Regression Analysis Summary for Hypothesis 2

	Susceptibility					Severity				
Predictor	(Constant)	β Unstandard Coefficients	β Standard Coefficients	T	Sig	(Constant)	β Unstandard. Coefficients	β Standard Coefficient	T	Sig
Knowledge	14.77	-.091	-.079	-1.06	.289	13.718	-.117	-.120	-1.58	.115
	Benefits					**Barriers**				
Knowledge	16.07	.184	.157	2.143	.033*	24.416	-.323	-.259	-3.55	.000**
	Self Efficacy									
Knowledge	18.999	.068	.029	.397	.692					

* p<.05
**p<.01

Table 4.31: Simple Regression Analysis Summary for Hypothesis 3

	Diet Stage					Exercise Stage				
Predictor	(Con-stant)	**B** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**	(Con-stant)	**β** Unstandard Coefficients	**β** Stand. Coeff.	**T**	**Sig**
Self Efficacy	1.492	.059	.375	5.694	.00**	1.250	.054	.320	4.726	.00**

* p<.05

**p<.01

Table 4.32: Simple Regression Analysis Summary for Hypothesis 4

	Diet Stage					Exercise Stage				
Predictor	(Con-stant)	**β** Unstan. Coeff.	**β** Stand. Coeff.	**T**	**Sig**	(Con-stant)	**β** Unstan. Coeff.	**β** Stan. Coeff.	**T**	**Sig**
Suscep-tibility	3.282	-.224	-.145	-2.07	.039*	3.359	-.384	-.231	-3.33	.001**
Severity	3.231	-.231	-.126	-1.77	.079	2.324	.022	.011	.154	.878
Benefits	3.088	-.115	-.064	-.912	.363	3.151	-.233	-.118	-1.67	.097
Barriers	3.817	-.496	-.172	-2.45	.015*	3.622	-.556	-.180	-2.53	.011*

* p<.05

**p<.01

<u>H6) Depression has a direct relationship with diet and exercise behaviors.</u>

This hypothesis was also fully supported (see Table 4.34). Depression is a significant predictor of diet (p = .001) and exercise (p = .007) adherence. The reader is reminded that higher CESD scores indicate higher suspicion for depression; scores of 16 or higher suggest depression and warrant further evaluation (Radloff, 1977).

Table 4.33: Simple Regression Analysis Summary for Hypothesis 5

	Diet Adherence					Exercise Adherence				
Predictor	(Con-stant)	**β** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**	(Con-stant)	**β** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**
Diet Stage	4.204	.607	.465	7.330	.00**	---	---	---	---	---
Exercise Stage	---	---	---	---	---	4.225	1.451	.609	10.464	.00**

* p<.05
**p<.01

Table 4.34: Simple Regression Analysis Summary for Hypothesis 6

	Diet Adherence					Exercise Adherence				
Predictor	(Con-stant)	**β** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**	(Con-stant)	**β** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**
Depression	6.241	-.030	-.243	-3.526	.001**	8.305	-.046	-.194	-2.737	.007**

* p<.05
**p<.01

H7) Social support has a direct relationship with diet and exercise behaviors.

This hypothesis was fully supported (see Table 4.35). Social support is a significant predictor of adherence to diet (p = .00) and exercise (p = .00). Further evaluation of social support subscales (Diabetes Support from Friends and Healthcare Team and Diabetes Support from Spouse/Significant Other) revealed that each source of social support was also a significant predictor of diet and exercise adherence (see Table 4.35). As a result, it was not necessary to distinguish between the two different types of support in the data analysis to address the aims of the current study. The reader is reminded that higher support scores indicate higher perceptions of support.

H8) Socioeconomic Status has a direct relationship with diet and exercise behaviors.

Simple regression analyses of each individual SES indicator and diet or exercise adherence scores revealed that education level was a significant predictor of exercise adherence (p = .044; see Table 4.36) although it accounted for only 2% of the variance in exercise scores (R^2 = .021). Evaluation of all SES variables together in one model revealed that the SES model did not significantly predict exercise adherence (p = .329; see Table 4.38). The SES model was found to be a significant predictor of diet adherence (p = .042; see Table 4.37) accounting for 5% of the variance (R^2 = .053) in diet adherence. Employment group was the only significant contributor of diet adherence (p = .022) in the SES model.

Table 4.35: Simple Regression Analysis Summary for Hypothesis 7

	Diet Adherence					**Exercise Adherence**				
Predictor	(Con-stant)	β Unstand. Coeff.	β Stand. Coeff.	**T**	**Sig**	(Con-stant)	β Unstand. Coeff.	β Stand. Coeff.	**T**	**Sig**
Social Support: Total	3.577	.166	.352	4.930	.00**	4.101	.265	.302	4.102	.00**
Social Support: Friends, Healthcare Providers	3.005	.400	.377	5.764	.000**	2.686	.702	.348	5.167	.000**
Social Support: Spouse, Significant Other	4.640	.183	.260	3.525	.001**	5.945	.268	.205	2.708	.007**

* p<.05

**p<.01

Table 4.36: Simple Regression Analysis Summary for Hypothesis 8

	Diet Adherence					Exercise Adherence				
Predictor	(Con-stant)	**β** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**	(Con-stant)	**β** Unstand. Coeff.	**β** Stand. Coeff.	**T**	**Sig**
Income	5.549	.125	.121	1.668	.097	7.655	-.001	-.001	-.010	.992
Education Level	5.368	.156	.122	1.731	.085	6.656	.345	.145	2.025	.044*
Employment Status	5.415	.188	.125	1.783	.076	7.158	.227	.079	1.109	.269
Insurance Status	6.144	-.284	-.075	-1.073	.285	7.756	-.086	-.012	-.166	.868

* p<.05
**p<.01

Table 4.37: Multiple Regression Analysis Summary for Hypothesis 8 – Diet Adherence

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.923	.588		8.374	.000
	Income	.116	.080	.112	1.442	.151
	Education level	.111	.100	.086	1.106	.270
	Employment Status	.254	.110	.169	2.309	**.022***
	Insurance Status	-.222	.294	-.057	-.755	.451

a Dependent Variable: Diet Adherence
* p<.05 **p<.01

Table 4.38: Multiple Regression Analysis Summary for Hypothesis 8 – Exercise Adherence

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.111	1.137		5.377	.000
	Income	-.075	.157	-.038	-.474	.636
	Education level	.327	.195	.135	1.678	.095
	Employment Status	.305	.212	.109	1.440	.152
	Insurance Status	.077	.568	.011	.136	.892

a Dependent Variable: Exercise Adherence

<u>H9) Comorbidity and duration of diabetes have a direct relationship with knowledge and diet and exercise behaviors.</u>

None of the predicted relationships in this hypothesis were significant (see Table 4.39). Thus this hypothesis was not supported. The reader is reminded that higher comorbidity scores indicate a higher number of comorbid conditions and higher duration scores indicate longer duration of diabetes.

Table 4.39: Simple Regression Analysis Summary for Hypothesis 9

	Diet Adherence					Exercise Adherence				
Predictor	(Con-stant)	β Unstand. Coeff.	β Stand. Coeff.	**T**	**Sig**	(Con-stant)	β Unstand. Coeff.	β Stand. Coeff.	**T**	**Sig**
Comorbid Conditions	5.973	-.019	-.040	-.544	.587	7.946	-.030	-.033	-.444	.657
Duration of Diabetes	5.776	.002	.013	.184	.854	7.637	.001	.006	.085	.932

	Knowledge				
Predictor	(Con-stant)	β Unstand. Coeff.	β Stand. Coeff.	**T**	**Sig**
Comorbid Conditions	20.976	.051	.056	.731	.466
Duration of Diabetes	20.992	.010	.039	.511	.610

* p<.05
**p<.01

AIM THREE: EVALUATION OF THE INTEGRATED MODEL THROUGH PATH ANALYSIS

To evaluate the ability of the conceptual model to predict or explain diet and exercise behaviors in a population of persons with type 2 diabetes, multiple regression and path analysis techniques were used. Each pathway in the conceptual model was evaluated separately using multiple regression techniques described in the previous section. The structure of the conceptual model as predicted was explored through path analysis. Next, two empirical models (one for diet adherence and one for exercise adherence) were constructed based on each significant path from the conceptual model identified through regression analyses of the hypothesis statements. The empirical models that were tested in this study are presented in figure 4.1.

Evaluation of the Conceptual Model

After all individual paths within the conceptual model had been evaluated, the next step was to evaluate the structure of the full conceptual model that shows the paths from each of the model variables (predictors) to the outcome variables diet and exercise adherence (Figure 1). Although the sample size in this study was inadequate for path analysis (minimum of 390 required), the structure of the model was explored using path analysis techniques as a first step in evaluation of the overall model in this exploratory study. Using the AMOS 6.0 software package for path analysis, two parallel models were constructed: one model to predict diet adherence and one to predict exercise adherence. Each model was identical except for the stage and adherence measures. Stage of change for diet (SODS) and the diet adherence subscale score from the TDAQ were used in the diet model and stage of change for exercise (SOES) and the exercise adherence subscale score from the TDAQ were used in the exercise model. In both path analyses, neither the diet ($\chi^2 = 484.1$, df = 143, p = .000) nor the exercise ($\chi^2 = 470.4$, df = 143, p = .000) models were a good fit for the data. The conceptual model was then simplified to include only the significant predictor variables identified at the $p<.05$ level in the initial path analysis. Again, neither revised model was a good fit for the data (diet: $\chi^2 = 201.9$, df = 56, p = .000; exercise: $\chi^2 = 56.2$, df = 28, p = .001), although all paths remained significant.

Figure 4.1: A) Empirical Model for Prediction of Diet Adherence
(Non-significant paths deleted)

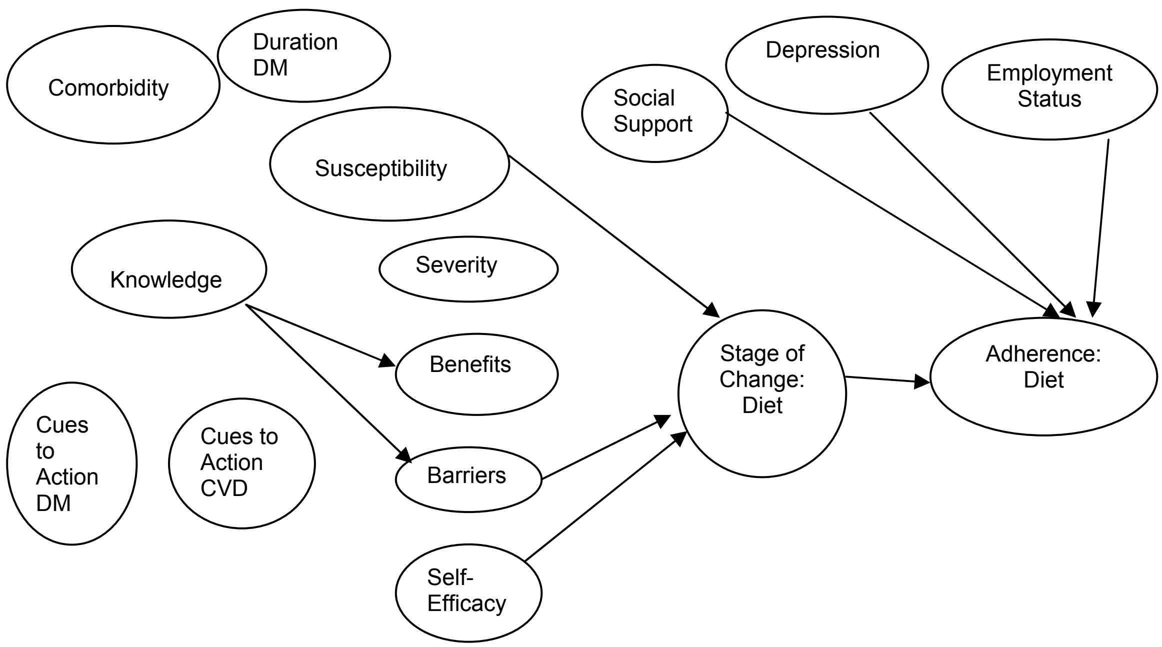
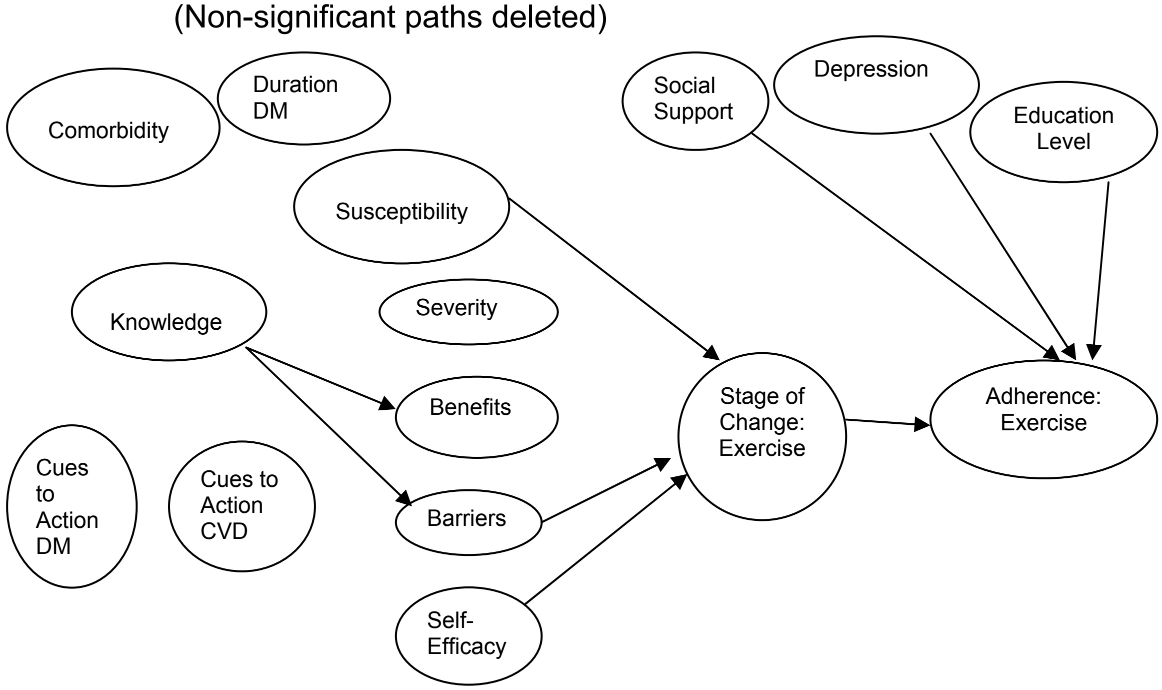


Figure 4.1: B) Empirical Model for Prediction of Exercise Adherence
(Non-significant paths deleted)



Evaluation of the Empirical Model

An alternate strategy was to build a model for diet adherence and one for exercise adherence using an empirical approach based on significant relationships between the model variables identified through regression analyses previously described. These paths are identified in Figure 4.1, with nonsignificant paths that were hypothesized in the original integrated model deleted so that the paths that remain are those that were significant at the $p<.05$ level in the regression analyses. Two empirical models were tested using multiple regression analyses: one for diet adherence and one for exercise adherence.

The entire empirical model for diet was found to be a significant predictor of diet adherence ($p = .000$) and explained 37% of the variance in diet adherence scores ($R = .61$, $R^2 = .374$). Four of the variables within the diet empirical model were found to be significant contributors to the overall model (see Table 4.40). Stage of change for diet was the strongest predictor, followed by susceptibility, self efficacy, and finally social support.

Similarly, the empirical model for exercise was found to be a significant predictor of exercise adherence ($p = .000$) and explained 49% of the variance in exercise adherence scores ($R = .701$, $R^2 = .491$). Three variables were found to be significant contributors to the overall model (see Table 4.41). Stage of change for exercise was the strongest predictor followed by social support and finally self efficacy. Susceptibility was not significant in the exercise model, although it had the next highest correlation among the remaining model variables.

It is important to note that although depression was a significant predictor of both diet and exercise adherence in the individual regression analyses, depression was no longer significant when included in the empirical models. However, social support remained significant in both the diet and exercise adherence models.

Because of their potential influence on diet and exercise adherence, several variables were added to the empirical models to allow for control of these variables in subsequent regression analyses in an attempt to identify the best predictor model for diet and exercise adherence. These variables included age, employment, and BMI group, as well as whether or not the person was taking insulin. The best model for predicting exercise was the original exercise empirical model provided in Figure 4.1, which accounted for the greatest amount of variance of all the models (adjusted R^2= .461). The best predictive model for diet included the original diet empirical model plus age group (adjusted R^2= .374).

Evaluation of Relationships Between the Health Belief Model, Stages of Change, and Diet and Exercise Adherence

Although individual paths between the HBM variables and diet and exercise stage of change were evaluated through the hypothesis testing previously described, the path through which the complete HBM predicts stage of change remained to be evaluated. This path was evaluated by placing all HBM variables into two regression equations as the predictor variables with diet stage (SODS) as one outcome variable and exercise stage (SOES) as the other.

Both regression models were significant indicating that the HBM as a whole does predict stage of change. In the regression models, the HBM accounted for 17% of the variance in stage of diet scores (R= .42, R^2 = .173, p = .00) and 16% of the variance in stage of exercise scores (R= .40, R^2 = .159; p = .00). Among all HBM variables, self efficacy was the only significant predictor of diet stage (see Table 4.42) and benefits and self efficacy were the only significant predictors of exercise stage (see Table 4.43).

Table 4.40: Multiple Regression Analysis Summary of Empirical Model Variables Predicting Diet Adherence

Model		Unstandardized Coefficients		Standardized Coefficients	t	p
		B	Std. Error	Beta		
1	(Constant)	1.369	1.348		1.016	.311
	Knowledge	.045	.032	.099	1.394	.166
	Susceptibility	-.417	.164	-.198	-2.538	.012*
	Benefits	.167	.177	.071	.946	.346
	Barriers	.372	.308	.092	1.209	.229
	Self Efficacy	.037	.015	.188	2.385	.018*
	Depression	.009	.010	.065	.841	.402
	Social Support	.076	.038	.162	2.0	.048*
	Stage of Change: Diet	.488	.102	.370	4.775	.000**

a Dependent Variable: Diet Adherence

* p<.05 **p<.01

Table 4.41: Multiple Regression Analysis Summary of Empirical Model Variables Predicting Exercise Adherence

Model		Unstandardized Coefficients		Standardized Coefficients	t	p
		B	Std. Error	Beta		
1	(Constant)	1.361	2.255		.604	.547
	Knowledge	.050	.055	.059	.916	.362
	Susceptibility	-.511	.273	-.132	-1.870	.064
	Benefits	.180	.297	.041	.606	.545
	Barriers	-.011	.495	-.002	-.022	.982
	Self Efficacy	.053	.025	.149	2.144	.034*
	Depression	.011	.017	.046	.651	.516
	Social Support	.141	.061	.166	2.315	.022*
	Stage of Change: Exercise	1.233	.158	.535	7.799	.000**

a Dependent Variable: Exercise Adherence

* p<.05 **p<.01

The HBM was also evaluated for its ability to explain diet and exercise adherence scores. The regression models are presented in tables 4.44 and 4.45. Both models accounted for a significant portion of the variance in diet scores (R = .49, R^2= .24, p = .000, table 4.44) and exercise scores (R = .46, R^2= .21, p = .000, table 4.45) with self efficacy as the only significant predictor.

Table 4.42: Multiple Regression Analysis Summary for HBM Variables Predicting Diet Stage of Change

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.205	.728		4.402	.000
	Susceptibility	.051	.116	.034	.440	.661
	Severity	-.189	.130	-.103	-1.452	.148
	Benefits	-.158	.126	-.089	-1.258	.210
	Barriers	-.379	.217	-.129	-1.750	.082
	Self Efficacy	.057	.011	.364	5.212	.000**

a Dependent Variable: Diet Stage
* p<.05 **p<.01

Table 4.43: Multiple Regression Analysis Summary for HBM Variables Predicting Exercise Stage of Change

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.447	.800		4.311	.000
	Susceptibility	-.203	.124	-.126	-1.630	.105
	Severity	.194	.141	.098	1.374	.171
	Benefits	-.293	.139	-.151	-2.105	.037*
	Barriers	-.439	.232	-.141	-1.889	.061
	Self Efficacy	.046	.012	.275	3.879	.000**

a Dependent Variable: Exercise stage
* p<.05 **p<.01

Finally, to evaluate the relationships among the HBM and stage variables when combined, the HBM variables and stage of change for diet and exercise were included together in two parallel regression models (one for diet and one for exercise). The HBM variables and stage of change (diet and exercise) were entered as the predictor variables and the diet or exercise adherence score was entered as the outcome variable. Not surprisingly, the combined model accounted for a greater percentage of the variance in both diet (R = .57, R^2 = .32, p = .000) and exercise (R = .66, R^2 = .44, p = .000) than either the HBM or stage of change model alone (see table 4.46). The significant contributors within the combined model for diet included diet stage (ß = .35, p = .000), self efficacy (ß = .27, p = .000) and susceptibility (ß = -.16, p = .025). While for the exercise model exercise stage (ß = .53, p = .000) and self efficacy (ß = .24, p = .000) were the only significant variables within the combined model.

Table 4.44: Multiple Regression Analysis Summary for HBM Variables Predicting Diet Adherence

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.903	.936		5.236	.000
	Susceptibility	-.255	.144	-.130	-1.767	.079
	Severity	-.217	.165	-.089	-1.312	.191
	Benefits	.083	.162	.035	.511	.610
	Barriers	.010	.273	.003	.036	.971
	Self Efficacy	.087	.014	.424	6.352	.000**

a Dependent Variable: Diet Adherence

* p<.05 **p<.01

Table 4.45: Multiple Regression Analysis Summary for HBM Variables Predicting Exercise Adherence

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	7.345	1.863		3.943	.000
	Susceptibility	-.368	.282	-.098	-1.302	.195
	Severity	.492	.323	.105	1.520	.130
	Benefits	-.388	.327	-.084	-1.185	.238
	Barriers	-.789	.538	-.106	-1.467	.144
	Self Efficacy	.156	.027	.398	5.817	.000**

a Dependent Variable: Exercise Adherence

* p<.05 **p<.01

Evaluation of the relationships between the HBM and diet and exercise stages and diet and exercise adherence scores revealed that the HBM is able to explain a significant portion of the variance in both stages and adherence scores. In fact, the HBM explained a greater portion of the variance in diet and exercise adherence scores than it did for the diet and exercise stages. These findings also identified self efficacy as the most important variable in the HBM to predict either diet and exercise stage or diet and exercise adherence.

Findings also revealed that individually, both the HBM and Stage of Change models were significant predictors of diet and exercise adherence. The HBM was a stronger predictor of diet adherence while the Stage of Change for exercise model was a stronger predictor of exercise adherence. However, the integration of the two models into one model increased the explanatory for both diet and exercise adherence substantially compared to each individual model alone.

Table 4.46: Multiple Regression Analysis Summary for Three Models (HBM, SOC, and the HBM and SOC Combined) Predicting Diet and Exercise Adherence

	Diet Adherence			Exercise Adherence		
Predictor Model	R	R^2	p	R	R^2	p
Health Belief Model	.493	.243	.000	.460	.212	.000
Stage of Change (Diet/Exercise)	.465	.216	.000	.609	.371	.000
Health Belief Model + Stage of Change (Diet/Exercise)	.567	.322	.000	.664	.441	.000

POST HOC ANALYSES

To add to the practical significance of the current study, several post hoc data analyses were conducted. Of particular interest were additional exploration of knowledge and depression scores in the study population and evaluation of how these scores differed among groups. These additional analyses yielded important information that will be applied in future intervention studies that will aim to decrease CVD morbidity and mortality in adults with type 2 diabetes.

Knowledge

Individual items within the Heart Disease Fact Questionnaire (HDFQ) (Wagner et al., 2005) were evaluated for the percentage of participants who answered each item correctly. The majority of items were answered correctly by more than 90% of the participants. The items that were answered correctly by less than 90% of the participants are presented in Table 4.47.

Table 4.47: Heart Disease Fact Questionnaire Items with Less Than 90% Correct Responses

Item		Correct Response	Frequency Correct	Percent Correct
3.	The older a person is, the greater their risk of having heart disease	True	120	56
10.	If your 'good' cholesterol (HDL) is high you are at risk for heart disease	False	134	63
15.	Walking and gardening are considered exercise that will help lower a person's chance of developing heart disease	True	191	89
17.	High blood sugar puts a strain on the heart	True	176	83
18.	If your blood sugar is high over several months it can cause your cholesterol level to go up and increase your risk of heart disease	True	140	65
20.	People with diabetes rarely have high cholesterol	False	185	86
22.	People with diabetes tend to have low HDL (good) cholesterol	True	47	23
25.	Men with diabetes have a higher risk of heart disease than women with diabetes	False	84	41

To determine group differences in heart disease knowledge scores, one-way analysis of variance tests were performed across selected groups. Results are reported in Table 4.1. Group differences were found between race groups (p = .021) and evaluation of group means revealed that the Caucasian group had the highest knowledge mean score while the Hispanic group had the lowest mean score. Significant differences were also found between education groups (p = .045) with the highest mean knowledge score in the most educated group (post graduate education) and the lowest mean score in the least educated group (less than high school). Simple regression was used to evaluate the direct relationship between heart disease knowledge and diet and exercise adherence scores as well as for diet stage and exercise stage. Results revealed that heart disease knowledge was not a significant predictor of either diet (p = .216) or exercise (p = .716) adherence scores nor for diet stage (p = .381) or exercise stage (p = .985).

Evaluation of the frequency of exposure to each cue to action listed in the study questionnaire revealed that diabetes related information was most commonly received from brochures from a health care provider, in the mail or in public areas (31%) followed by the internet (21%) and friends and relatives (22%). The most common source of CVD related information was from members of the participants' health care team (25%) followed by cardiovascular disease related support group meetings (17%) and the internet (17%).

Depression and Adherence to Diet and Exercise

Self-reported diagnosis of depression, self-reported treatment for depression, and total scores on the CESD depression scale were compared. Frequencies and percentages of self reported diagnosis and treatment can be found in Table 4.2 while Table 4.1 includes descriptive information for CESD scores for the depression groups as well as results from analysis of variance tests to evaluate differences between groups across model variables. Findings revealed similar percentages for self-reported depression (35%) and CESD scores indicating depression (38%) with 27% of the participants taking medication for depression.

Analysis of each response for each individual participant that scored 16 or higher on the CESD (n = 79) identified that 34% (n = 27) screened positive for depression but had not been diagnosed with depression and were not being treated for depression, which suggests the possibility of under-identification of depression in this population. Eleven percent (n = 9) of the depressed participants reported that they had been diagnosed with depression, but were not being treated with medication, which suggests the possibility of under treatment of depression in this population. Finally, the remaining participants with CESD scores of 16 or higher (54%) reported being diagnosed with depression and taking medication for it, however the high CESD score indicates the need for additional intervention strategies.

Next, between group differences across CESD scores were evaluated by one-way analysis of variance tests. Findings are presented in Table 4.1. Significant differences occurred between age groups (p = .002) and employment groups (p = .000). The highest CESD scores were found in the youngest group (50 years or less) and those participants who were out of work. Group differences between participants who were classified as “depressed” (CESD >/= 16) or “not depressed” (CESD <16) were also evaluated by one-way analysis of variance tests. These findings are also presented in Table 4.1, which consists of ANOVA results of between group differences across model variables. Findings revealed that participants who were classified as depressed reported significantly lower mean scores for the diet (p = .013) and exercise (p = .049) adherence subscales compared to the non depressed group. In addition, depressed participants reported significantly lower social support (p = .000) and self efficacy for diabetes self management (p = .000) as well as stronger severity beliefs (p = .001).

As previously noted, an interesting finding in this study is that in the multiple regression analyses of the empirical models, CESD score was no longer a significant predictor of diet or exercise adherence while social support remained a significant predictor for both adherence behaviors. These findings support the importance of social support for adherence to diet and exercise, but also suggest that the presence of depressive symptoms may not be as important as social support in the context of diet and exercise behaviors. This finding warrants further investigation.

CHAPTER SUMMARY

In summary, psychometric evaluation of the HBCVD provided adequate support for the validity and internal consistency of the four subscales although the barriers subscale needs improvement. Four sub-factors were identified within the nine items of the barriers subscale and as a result, adding additional items to the subscale to measure each sub-factor would likely increase inter-item correlations and improve the internal consistency of this scale.

Significant differences in diet and exercise adherence scores were found between education levels, with the lowest adherence scores among participants with the lowest level of education. In addition, diet adherence scores differed significantly across age and employment groups with lowest diet adherence scores found among the youngest age group and participants who were out of work.

Health beliefs as measured in the current study were found to vary across stages of change for diet and exercise. Perceived susceptibility to heart attack and stroke, barriers to diet and exercise, and self efficacy for diabetes self management were significantly different across exercise stage such that the higher the stage the lower the perceptions of susceptibility and barriers and the higher the self efficacy beliefs. The same relationship was found between barriers and self efficacy across diet stages; the higher the stage the lower the perceived barriers and the higher the self efficacy beliefs.

Regression analyses supported the relationships between knowledge and benefits and barriers; between stage of change and susceptibility, barriers, and self efficacy; between education level and exercise adherence; and the relationships between social support, depression, and diet and exercise adherence. The theoretical model proposed in this study did not explain diet or exercise adherence behaviors well, although several of the pathways presented in the model were supported. The empirical model for diet adherence identified diet stage of change, susceptibility, self efficacy, and social support as the significant predictors within the model. In the exercise adherence empirical model, exercise stage of change, social support and self efficacy were identified as the significant predictors. In addition, the significant relationships found between the HBM variables, diet and exercise stage of change, and diet and exercise adherence behaviors support the importance of both health beliefs and stage of change in explaining diet and exercise behavior.

Post hoc analyses revealed significant differences in knowledge of heart disease risk between groups across education level and race. Participants who had less than high school education or were Hispanic had the lowest knowledge scores of all groups. Item analysis of the Heart Disease Fact Questionnaire identified several knowledge deficits regarding heart disease risk factors in diabetic patients that should be emphasized in future educational interventions. Finally, participants in this study who had CESD scores suggestive of depression had significantly less favorable scores on diet and exercise adherence, self efficacy for diabetes self management, social support and perceived severity of heart attack or stroke indices.

This study resulted in a number of important findings. These findings are applicable to clinicians who provide care for adults with type 2 diabetes and provide direction for future research. Nursing implications related to the findings and recommendations for future research will be discussed in the following chapter.

Chapter 5: Discussion and Recommendations

INTRODUCTION

In this chapter, the purpose of this study is summarized and the major findings are discussed. Limitations in the study design, methods and implications for nursing practice, and theory are discussed, and recommendations for future research are suggested.

OVERVIEW OF THE RESEARCH PURPOSE AND AIMS

The purpose of this study was to explore the relationships between selected bio-psychosocial factors and adherence to diet and exercise behaviors to add to our understanding of factors related to diet and exercise adherence. A conceptual model depicting hypothesized relationships between these behaviors and knowledge, cues to action for diabetes and CVD, health beliefs, stage of change, social support, depression, comorbidity, duration of illness, and socioeconomic status was tested in a population of 212 adults with type 2 diabetes. The design of this study was a cross-sectional, descriptive correlational study using convenience sampling techniques. The specific aims of this study were to:

1) Evaluate the psychometric properties of The Health Beliefs related to Cardiovascular Disease scale (HBCVD) in a population of adults with type 2 diabetes.
2) Explore the relationships among selected biological and psychosocial variables and diet and exercise behaviors in a population of adults with type 2 diabetes.
3) Evaluate the ability of a conceptual model integrating the Health Belief Model (HBM) and Stages of Change (SOC), with knowledge, social support, depression, socioeconomic status, comorbid disease, and duration of diabetes to predict or explain diet and exercise behaviors in a population of adults with type 2 diabetes.

The two research questions that guided this study were: 1) What are the relationships among biological and psychosocial variables and diet and exercise behaviors in a population of persons with type 2 diabetes?; and 2) How well does the integrated model explain diet and exercise behaviors in a population of persons with type 2 diabetes? Analysis of variance tests were employed to examine differences between groups across diet and exercise adherence scores. Multiple regression and path analysis techniques were used to test the hypothesized relationships among the model variables and to evaluate the theoretical and empirical models tested in this study. In addition, post hoc analyses were conducted to further evaluate relationships between selected study variables.

PRESENTATION AND DISCUSSION OF MAJOR FINDINGS

In this section, major findings from this study are presented. First, major findings regarding the sample are discussed, followed by discussion of the findings for each of the three aims of this study and the post hoc analyses.

Sample Characteristics

The sample in this study consisted of 212 adult participants with self-reported type 2 diabetes. The mean duration of diabetes was 12 years and the mean age of this sample was 58 years. The study participants were predominantly female, Caucasian, and in a relationship with a significant other. Socioeconomic status indicators revealed that overall the sample was well-educated, with the majority reporting part college/trade school education or beyond. The majority of the participants were retired, reported an annual income of less than $20,000, and had some form of health insurance. Because this sample is predominantly Caucasian, female, and well-educated, it does not reflect the general population of diabetic patients. According the Centers for Disease Control (2005), Caucasians have the lowest age-adjusted total prevalence rates compared to African American, Hispanic and American Indians/Alaska Natives ethnic groups, and men and women have approximately equal prevalence rates of diabetes. In addition, diabetes prevalence rates are greater among adults with less than a high school education (Annis et al., 2005). Future studies should aim to capture a more representative population of adults with type 2 diabetes.

Based on self reported data, the overall health of this sample meets some of the national guidelines as determined by the American Diabetes Association (2007) and the American Heart Association (2002), though it does not meet several of the others. It is important to note that only ~30 participants entered data for lipid levels, less than 70 reported HgA1c values, and less than 100 participants reported blood pressure levels. These low rates are likely due in part to the fact that many of the participants may not have known what their most recent lab values were whether because of lack of concern, inability to remember, or other factors. Future studies would benefit from obtaining biological data from chart reviews whenever possible. This would also address validity issues related to self report data.

Nevertheless, of the participants who answered the health status questions, positive health indicators for the majority of these participants included HgA1c levels less than 7 mg/dL, LDL levels less than 100 mg/dL, HDL levels greater than 40 mg/dL, and total cholesterol levels of 200 mg/dL or less. Because abnormal lipid levels significantly contribute to CVD risk, these findings are encouraging—the majority of the participants who provided these data had normal LDL, HDL, and total cholesterol levels, and thus likely did not have increased risk for CVD due to high levels of these labs. In addition, the majority were taking aspirin, which is consistent with the AHA (2007) recommendation for daily aspirin for persons at high risk for CVD unless otherwise indicated.

Unfortunately, negative health indicators were the predominant finding in this sample. The majority of this sample was obese and only moderately adherent to recommended diet and exercise behaviors. Of those participants who responded to the health status questions, the majority of participants reported systolic hypertension and triglyceride levels above 150 mg/dL. In addition, this sample reported multiple comorbidities including hypertension, high cholesterol, depression, CVD, and history of heart attack and stroke.

Evaluation of the sample's overall mean scores among the additional model variables revealed that the majority of these well-educated participants were knowledgeable about heart disease risk in diabetics and perceived moderate self efficacy in their ability to manage their diabetes. The majority of the participants perceived high social support related to diabetes, while slightly over one third of the participants had CESD scores suggestive of depression. Most of the participants felt moderately susceptible to heart attack or stroke, had somewhat low severity beliefs, and felt that diet and exercise would be beneficial for decreasing their risk for heart attack and stroke. In this sample, perceived barriers were actually lower than the author anticipated given the relatively low rates of adherence to diet and exercise, with the mean barriers score indicating that participants were more likely to disagree than agree that the selected barriers were in fact barriers. Given the myriad of potential barriers, it is possible that this scale did not capture other important barriers that may have influenced adherence behaviors. Finally, the majority of participants reported being in the preparation stage for both diet and exercise stage of change, which is consistent with the low adherence scores. Moreover, this finding suggests that participants engage in recommended diet and exercise behaviors some of the time, but not consistently.

Aim One: Psychometric Properties of the HBCVD

This study provided sufficient support for the validity and reliability of the HBCVD to measure health beliefs regarding susceptibility to and severity of heart attack and stroke, benefits of diet and exercise to modify CVD risk, and barriers to diet and exercise behaviors in English speaking adults with type 2 diabetes. Cronbach's alpha for the total 25 item scale was .75, with adequate alphas for each subscale. The susceptibility and benefits subscales had the strongest internal consistency, followed by the severity subscale, and no item revisions are recommended at this time for these subscales.

However, evaluation of the barriers subscale items revealed an undesirable alpha of .61. The low inter-item correlations between the barriers subscale items likely contributed to the relatively lower internal consistency among the HBCVD subscale items. The low inter-item correlations, in addition to the forced factor analysis results, which revealed the presence of four separate factors within the nine barriers subscale items, suggest that this subscale did not fully capture the barriers domain. Because barriers are unique, often vary given the individual and/or situation, and can be numerous, it is likely that a comprehensive barriers scale is not possible. However, the current barriers subscale could be improved with the inclusion of additional items assessing the four sub factors within the barriers subscale, which have been descriptively labeled as *Knowledge*, *Time and Other Problems*, *External Forces/Factors*, and *Financial*. These additional factors should be explored further and additional items should be included for each factor. Although the barriers subscale was acceptable for use in the current study, improvements in this scale may yield more powerful results in future studies.

Aim Two: Relationships among Model Variables

Group Differences in Diet and Exercise Adherence

Significant group differences did occur for diet and exercise adherence scores across several groups. Diet and exercise adherence scores increased as education level increased, which suggests that education level is an important factor in diet and exercise adherence. This finding was supported in part by the regression analyses in which education was a significant predictor of exercise adherence scores. This finding is also consistent with other studies that have found higher rates of physical activity and better weight management among non-institutionalized adults with at least some college education compared to similar adults with only a high school or less education (Soni, 2007).

Significant differences were also found for diet scores across age and employment groups. Younger participants and those who were out of work were the least adherent populations. These findings suggest that age and employment status are also important to consider and warrant further investigation regarding the influence of these factors on diet behaviors in adults with type 2 diabetes. One possible explanation for the lower diet adherence rates in the younger population may be related to duration of diabetes and/or susceptibility beliefs. The person who has had time to adjust and cope with the lifestyle changes necessary for disease management may more easily accept and adopt recommended health behaviors. Similarly, in the earlier stages of disease, patients may not feel as susceptible to complications, and thus may be less motivated to engage in preventive behaviors.

Differences in diet adherence between participants who were out of work compared to those who were employed or were unemployed because they were retired, a student, or a homemaker may be related to factors associated with their unemployment. For example, an unemployed person with physical or mental disabilities may find it more difficult to adhere to recommended diet behaviors. Future studies should elicit greater insight into employment status to investigate this relationship further.

Health Beliefs and Stages of Change

Several of the individual health beliefs were found to vary across stages. For diet and exercise stage, significant differences were found between groups across perceived barriers and self efficacy. As stage of change increased, self efficacy also increased. However, as stage of change increased, barriers decreased until the maintenance stage, at which point a slight increase in barriers was noted compared to the action stage. This finding suggests that behavior may be more difficult to maintain after the individual has been consistently engaging in the behavior for longer than six months. It is possible that motivation decreases when the reinforcement for the behavior changes decreases after an individual has been engaged in them for a period of six months. Perhaps healthy behavior can only be fully sustained for a given period of time, after which not only do reinforcements decrease but perceived barriers begin to increase and the behavior is more difficult to maintain. Indeed, self efficacy for surmounting barriers may be particularly important in the maintenance stage to prevent relapse (Prochaska et al., 1997).

These findings support the assertion by Prochaska et al. (1997) that the influence of health beliefs on stages of change and behavior are important to consider. In particular, Prochaska et al. (1997) addressed the importance of susceptibility, benefits and barriers in the early change stages, and self efficacy in the later stages of change. The positive relationship between self efficacy and stage and the inverse relationship between barriers and stage found in the current study are consistent with their assertions.

However, the relationship between susceptibility and stage of change is not consistent with the assertions by Prochaksa et al. (1997). In this study, susceptibility was found to differ significantly across exercise stage, with susceptibility decreasing as stage increased. Susceptibility did not differ significantly across diet stage, although trends in diet scores indicated a similar relationship. This inverse relationship between susceptibility and stage is inconsistent with Prochaska et al. (1997), who opined that susceptibility beliefs were likely to be lower in the precontemplation and contemplation stages because low susceptibility perceptions are likely related to low awareness of the consequences, ultimately resulting in a lack of motivation to change behavior. However, in the current study, susceptibility beliefs tended to be higher in the lower stages and lower in the higher stages for both diet and exercise. However, this was a better educated sample that may have been more aware of the consequences of these lifestyle behaviors. Nevertheless, this is also contrary to the predicted relationships in the HBM (Rosenstock, 2004), which posits that high susceptibility beliefs are important in behavior motivation and high susceptibility beliefs would be more likely to motivate a person to take action than low susceptibility beliefs. One possible explanation for this finding could be that the more active an individual is (indicated by increasing stage of change), the less susceptible they feel to heart attack or stroke because they know they are taking measures to prevent it.

Another interesting finding is that perceived severity and benefits were not found to vary across stages of change, although previous studies have found benefits to be the most powerful variable within the HBM (Harris et al., 1987). This is likely due to the fact that mean scores for the severity and benefits subscales did not vary much. The majority of participants agreed that the severity of heart attack or stroke was moderate (e.g., "my whole life would change, but having a heart attack or stroke is not always fatal"), and most participants believed that diet and exercise are beneficial for reducing CVD risk (benefits).

The regression analyses also did not support the predicted influence of perceived severity and benefits on diet and exercise stages or adherence scores. However, these findings should not be interpreted as lack of support for the importance of understanding perceptions of severity or benefits. It is likely that the general population will agree on a number of things, including the fact that heart attack and stroke are serious but not necessarily fatal, and that diet and exercise is good for you, which is what appeared to occur in this study. Because the sample participants generally held these beliefs, significant differences in beliefs between groups could not occur. However, in clinical practice, awareness of these beliefs by the clinician would identify any patient whose severity or benefits may deviate from the norm, deviations which could be influencing their adherence behaviors. Awareness of this information could be utilized to guide the patient’s individualized plan of care.

Support for Study Hypotheses

Regression analysis identified support for many of the study hypotheses. A summary of the results for the hypotheses that were supported is provided below.

Knowledge. Knowledge related to heart disease risk has a positive relationship with benefits of diet and exercise and a negative relationship with barriers to diet and exercise. These findings indicate that as knowledge increases, perceived benefits also increase and perceived barriers decrease. This finding supports the importance of emphasizing the benefits of diet and exercise and ways to overcome barriers in educational interventions targeting CVD knowledge in adult patients with type 2 diabetes.

In this study, knowledge related to CVD risk did not predict perceived susceptibility to or severity of heart attack or stroke. It is possible that this finding occurred because the questions in the knowledge questionnaire referred to heart disease and not specifically to heart attack or stroke, which was the wording used in the susceptibility and severity items. Future studies using instruments that are more consistent in their terminology may yield different findings.

The Health Belief Model and Stages of Change. Self efficacy has a positive relationship with diet stage and exercise stage, such that as self efficacy increases, stage increases. Self efficacy was found to be the strongest predictor of stage among all HBM variables. This finding supports previous research studies that have also found self efficacy to be the most important component of the HBM (Rosenstock, 2004), and underscores the importance of self efficacy beliefs related to stage of change for diet and exercise behaviors.

Perceived susceptibility to heart attack or stroke and perceived barriers to diet and exercise were also significant predictors of diet and exercise stage of change. Susceptibility had a negative relationship with both diet stage and exercise stage. Barriers also had a negative relationship with diet stage and exercise stage. As stage increased, susceptibility to heart attack or stroke decreased and barriers to diet and exercise decreased until the maintenance stage, at which point barriers showed an increase compared to the action stage.

As previously noted, the inverse relationship between susceptibility and stage was an interesting finding in this study. This finding was not as predicted: the author expected this relationship to be positive, indicating that increased susceptibility is associated with higher positive behavior scores, as this is the direction predicted by the HBM (Rosenstock, 2004). According to the HBM, as susceptibility increases, stage (as an alternate measure of adherence) should also increase as a function of the participant being motivated to take action based on their perceived increased risk of heart attack or stroke. The inverse relationship between susceptibility and stage warrants further evaluation. An alternative explanation could be that stage predicts susceptibility, and as stage increases, susceptibility decreases because the person is actively taking measures to prevent heart attack or stroke. This relationship should be evaluated in future longitudinal studies that could provide insight into the causal relationships among susceptibility beliefs and stage of change.

Although the relationship between barriers and stage was primarily as predicted, it would also be prudent to conduct longitudinal studies to explore this relationship and determine whether it is a function of barriers decreasing as stage increases, or that as stage increases, the ability to surmount barriers is realized and thus perceived barriers decrease. It is also important to further evaluate the finding that barriers were actually higher in the maintenance stage than in the action stage. Longitudinal studies should also provide insight into this finding and evaluate the assertion that diet and exercise behaviors may become more difficult to maintain the longer they are practiced.

Along the same lines it would also be interesting to evaluate the interactions between self efficacy and barriers on diet and exercise adherence and diet and exercise stage. Could barriers decrease as self efficacy for surmounting barriers increases? Does self efficacy for diet and exercise become more important in the maintenance stage? Or, perhaps self efficacy for surmounting barriers is critical in this stage. Could this interaction predict adherence behavior and/or stage? The inverse correlation found between self efficacy and perceived barriers suggests that this could be a possibility; however, longitudinal studies are also necessary to further evaluate the causal relationships.

Stage of Change and diet and exercise adherence. Stage of change was found to be a significant predictor of diet and exercise behavior. Diet stage was strongly related to diet adherence scores and exercise stage was strongly related to exercise adherence scores. These high correlations suggest that stage could be used as an alternate measure of adherence. Relationships between model variables and adherence behaviors as well as diet and exercise stage were evaluated and similar findings indicate that, when evaluated as outcome variables, the diet stage and exercise stage scores were consistent with the diet and exercise adherence scores. This subjective interpretation should be confirmed empirically in future research studies.

This finding has important practical implications, since it conceptually appears that the one item stage question does not differ in its ability to discriminate between the two item diet adherence subscale or the three item exercise adherence subscale score. While a more thorough and detailed measure of adherence would yield richer information regarding the complex phenomenon of adherence, the one item stage questionnaires used in this study also provide important information regarding adherence. The stage items specifically define desired diet and exercise behavior, and the response options elicit information regarding whether or not the person is even considering adopting healthy diet and exercise behaviors (precontemplation), is thinking about it but has not begun to take action (contemplation), has decided to make some changes and is preparing to adopt these behaviors (preparation), has begun practicing the health behavior but has been doing so for less than six months (action), or whether they have been able to maintain the healthy behavior for six months or longer (maintenance). This is clinically useful information that could guide clinicians' decisions regarding how to best address the importance of healthy diet and exercise behaviors among their patients. In addition, the one item per stage assessment is a fast and simple assessment method that can be easily implemented in busy practices settings, and could yield important information that can be used to guide the plan of care.

Depression and diet and exercise adherence. Depression screening scores, as measured by the CESD, were found to have a negative relationship with diet adherence scores and exercise adherence scores, such that as CESD scores increased, diet and exercise adherence scores decreased. These findings support the importance of screening diabetic individuals for depression and initiating treatment as indicated. It is important to note, however, that when depression was included with other variables in the empirical models, it was no longer significant. This was an interesting finding, especially since social support remained significant in both empirical models. Moreover, this finding suggests that depression may have less of an influence on diet and exercise behaviors with high perceived social support. Nevertheless, this assertion needs to be evaluated in future studies.

Social support and diet and exercise adherence. Social support, regardless of the sources measured in this study, was predictive of diet adherence and exercise adherence: as social support increased, adherence scores also increased. This path remained significant in the regression analyses of the diet and exercise empirical models. In this study, social support was the second strongest predictor in the empirical model for exercise adherence (second to exercise stage), and one of the four significant predictors in the diet adherence model, although it had the lowest correlation compared to stage of change, susceptibility, and self efficacy. This finding indicates that further evaluation of the role of social support in diet and exercise behaviors of adults with type 2 diabetes should be an important area for future research. Also, as mentioned in the preceding section, the finding that social support remained significant in the empirical models, while depression did not warrants further investigation.

Socioeconomic Status and Diet and Exercise Adherence. Of the SES variables (income, education level, employment status, and insurance status), only education level was a significant predictor of exercise adherence, and no SES variables were predictive of diet adherence. However, the regression model including the influence of all SES variables on diet adherence was significant, with employment status as the only significant path among the SES variables. This finding supports that at least education and employment status are important SES factors that could influence health behaviors.

Aim Three: Evaluation of the Integrated Model through Path Analyses

The integrated conceptual model proposed in this study was not supported through path analysis. Path analysis with multiple modifications was performed to find the best fitting, most parsimonious model. No such model was identified to explain or predict diet adherence scores. However, the large number of variables and relatively low number of participants included in the path analysis could have resulted in over-specification of the model; thus, truly significant paths may not have been detected (Kline, 2005). Future evaluation of this model with a larger sample is necessary to adequately evaluate the predicted relationships. Results from the current study do provide direction for further simplification of the model. The author recommends including only those paths that were found to be significant predictors of the outcome variables—e.g., diet and exercise adherence—and evaluating the direct and indirect paths between these variables and diet and exercise behaviors in a significantly larger sample of adults with type 2 diabetes.

Although the complete model was not supported, most likely due in part to the insufficient sample size, multiple regression results identified a number of individual paths within the model that were significant. The individual predictors identified through regression analysis have been summarized in the preceding section. The empirical models for diet and exercise adherence constructed from the significant paths found in the regression analyses identified that both models were significant predictors of their respective adherence behaviors. Evaluation of significant paths in the individual empirical models identified that of all the variables in the model, stage of change was the strongest predictor of diet and exercise behavior. This is understandable because measurement of stage of change provides a reasonable alternate measure of adherence, and is thus expected to be highly correlated with adherence scores. After diet stage of change, the second strongest predictor of diet adherence was susceptibility, followed closely by self efficacy, then by social support. After exercise stage of change, social support was the second strongest predictor of exercise adherence followed by self efficacy.

The Health Belief Model, Stages of Change, and Adherence Behaviors

Evaluation of the regression models entered for the HBM predicting stage of change and adherence scores provided support for the influence of health beliefs on stage of change as well as diet and exercise adherence behaviors as measured in this study. The multiple regression models revealed that the HBM accounted for 17% of the variance in stage of change for diet scores and 16% of the variance in stage of change for exercise scores. Similarly, the HBM accounted for 24% of the variance in diet adherence scores and 21% of the variance in exercise adherence scores. In each model, self efficacy was the strongest predictor, and the addition of the other HBM variables did not explain much more of the variance.

Regression models that included stage of change and the HBM variables together in one model provided more explanatory power than either model alone, as was proposed initially by the author. The HBM variables alone explained 24% of the variance in diet behaviors and 21% of the variance in exercise behaviors, while stage of change for diet explained 21% of the variance in diet adherence and stage of change for exercise accounted for 37% of the variance in exercise adherence. When the two models were combined into one regression model, the explanatory power increased to 32% for diet and 44% for exercise adherence scores.

The significant relationships found between the HBM variables, stages, and adherence behaviors do support the importance of both health beliefs and stage of change in explaining behavior motivation. Two of the HBM variables were not found to contribute significantly to stage or adherence behaviors: perceived severity to heart attack or stroke and perceived benefits of diet and exercise. However, information regarding perceptions of severity and benefits are clinically useful in the development of individualized plans of care for patients.

Post-Hoc Analyses

Knowledge

Knowledge is considered a necessary but insufficient component by itself of behavior change strategies (Arseneau et al., 1994). The identification of knowledge deficits among the participants in this study and evaluation of differences in knowledge scores between groups is an important contribution of this study, as this information can be used to inform educational components of behavior change intervention strategies.

Several of the Heart Disease Fact Questionnaire items were answered correctly by less than 90% of the participants and should be emphasized in future education interventions. Of particular importance are items related to the relationship between cholesterol and heart disease, gender differences in CVD risk, diabetes as a risk factor for CVD, age as a risk factor for CVD, and exercises to lower risk of CVD. In addition, differences across race and education groups were found for the knowledge scores. Participants with less than a high school education had the lowest knowledge scores compared to other education groups. Also, Hispanic participants had the lowest knowledge scores compared to other ethnic groups. This is an important clinical finding since Hispanics are almost twice as likely to have diabetes as their non-Hispanic white counterparts of similar age (National Diabetes Information Clearinghouse, 2005). Particular attention needs to be paid to ensuring that Hispanic patients are receiving adequate and culturally appropriate information about their risk for diabetic CVD.

These findings provide information about content that should be emphasized in educational interventions that aim to improve awareness of CVD risk in diabetic patients. In addition, the differences found between race and education groups indicate that these factors should be considered when designing and implementing behavior change strategies. For example, the lower knowledge scores among the Hispanic group could indicate that the questionnaire is not culturally appropriate and thus may not accurately represent the Hispanic participants' knowledge. Lower scores among the lowest education group could also indicate that this scale is inappropriate for participants with lower levels of education.

Finally, this study identified common sources of exposure to information related to diabetes and CVD in this study population. The most common sources of diabetes related information included receiving brochures from a health care provider, either in the mail or in public areas, followed by the internet, and friends & relatives. The most common source of CVD related information was from members of the participants' health care team, followed by cardiovascular disease-related support group meetings, and the internet. These primary sources of information identified can be used to inform future decisions regarding dissemination of information to the public.

Depression and Diet and Exercise Adherence

In this study population, 38% of the participants reported significant depressive symptoms as evidenced by CESD scores of 16 or higher. These findings are consistent with previous studies that have found that approximately 30% of patients with diabetes have depressive symptoms (Anderson et al., 2001). The relationship between depression and adherence in diabetic patients identified by DiMatteo et al. (2000) was supported in this study. Because depression is considered a risk factor for diabetes complications including CVD (Lustman & Clouse, 2004), aggressive evaluation and management of depression in diabetic patients is important to improve health outcomes (DiMatteo, 2004; McKellar et al., 2004; Williams et al., 2006).

Analysis of individual responses to the depression related items on the questionnaires among the participants that scored 16 or higher on the CESD (n = 79) suggest the possibility of under-identification, under-treatment and sub-optimal management of depression in diabetes. However, additional research to explore these claims is essential, as the descriptive statistics related to the treatment of depression among this study's participants are simplistic and have not controlled for any potential confounds impacting these numbers. Nevertheless, these findings do warrant further investigation.

The between group differences found across CESD scores indicate that participants who were younger and/or unemployed were more likely to be depressed than older participants and those who were working or not working because they were a retiree, student, or homemaker. In addition, participants in this sample who had CESD scores suggestive of depression reported significantly lower mean scores for diet and exercise adherence as well as higher perceptions of severity of heart attack and stroke. Lower perceived social support and self efficacy for diabetes self management were also associated with higher depression scores.

These findings warrant further investigation. One important question would include which came first: the depression or the diabetes? It could be that lack of motivation, fatigue, apathy, or other symptoms associated with depression may have contributed to lifestyle choices that led to the development of diabetes, particularly diet and physical activity choices that may have resulted in obesity. Similarly, an individual who is out of work may have physical or mental limitations that lead to depression and/or lifestyle choices associated with the development of diabetes.

STUDY LIMITATIONS

There are a few limitations of this study design and methodology, some of which were intentional and some of which were not. This section will discuss some of the potential limitations below.

Perhaps the most significant limitation of this study was not measuring individuals' history of previous behaviors related to diet and exercise. For example, factors such as previous experiences with engaging in regular physical activity, level of physical activity when younger, or a history of participation in organized sports could certainly influence present choices regarding adherence to recommended exercise. Similarly, previous experiences with eating a healthy diet or special dietary restrictions such as those associated with a certain culture or religion may also influence adherence to recommended dietary practices in either a negative or positive way. Including this information in future studies would provide greater insight into the results. It is not likely that a person suddenly decides that they will not be adherent, but rather non-adherence is something that often has been present for long periods of time.

Another possible limitation includes the design of this study. Although a descriptive correlational design was appropriate for the specific aims of this study, inherent to this design is the inability to make causal inferences based on the results (Tabachnick & Fidell, 2001). As a result, a number of questions have been left only partially answered. Based on the results of the current study, further evaluation with the use of longitudinal studies is warranted.

The use of convenience sampling techniques is also a limitation of this study, since results cannot be generalized to other adults with type 2 diabetes outside of the study population (Pedhauzer & Schmelkin, 1991). Nonrandom sampling methods, which were chosen for their feasibility and low financial burden, were appropriate for the current study. Since one aim of this study was to simply describe the relationships among the model variables in the study population as a first step in evaluating the conceptual model, a convenience sampling method was sufficient to address this aim. Future studies that are able to employ random sampling methods and recruit from a larger, more diverse population would be necessary to better inform public health interventions on a local, state, and national level.

The use of self report data was another limitation of this study. While the use of self report information to measure the study variables was appropriate for this study's design, protocol, and aims, this decision was made with the full awareness of the limitations of self report data. In general, self report data are not as reliable as more involved and/or directly observed measures, such as lab values obtained from chart review, point of care testing, or keeping a daily log of caloric intake and energy expenditure. However, these more reliable and often more labor intensive measures are frequently not practical for use in busy clinical settings.

The different compensation offerings that the author thought would present a problem in this study were not found to have a significant impact on the diet and exercise adherence scores. It is possible that there were other effects that occurred as a result of different compensation phases but were not identified in the data analysis. While it is always prudent to provide consistent compensation to all participants in a study, sometimes circumstances occur that are out of the researcher's control. The fact that there were no differences in diet and exercise scores in this study was a welcome discovery.

Another potential limitation in this study is the similarity between the outcome variable and one of the conceptual model variables, stage of change. In this study, The Diabetes Activity Questionnaire (TDAQ) (Hernandez, 1997) did not appear to provide any more clinically relevant information than the stage of change items did. This scale was originally selected because of its ease in administration, adequate reliability and validity indicators, and because it provided a general measure of overall diabetes self care. Conceptually, the items from the TDAQ that composed the diet and exercise subscales identified by the author of the current study were not sufficient to provide much more meaningful data than the stage items, although the scale as a whole appears to be a good tool to measure general diabetes self management adherence. While the information obtained regarding adherence was appropriate and useful in this initial study, a different instrument designed to elicit more information about diet and exercise adherence would more adequately measure the complex phenomenon of adherence and would be necessary if clinical decisions would be made based on the responses.

The author's decision to change the TDAQ response options to be consistent with the other scales used in the current study, in hindsight, was not wise. Reducing the response options from a 100 millimeter long visual analog scale ranging from never to always to the four response options of always, sometimes, rarely, and never in the current study sacrificed important variance in responses that would have likely resulted in greater variation in adherence scores, and thus greater interpretability of the findings. Future studies using the TDAQ should use the VAS response option from the original scale.

In addition, the TDAQ scale had only two items pertaining to a general diet that were not specifically related to management of fluctuation in blood glucose levels, and only three items pertaining to exercise. These few items likely did not provide as much meaningful data regarding adherence to diet and exercise behaviors as would have been gleaned from a different scale with more items addressing a greater variety of diet and exercise behaviors. The TDAQ does appear to be a good scale to obtain general information about overall diabetes self management, for which it was originally intended.

Implications for Nursing

The findings in this study identified a number of important relationships between the psychosocial and biological variables measured in this study. These findings provide support for the importance of approaching diet and exercise behaviors from a biopsychosocial perspective as suggested by Peyrot et al. (1999). In this study, significant relationships were found between diet and exercise adherence and health beliefs, stage of change, social support, depression, knowledge, age, education, and employment status. These findings have important clinical implications. A discussion of some of these implications is provided below.

The Health Belief Model

The HBCVD scale demonstrated sufficient evidence for validity and reliability. In its current version, the HBCVD is appropriate to use in adults with diabetes as a measure of assessing health beliefs related to heart attack and stroke severity and susceptibility and benefits and barriers to diet and exercise, although improvements in the barriers subscale would likely provide a more thorough and internally consistent measure of barriers. The HBCVD is a practical self report scale that is fast and easy to administer by clinicians and is feasible for use in busy practice settings. The author recommends the use of the HBCVD and the Self-Efficacy subscale developed by Talbot et al. (1997) as used in the current study to measure health beliefs of diabetic patients as part of any plan of care that aims to decrease risk of CVD morbidity and mortality among diabetics. These scales can be used by clinicians to identify diabetic patients who have erroneous or counterproductive health beliefs that may interfere with their diabetes self management. Asking patients to complete the HBCVD while waiting for their office visit provides a quick tool for clinicians to use in which they can quickly identify particular beliefs that may have a negative impact on diabetes self-management behaviors. Clinicians can then focus on these areas during the brief office visit and include them in the teaching plan and overall plan of care. Of all the things that could be addressed during this short visit, the HBCVD and self efficacy scales provide an effective way to identify priority educational and behavioral change needs of the patient, which can serve to maximize the patient-clinician encounter.

The Health Belief Model and Stages of Change

Health beliefs were found to be good predictors of stage of change for diet, and exercise and several health beliefs were found to vary significantly across stages of change. In addition, both the HBM and stage of change models explained a significant portion of the variance in diet and exercise adherence scores when each was evaluated as a separate model. When the two models were combined, the variance in diet and exercise adherence scores explained by the combined model increased by as much as 15% for diet behaviors and 28% for exercise behaviors. While more sophisticated statistical analyses are necessary to adequately explore the strength of the combined model, the findings presented in this study do lend support to the importance of evaluating health beliefs in the context of stage of change as one effective strategy for understanding motivation for diet and exercise behaviors.

Identifying the diet and/or exercise stage a patient is in and having an awareness of the individual's health beliefs regarding CVD risk and diet and exercise provides meaningful information to the clinician and provides guidance for the development of the patient's plan of care. This plan of care could be individualized to the patient's needs, and thus would likely be more appropriate with greater potential for success for the patient than a standardized plan that may or may not address the actual needs of the patient.

Socioeconomic Status

In this study, participants who were younger, out of work, and had less than a high school education had significantly lower diet adherence scores compared to participants in the other grouping categories. Similarly, significant differences were found between employment and education groups with participants who were out of work and/or depressed having the lowest exercise adherence scores. These groups should be targeted in future interventions and specific needs of these groups should be identified to inform intervention development.

Knowledge

In this study, scores on the Heart Disease Fact Questionnaire (Wagner et al., 2005) revealed several areas of deficient knowledge related to heart disease risk in diabetic patients. In particular, age, gender and lipid related factors should be emphasized in future educational interventions. Race and education level differences in knowledge scores were also identified. While educational interventions to improve knowledge of CVD risk in diabetics are important for all groups, emphasis should be placed on ensuring that strategies are appropriate for the reading and education level as well as the ethnic group of the individual.

Depression

The findings in this study revealed that 38% of the sample was depressed, and descriptive statistics suggest the possibility that some of these participants may not have been identified as at risk for depression or their depression may not have been properly managed. The finding that participants who were identified as depressed had significantly lower diet and exercise adherence scores supports the need for aggressive evaluation and management of depression in diabetics. Diet and exercise are an essential part of the strategy to reduce CVD morbidity and mortality among diabetics in general. Improvements in depressive symptoms may lead to increased adherence to recommended diet and exercise behaviors. Because of the clinical implications, the author recommends using a diagnostic tool for depression, such as the Beck Depression Inventory (Beck et al., 1996), to provide a more sensitive and specific measure of depression than the CESD, which is more appropriate as a screening tool for depression.

RECOMMENDATIONS FOR FUTURE RESEARCH

Although a number of significant findings resulted from this study, a number of questions remain only partially answered. Throughout this chapter, suggestions for future research have been provided in the context of the findings that were being discussed. Some of the most important recommendations for future research are discussed below.

The first recommendation is the continued refinement of the HBCVD. Refinement of the barriers subscale is needed and psychometric evaluation of the overall instrument needs to continue with larger samples and more diverse populations. Translation of the HBCVD into languages other than English is also recommended. Translation of the HBCVD into Spanish has already been completed by the author and her colleagues and is currently being tested in a Hispanic population.

Future studies should also further explore the relationships between health beliefs and stages of change. The development of interventions that are tailored to individual health beliefs and stage of change are warranted. Longitudinal studies should evaluate the effects of interventions on heath beliefs and stage of change and explore how these variables interact with each other in the context of behaviors and behavior change. The author recommends the consideration of forward movement through stages as an important outcome variable and not just the attainment of the action or maintenance stage of change as a measure of success.

Further exploration of the relationships between social support, stage of change, self efficacy and susceptibility and their impact on diet and exercise behaviors is also warranted. In addition, further analysis of the relationships among the predictor variables tested in this model should be conducted using a larger, more diverse population of adults with diabetes. The author recommends including only those paths that were found to be significant predictors of diet and exercise adherence, and evaluating the direct and indirect paths between these variables and diet and exercise behaviors.

The influence of social support and depression on diet and exercise adherence as well as the interactions between these two variables should be explored further. Findings from this study revealed that depression was a significant predictor of diet and exercise adherence when evaluated as a direct path. However, when included in the empirical models with other variables influencing the outcomes and in the model with only depression and social support, depression was no longer a significant predictor of either diet or exercise adherence. This finding suggests that the presence of social support may be more important for diet and exercise adherence than whether or not depressive symptoms are present.

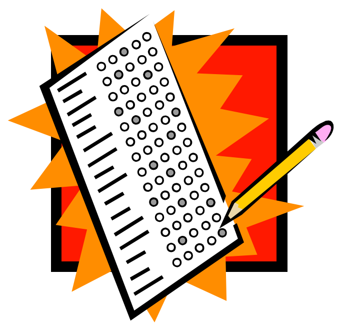
Finally, although the combined Health Belief Model and Stages of Change explained a significant and substantial portion of the variance in both diet and exercise behaviors, there may be other behavior change models that would provide stronger explanatory power for diet and exercise adherence. As a result, comparison of the combined model to other appropriate theoretical frameworks is recommended. This would help to identify the most effective frameworks to use in the development of interventions that aim to reduce the risk of cardiovascular disease morbidity and mortality through improving adherence to recommended diet and exercise behaviors among diabetic patients.

CHAPTER CONCLUSION

This chapter discussed the major findings of this dissertation study. Limitations of this study, nursing implications, and recommendations for future research were discussed. The specific aims of this study were achieved and post hoc analyses identified additional clinically relevant information. The findings from this study can and should be applied in the care of adults with type 2 diabetes in outpatient clinical settings. Implementation of the findings presented in this study may lead to improvements in diet and exercise adherence and ultimately reductions in CVD morbidity and mortality in adults with type 2 diabetes.

Appendix A: Recruitment Flyer
(Compensation: Lottery)

VOLUNTEERS NEEDED



RECEIVE A **FREE TAPE MEASURE** AND HAVE YOUR NAME ENTERED INTO A DRAWING FOR **A $100.00 GIFT CERTIFICATE TO A STORE OF YOUR CHOICE**

WHEN YOU COMPLETE

A SURVEY

ABOUT HEALTH BELIEFS AND BEHAVIOR

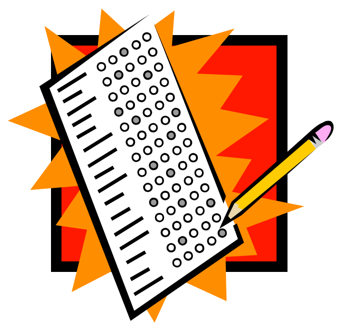
PLEASE ASK

THE RECEPTIONIST OR YOUR NURSE FOR

FOR MORE INFORMATION

Appendix A: Recruitment Flyer
(Compensation: Healthy Snack and Tape Measure Only)

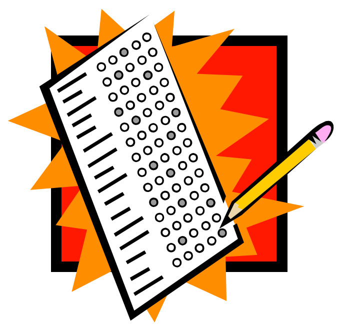
VOLUNTEERS NEEDED



RECEIVE A
FREE TAPE MEASURE
WHEN YOU COMPLETE
A SURVEY
FOR PATIENTS WITH DIABETES
PLEASE ASK
THE RECEPTIONIST OR YOUR NURSE
FOR
FOR MORE INFORMATION

Appendix A: Recruitment Flyer
(Compensation: Gift Card)

VOLUNTEERS NEEDED



RECEIVE A
WAL-MART GIFT CARD
WHEN YOU COMPLETE
A SURVEY
FOR PATIENTS WITH DIABETES

PLEASE ASK
THE RECEPTIONIST OR YOUR NURSE FOR
FOR MORE INFORMATION

Appendix A: Electronic Recruitment Announcement Sent to Institutional List Serve

RESEARCH VOLUNTEERS NEEDED FOR STUDY – TYPE 2 DIABETES

You are eligible to participate in this study if you have been diagnosed with Type 2 Diabetes.

Volunteers will be asked to complete a series of questionnaires asking about your health history, health beliefs, and health behaviors. Completing the questionnaires will take approximately 30 minutes.

For more information or to schedule an appointment for the study please contact
Elizabeth Gressle at 409-772-1241 esgressl@utmb.edu
Or
Karimot Dikko at 832-875- 6156 kkdikko@utmb.edu

Appendix B: Recruitment Letter for Clinical and Community Settings (Compensation: Lottery)

August 9, 2006

Dear Prospective Volunteer:

I believe that understanding patient attitudes, beliefs and other psychosocial factors and the relationships between these factors and health behaviors is important to patient care. Therefore, I am conducting a study to explore the relationships between psychosocial factors such as knowledge, health beliefs, and readiness for exercise, your current health behavior practices, and your current health status. I hope that this information will lead to a greater understanding of factors associated with health behaviors.

If you would like to participate, please answer all questions in the attached questionnaire packet. Filling out the questionnaires should take approximately 30 minutes and the information you provide could help us give better care to other patients like your self. Your decision not to participate will in no way affect your care at UTMB or anywhere else.

All information you provide will be kept strictly confidential and will be used only for statistical and descriptive purposes. You may be contacted approximately one week after receipt of the first questionnaire to be given an opportunity to complete a second shorter questionnaire which should take approximately 15 minutes to complete.

Upon completion of the questionnaires, you will receive a small tape measure or a healthy snack. In addition, your name, address and/or phone number will be entered into a drawing for a $100.00 gift certificate to Wal-Mart*. If you complete the second questionnaire, your name will be entered into the drawing twice. The Drawing will take place November 1, 2006. Winners will be notified by phone or mail.

If you have any questions or concerns, please contact me at 409-772-1241 or my Research Assistant Karimot Dikko at 832-875-6156.

Thank you for your time and consideration to this invitation to participate.

Sincerely,

Elizabeth Gressle, RN, MSN, FNP-C

Nursing Doctoral Student
The University of Texas Medical Branch
School of Nursing Route 1029
(409) 772-1241 (office)
esgressl@utmb.edu

If you are unable to complete the questionnaires during your clinic visit, please mail the completed forms to:

Elizabeth Gressle
301 University Boulevard - Route 1029
Galveston, Texas 77555-1029

*Your name will be entered into the drawing once all completed questionnaires have been received (The desk receptionist can provide you with a stamp and envelope if you should need them to mail the questionnaires)

Appendix B: Recruitment Letter for Clinical and Community Settings
(Compensation: Healthy Snack and Tape Measure Only)

September 8, 2006

Dear Prospective Volunteer:

I believe that understanding patient attitudes, beliefs and other psychosocial factors and the relationships between these factors and health behaviors is important to patient care. Therefore, I am conducting a study to explore the relationships between psychosocial factors such as knowledge, health beliefs, and readiness for exercise, your current health behavior practices, and your current health status. I hope that this information will lead to a greater understanding of factors associated with health behaviors.

If you would like to participate in this study, please answer all questions asked in the attached questionnaire packet. Filling out the questionnaires should take approximately 30 minutes. You may be contacted approximately one week after receipt of the first questionnaire to be given an opportunity to complete a second shorter questionnaire which should take approximately 15 minutes to complete.

All information you provide will be kept strictly confidential and will be used only for statistical and descriptive purposes. This information will help us give better care to other patients like your self. Your decision not to participate will in no way affect your care at UTMB or anywhere else.

If you have any questions or concerns, please contact me at 409-772-1241 or my Research Assistant
Karimot Dikko at 832-875-6156.
Thank you for your time and consideration to this invitation to participate.

Sincerely,

Elizabeth Gressle, RN, MSN, FNP-C
Nursing Doctoral Student
The University of Texas Medical Branch
School of Nursing Route 1029
(409) 772-1241 (office)
esgressl@utmb.edu

If you are unable to complete the questionnaires during your meeting or visit, please mail the completed forms to:

Elizabeth Gressle
301 University Boulevard
Route 1029
Galveston, Texas 77555-1029

*Your name will be entered into the drawing once all completed questionnaires have been received

- Please ask for a stamp and envelope if you should need them to return the questionnaires

Appendix B: Recruitment Letter for Clinical and Community Settings
(Compensation: Gift Card)

January 3, 2007

Dear Prospective Volunteer:

I believe that understanding patient attitudes, beliefs and other psychosocial factors and the relationships between these factors and health behaviors is important to patient care. Therefore, I am conducting a study to explore the relationships between psychosocial factors such as knowledge, health beliefs, and readiness for exercise, your current health behavior practices, and your current health status. I hope that this information will lead to a greater understanding of factors associated with health behaviors.

If you would like to participate in this study, please answer all questions asked in the attached questionnaire packet. Filling out the questionnaires should take approximately 30 minutes. You may be contacted approximately one week after receipt of the first questionnaire to be given an opportunity to complete a second shorter questionnaire which should take approximately 15 minutes to complete.

To compensate for your time/inconvenience towards your participation, you will receive a gift card or coupon worth $5.00 once you have submitted the completed questionnaires.

All information you provide will be kept strictly confidential and will be used only for statistical and descriptive purposes. This information will help us give better care to other patients like your self. Your decision not to participate will in no way affect your care at UTMB or anywhere else.

If you have any questions or concerns, please contact me at 409-772-1241 or my Research Assistant
Karimot Dikko at 832-875-6156.
Thank you for your time and consideration to this invitation to participate.

Sincerely,

Elizabeth Gressle Tovar, RN, MSN, FNP-C
Nursing Doctoral Student
The University of Texas Medical Branch
School of Nursing Route 1029
(409) 772-1241 (office)

esgressl@utmb.edu

If you are unable to complete the questionnaires during your meeting or visit, please mail the completed forms to:

Elizabeth Gressle
301 University Boulevard
Route 1029
Galveston, Texas 77555-1029

* Please ask for a stamp and envelope if you should need them to return the questionnaires

Appendix C: Contact Information
(Compensation: Lottery)

Please provide your contact information and return this with your completed questionnaires.

This information will be kept strictly confidential and will be used only for the drawing. Only members of the research team will handle this information and all identifying information will remain separate from your questionnaires.

Contact Information for $100.00 Gift Certificate to Wal-Mart®

Name: ________________________________
Preferred Method of Contact (pick one or both)
Mailing Address: ___________________________________(street and apt. #)
____(city) __________(state)
_______________(zip code)
Telephone number: (____)_______________________

Appendix C: Contact Information
(Compensation: Healthy Snack and Tape Measure)

Please provide your contact information and return this with your completed questionnaires if you agree to complete the second questionnaire described in the attached letter.

This information will be kept strictly confidential and will be used only for study purposes. Only members of the research team will handle this information and all identifying information will be kept separate from your questionnaires.

If you provide your mailing address, the second questionnaires will be mailed to you within 2 weeks of receipt of this packet.

Thank you!

Name: ________________________________
Preferred Method of Contact (pick one or both)
Mailing Address: ____ (street and apt. #)
____(city) __________(state)
_______________(zip code)
Telephone number: (____)_______________________

Appendix C: Contact Information

(Compensation: Gift Card)

Please provide your contact information and return this with your completed questionnaires.

The $5.00 gift certificate will be mailed to the address you provide below.

In addition, we will send the second questionnaire described in the attached letter.

This information will be kept strictly confidential and will be used only for study purposes. Only members of the research team will handle this information and all identifying information will be kept separate from your questionnaires.

Thank you!

Name: ______________________________ (optional)

Mailing Address: _________________________________(street and apt. #)

_____________________________________(city) __________(state)

_______________(zip code)

Telephone number: (____)______________________

Appendix D: Demographic and Biographic Questionnaire
Questionnaire Packet: Part 2

Participant ID: ________________ Today's date: ___________________

Participant Information Questionnaire

Please answer the following questions that you know about yourself by placing a check mark (√) in the box below that best represents you answer.

What is your Age?

________ years

What is your Gender? (please place a check mark (√) in the box below)

Male	☐
Female	☐

What is your Marital Status? (please place a check mark (√) in the box below)

Single never married	☐
Divorced	☐
Separated	☐
Married or with Life Partner	☐
Widowed	☐
Member of an Unmarried Couple	☐

What are your Current living arrangements? (please place a check mark (√) in the box below)

Living alone at home	☐
Living with family/friends	☐
Assisted Living Facility	☐
Nursing Home	☐

What is your Race/Ethnicity? (please place a check mark (√) in the box below)

African American/Black	☐
Asian or Pacific Islander	☐
Caucasian/White	☐
Hispanic	☐
Native American	☐
Other	☐ Please list ______________

What is your Education Level? (please place a check mark (√) in the box below)

Less than high school	☐
High school graduate	☐
Part college/trade school	☐
College graduate	☐
Post-graduate education	☐

What is your Gross Annual Income in dollars? (please place a check mark (√) in the box below)

< $20000	☐
$21000–40000	☐
$41000–60000	☐
$61000–80000	☐
> $80000	☐

What is your Employment Status? (please place a check mark (√) in the box below)

Employed for wages full-time	☐
Employed for wages part-time or less	☐
Out of work for more than 1 year	☐
Out of work for less than 1 year	☐
A Homemaker	☐
A Student	☐
Retired	☐
Unable to work	☐

Do you have health insurance? (please place a check mark (√) in the box below)

Yes	☐
No	☐
I'm not sure	☐

If yes, please place a check mark (√) in the box below that best represents your insurance type:

Medicare	☐
Medicaid	☐
Private Insurance	☐

Health Information:

	YES	NO
Have you been admitted to a hospital for any reason within the last 6 months?	☐	☐

For how many years have you been diagnosed with diabetes? ___________years
For how many years have you been diagnosed with high blood pressure? _________years

If you know any of your following lab values or measurements below, please list:

Lab or Measurement	**Value**	**Date of Lab or Measure**
Example: Blood Sugar (Glucose)	*110*	*4/6/06*
Height	_______inches	
Weight	_______pounds	
Blood Sugar		
HgA1C (average of your sugars)		
LDL (Bad Cholesterol)		
HDL (Good Cholesterol)		
Blood Pressure	/	
Triglycerides		
Total Cholesterol		

Have you ever smoked cigarettes?

Yes	☐
No	☐

If yes, do you currently smoke cigarettes?

Select "Yes" if you have smoked any cigarettes in the past month or "No" if you stopped smoking over one month ago and are confident you will remain a non-smoker. (Please place a check mark (√) in the box below)

Yes	☐
No	☐

In the **last 6 months** have you received or used any of the following resources for information regarding your diabetes? (Please place a check mark (√) in the box below)

	YES	NO
1. Have you received education about diabetes from any member of your health care team (for example your doctor, nurse, or dietitian)?	☐	☐
2. Have you regularly attended diabetes support group meetings?	☐	☐
3. Have you used the internet or other resources to learn more about diabetes on your own?	☐	☐
4. Have you received information brochures about diabetes from your health care provider, in the mail, or public areas?	☐	☐
	YES	**NO**
5. Have you received information about diabetes from a friend or relative?	☐	☐
6. Have you seen or heard information about diabetes from television, magazines, newspapers, radio, or other media?	☐	☐

In the **last 6 months** have you received or used any of the following resources for information regarding cardiovascular disease? (Please place a check mark (√) in the box below)

	YES	NO
1. Have you received education about cardiovascular disease from any member of your health care team (for example your doctor, nurse, or dietitian)?	☐	☐
2. Have you regularly attended cardiovascular disease related support group meetings?	☐	☐
3. Have you used the internet or other resources to learn more about cardiovascular disease on your own?	☐	☐
4. Have you received information brochures about cardiovascular disease from your health care provider, in the mail, or public areas?	☐	☐
5. Have you received information about cardiovascular disease from a friend or relative?	☐	☐
6. Have you seen or heard information about cardiovascular disease from television, magazines, newspapers, radio, or other types of media?	☐	☐

Have you ever been told by a health care professional that you **have or have had any of the following problems or conditions**? Please place a check mark (√) in the box below

	YES	NO	I'M NOT SURE
Cardiovascular disease	☐	☐	☐
Diabetes	☐	☐	☐
High blood pressure	☐	☐	☐
Stroke	☐	☐	☐
Heart valve problem	☐	☐	☐
Heart attack	☐	☐	☐
Heart rhythm problem	☐	☐	☐
Left Ventricular Hypertrophy (Enlarged heart)	☐	☐	☐
Chronic obstructive pulmonary disease	☐	☐	☐
Chronic liver disease	☐	☐	☐
High Cholesterol	☐	☐	☐
Malignancy (cancer)	☐	☐	☐
Depression	☐	☐	☐
Arthritis or gout	☐	☐	☐
Circulation problems in the legs	☐	☐	☐
Stomach problems like ulcer or heartburn	☐	☐	☐
Retinopathy	☐	☐	☐
Kidney Problems	☐	☐	☐
Peripheral Neuropathy	☐	☐	☐
Diabetic foot	☐	☐	☐

If you answered YES to any of the previous questions, **are you currently being treated with medication for any of the conditions** for which you answered YES? Please place a check mark (√) in the box below

Problem or Condition:	**YES**	**NO**	**I'M NOT SURE**
Cardiovascular disease	☐	☐	☐
Diabetes	☐	☐	☐
High blood pressure	☐	☐	☐
Stroke	☐	☐	☐
Heart valve problem	☐	☐	☐
Heart attack	☐	☐	☐
Heart rhythm problem	☐	☐	☐
Left Ventricular Hypertrophy (Enlarged heart)	☐	☐	☐
Chronic obstructive pulmonary disease	☐	☐	☐
Chronic liver disease	☐	☐	☐
High Cholesterol	☐	☐	☐
Malignancy (cancer)	☐	☐	☐
Depression	☐	☐	☐
Arthritis or gout	☐	☐	☐
Circulation problems in the legs	☐	☐	☐
Stomach problems like ulcer or heartburn	☐	☐	☐
Retinopathy	☐	☐	☐
Kidney Problems	☐	☐	☐
Peripheral Neuropathy	☐	☐	☐
Diabetic foot	☐	☐	☐

Are you **currently** taking any of the following **medications**?

Medication	**YES**	**NO**	**I'M NOT SURE**
Insulin	☐	☐	☐
Diabetic medications by mouth	☐	☐	☐
Aspirin	☐	☐	☐
Plavix/Clopidogrel	☐	☐	☐

You are finished - Thank You!

Please return this package to your nurse, office personnel, or the researchers

Appendix E: Heart Disease Fact Questionnaire (HDFQ)

Questionnaire Packet Part 1

Directions: Please answer the following questions by placing a check mark (√) in the appropriate box below

	TRUE	FALSE	I DON'T KNOW
1. A person knows when they have heart disease.	☐	☐	☐
2. If you have a family history of heart disease, you are at risk for developing heart disease.	☐	☐	☐
3. The older a person is, the greater their risk of having heart disease.	☐	☐	☐
4. Smoking is a risk factor for heart disease.	☐	☐	☐
5. A person who stops smoking will lower their risk of developing heart disease.	☐	☐	☐
7. Keeping blood pressure under control will reduce a person's risk for developing heart disease.	☐	☐	☐
8. High cholesterol is a risk factor for developing heart disease.	☐	☐	☐
9. Eating fatty foods does not affect blood cholesterol levels.	☐	☐	☐
10. If your "good" cholesterol (HDL) is high you are at risk for heart disease.	☐	☐	☐
11. If your "bad" cholesterol (LDL) is high you are at risk for heart disease.	☐	☐	☐
12. Being overweight increases a person's risk for heart disease.	☐	☐	☐
13. Regular physical activity will lover a person's chance of getting heart disease.	☐	☐	☐
14. Only exercising at a gym or in an exercise class will lower a person's chance of developing heart disesase.	☐	☐	☐
15. Walking and gardening are considered exercise that will help lower a person's chance of developing heart disease.	☐	☐	☐
16. Diabetes is a risk factor for developing heart disease.	☐	☐	☐
17. High blood sugar puts a strain on the heart.	☐	☐	☐
18. If your blood sugar is high over several months it can cause your cholesterol level to go up and increase your risk of heart disease.	☐	☐	☐
19. A person who has diabetes can reduce their risk of developing heart disease if they keep their blood sugar levels under control.	☐	☐	☐
20. People with diabetes rarely have high cholesterol.	☐	☐	☐

	TRUE	FALSE	I DON'T KNOW
21. If a person has diabetes, keeping their cholesterol under control will help to lower their chances of developing heart disease.	☐	☐	☐
22. People with diabetes tend to have low HDL (good) cholesterol.	☐	☐	☐
23. A person who has diabetes can reduce their risk of developing heart disease if they keep their blood pressure under control.	☐	☐	☐
24. A person who has diabetes can reduce their risk of developing heart disease if they keep their weight under control.	☐	☐	☐
25. Men with diabetes have a higher risk of heart disease than women with diabetes.	☐	☐	☐

Thank you!

Please proceed to next items

Appendix F: Health Beliefs related to Cardiovascular Disease scale (HBCVD)

Instructions: Please respond to the following 25 brief statements by placing a check mark (√) in the appropriate box below. You have no time limit, but please work as quickly as you can. Please be as open and honest as possible and answer based on how you feel and what you do <u>most</u> of the time.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. It is likely that I will suffer from a heart attack or stroke in the future	☐	☐	☐	☐
2. My chances of suffering from a heart attack or stroke in the next few years are great	☐	☐	☐	☐
3. I feel I will have a heart attack or stroke sometime during my life	☐	☐	☐	☐
4. Having a heart attack or stroke is currently a possibility for me	☐	☐	☐	☐
5. I am concerned about the likelihood of having a heart attack or stroke in the near future	☐	☐	☐	☐
6. Having a heart attack or stroke is always fatal	☐	☐	☐	☐
7. Having a heart attack or stroke will threaten my relationship with my significant other	☐	☐	☐	☐
8. My whole life would change if I had a heart attack or stroke	☐	☐	☐	☐
9. Having a heart attack or stroke would have a very bad effect on my sex life	☐	☐	☐	☐
10. If I have a heart attack or stroke I will die within ten years	☐	☐	☐	☐
11. Increasing my exercise will decrease my chances of having a heart attack or stroke	☐	☐	☐	☐
12. Eating a healthy diet will decrease my chances of having a heart attack or stroke	☐	☐	☐	☐
13. Eating a healthy diet and exercising for 30 minutes most days of the week is one of the best ways for me to prevent a heart attack or stroke	☐	☐	☐	☐
14. When I exercise I am doing something good for myself	☐	☐	☐	☐
15. When I eat healthy I am doing something good for myself	☐	☐	☐	☐

	Strongly Disagree	Disagree	Agree	Strongly Agree
16. Eating a healthy diet will decrease my chances of dying from cardiovascular disease	☐	☐	☐	☐
17. I do not know the appropriate exercises to perform to reduce my risk of developing cardiovascular disease	☐	☐	☐	☐
18. It is painful for me to walk for more than 5 minutes	☐	☐	☐	☐
19. I have access to exercise facilities and/or equipment	☐	☐	☐	☐
20. I have someone who will exercise with me	☐	☐	☐	☐
21. I do not have time to exercise for 30 minutes a day on most days of the week	☐	☐	☐	☐
22. I do not know what is considered a healthy diet that would prevent me from developing cardiovascular disease	☐	☐	☐	☐
23. I do not have time to cook meals for myself	☐	☐	☐	☐
24. I can not afford to buy healthy foods	☐	☐	☐	☐
25. I have other problems more important than worrying about diet and exercise	☐	☐	☐	☐

Thank you!
Please proceed to next items

Appendix G: Center for Epidemiologic Studies Depression Scale (CESD)

Directions: Please place a check mark (√) in the appropriate box below to select the statement that best describes how often you felt or behaved this way DURING THE PAST WEEK

DURING THE PAST WEEK,

	1 Rarely or none of the time (less than 1 day)	**2 Some or a little or the time (1-2 days)**	**3 Occasionally or a moderate amount of time (3-4 days)**	**4 Most or all of the time (5-7 days)**
I was bothered by things that usually don't bother me.	☐	☐	☐	☐
I did not feel like eating; my appetite was poor.	☐	☐	☐	☐
I felt that I could not shake off the blues even with help from my family or friends.	☐	☐	☐	☐
I felt that I was just as good as other people.	☐	☐	☐	☐
I had trouble keeping my mind on what I was doing.	☐	☐	☐	☐
I felt depressed.	☐	☐	☐	☐
I felt that everything I did was an effort.	☐	☐	☐	☐
I felt hopeful about the future.	☐	☐	☐	☐
I thought my life bad been a failure.	☐	☐	☐	☐

	1 Rarely or none of the time (less than 1 day)	**2 Some or a little or the time (1-2 days)**	**3 Occasionally or a moderate amount of time (3-4 days)**	**4 Most or all of the time (5-7 days)**
I felt fearful.	☐	☐	☐	☐
My sleep was restless.	☐	☐	☐	☐
I was happy.	☐	☐	☐	☐
I talked less than usual.	☐	☐	☐	☐
I felt lonely.	☐	☐	☐	☐
People were unfriendly.	☐	☐	☐	☐
I enjoyed life.	☐	☐	☐	☐
I had crying spells.	☐	☐	☐	☐
I felt sad.	☐	☐	☐	☐
I felt that people dislike me.	☐	☐	☐	☐
I could not get "going."	☐	☐	☐	☐

Appendix H: Multidimensional Diabetes Questionnaire - Self-Efficacy Subscale (MDQ-SE)

Directions: Please place a check mark (√) in the appropriate box below to indicate how confident you usually feel about the following areas in your life.

	Very Confident	**Moderately Confident**	**Only a little Confident**	**Not at all Confident**
1. How confident are you in your ability to follow your diet?	☐	☐	☐	☐
2. How confident are you in your ability to test your blood sugar at the recommended frequency?	☐	☐	☐	☐
3. How confident are you in your ability to exercise regularly?	☐	☐	☐	☐
4. How confident are you in your ability to keep your weight under control?	☐	☐	☐	☐
5. How confident are you in your ability to keep your blood sugar level under control?	☐	☐	☐	☐
6. How confident are you in your ability to resist food temptations?	☐	☐	☐	☐
7. How confident are you in your ability to follow your diabetes treatment (diet, medication, blood sugar testing, exercise)?	☐	☐	☐	☐

Thank you!
Please proceed to next items

Appendix I: Multidimensional Diabetes Questionnaire – Social Support Subscale (MDQ-SS)

Directions: Please place a check mark (√) in the appropriate box below to indicate how you usually feel about the following areas of support in your life.

	Always	Sometimes	Rarely	Never
1. To what extent does your spouse (or significant other) support you with your diabetes?	☐	☐	☐	☐
2. To what extent do your family and friends support you or help you with your diabetes?	☐	☐	☐	☐
3. To what extent does your spouse (or significant other) pay attention to you because of your diabetes?	☐	☐	☐	☐
4. To what extent does your doctor or health care team support youor help you with your diabetes?	☐	☐	☐	☐

Thank you!
Please proceed to next items

Appendix J: Stage of Change for Exercise (SOES)

Directions: Please CIRCLE the number below that best describes your present exercise behavior. “Regular exercise” equals three or more days per week for 20 minutes or more each day (for example, swimming or walking).

4	I presently exercise on a regular basis and have been doing so for longer than 6 months
3	I presently exercise on a regular basis, but I have only begun doing so within the past 6 months
2	I presently get some exercise, but not regularly
1	I presently do not exercise, but have been thinking about starting to exercise within the next 6 months
0	I presently do not exercise and do not plan to start exercising in the next 6 months

Thank you!
Please proceed to next items

Appendix K: Stage of Change for Diet (SODS)

Directions: Please CIRCLE the number below that best describes your present eating habits. "Healthy diet" is one that includes fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products; lean meats, poultry, fish, beans, eggs, and nuts; and is low in saturated fats, *trans* fats, cholesterol, salt (sodium), and added sugars.

4 →	I presently eat a healthy diet regularly and have been doing so for longer than 6 months
3 →	I presently eat a healthy diet regularly, but I have only begun doing so within the past 6 months
2 →	I presently eat a healthy diet sometimes, but not regularly
1 →	I presently do not eat a healthy diet, but have been thinking about starting to eat better within the next 6 months
0 →	I presently do not eat a healthy diet and do not plan to start eating better in the next 6 months

Thank you!
Please proceed to next items

Appendix L: The Diabetes Activity Questionnaire (TDAQ)

Directions: The questions below will ask you about your personal experience with diabetes. Each question is designed to find out about your experience with the activities related to your diabetes. Remember that the word educator can refer to any member of the health care team (doctor, nurse, dietitian, exercise therapist, etc).

For each of the questions below, Please place a check mark (√) in the appropriate box below to indicate how you usually feel about your personal experience with the activities related to your diabetes.

	Always	**Sometimes**	**Rarely**	**Never**
1. I follow my meal plan exactly as suggested by my educator.	☐	☐	☐	☐
2. I try to keep my weight within the range suggested by my educator.	☐	☐	☐	☐
3. I exercise as often as my educator advised me to.	☐	☐	☐	☐
4. I only do *exercises/activities* recommended by my educator.	☐	☐	☐	☐
5. I exercise at the times suggested by my educator.	☐	☐	☐	☐
6. Each day I take exactly the number of injections/pills prescribed by my doctor.	☐	☐	☐	☐
7. I take insulin/pills at the times prescribed by my educator	☐	☐	☐	☐
8. I only adjust the dose of my insulin/pills if my educator tells me to.	☐	☐	☐	☐
9. I test my blood sugar as often as suggested by my educator.	☐	☐	☐	☐
10. I test my blood sugar at the times suggested by my educator.	☐	☐	☐	☐
11. I treat low blood sugar reactions with the type of food/ drink/candy advised by my educator.	☐	☐	☐	☐
12. When I have a reaction I only eat/drink the amount suggested by my educator.	☐	☐	☐	☐
13. I examine my feet daily.	☐	☐	☐	☐

Thank you!
Please proceed to next items

Appendix M: Preliminary Instrument Development Study

In this appendix, the development of the Health Beliefs related to CardioVascular Disease scale (HBCVD) and a description of the pilot study to test the psychometric properties of the HBCVD are described. Background information regarding the measurement of health beliefs is provided and support for the need for the HBCVD scale is presented. The development of the item pool and pilot study procedures are described and preliminary data analyses are presented. This preliminary study provided sufficient evidence to support continued evaluation of the HBCVD in the current study.

Background and Significance

The Health Belief Model has been widely used as a behavioral theory to predict health behaviors and there is substantial evidence to support its predictive power (Aljasem et al., 2001; Champion & Scott, 1997; Janz, 1988; Janz & Becker, 1984; Koch, 2002), particularly since the inclusion of self-efficacy (Rosenstock, 2004). Due to the high risk of CVD morbidity and mortality among patients with diabetes and the known benefits of diet and exercise to decrease this risk (ADA, 2005), it is important to explore the relationships between patients' health beliefs related to CVD and diet and exercise behaviors. Greater insight into these relationships could provide a better understanding of diabetic patients' motivations to engage or to not engage in health protective behaviors, and could be applied to the development or improvement of interventions aimed at preventing CVD morbidity and mortality in this population. As a result, one of the aims of the current study was to evaluate the relationships between health beliefs related to CVD risk and diet and exercise behaviors in a population of adults with type 2 diabetes.

To address this aim, it was necessary to identify an instrument possessing adequate validity and reliability to measure these specific health beliefs in the study population. A review of the published literature identified no such instrument; as a result, the author developed the Health Beliefs related to CardioVascular Disease scale (HBCVD) to fill this void. The purpose of the pilot study described in this appendix was to develop and refine the HBCVD scale, and to test the feasibility of recruitment and data collection methods.

Development and Description of the Construct

Review of the Literature

There are a number of instruments that exist to measure components of the HBM in various populations; however, no instrument exists using the HBM as a framework to measure health beliefs related to CVD risk and diet and exercise behaviors in adults with type 2 diabetes. When measuring health beliefs related to a specific health problem (i.e., CVD), it is prudent to develop a scale that measures health beliefs pertaining to CVD specifically rather than using scales that do not mention the particular disease or health problem of interest (Given et al., 1983).

According to Jette et al. (as cited in Given et al., 1983), more specific scales tend to have higher reliabilities than more general scales of health beliefs. In addition, one could conclude that the construct and face validity of the scale would also be improved. This is due, in part, to the fact that health beliefs will likely differ according to the disease process being studied as well as the potential for differences between variables such as health status, disease processes, and degree of illness when compared to other populations. Furthermore, since there are so many factors that can influence motivation, theoretically, the more specific you can be with your problem and behavior, the more valid your findings will be, and, in turn, the more confidence you can have in your results. For example, in a study exploring health screening behaviors in diabetic males, it would not be appropriate to use an instrument designed to measure health beliefs related to mammography in a group of healthy women for a male patient diagnosed with diabetes. While one may find adequate reliability, this mammography beliefs scale would not meet validity criteria.

There has been a significant amount of debate over existing scales that claim to measure health beliefs and much of this debate focuses on reliability and validity issues (Harris et al., 1987; Hurley, 1990). Experts in the use of the HBM agree that a generalized health belief scale is not as useful because scales are more reliable when developed for a specific disease (Given et al., 1983). Rather it is necessary to develop separate scales tailored to the specific behavior and/or to the specific disease of interest and within the context of the population under study (Harris et al., 1987). Since no existing instrument that met the criteria suggested by Harris et al. was identified in the literature, the author felt that it was necessary to develop a scale measuring health beliefs specifically related to CVD risk in diabetic patients.

Evaluation of Existing Health Belief Scales

A number of valid and reliable health belief scales have been developed for specific populations and for specific behaviors. For example, Given et al. (1983) developed the HBM76 to measure health beliefs of diabetic patients. A review of this 76 item scale revealed that the focus of the scale was on beliefs about diabetes as a disease in general and elements of the prescribed treatment regimen (disease management of diabetes). Becker and Janz (1985) shortened the HBM76 to 16 items, with four items for each dimension of the HBM: perceived susceptibility, severity, benefits, and barriers. Hurley (1990) performed a psychometric evaluation of the HBM16 and was able to further reduce the scale to 11 items with acceptable validity and reliability levels. However, the scale is geared toward beliefs about therapeutic regimen and is specific for diabetic individuals who use insulin, thus making it inadequate for the current study. Harris et al. (1987) developed the Diabetes Health Belief Scale, which also focused on attitudes about diabetes care in general to explain compliance to a prescribed medical regimen. None of these scales specifically addressed beliefs related to risk for CVD morbidity and mortality.

As a result, the literature review continued toward the goal of identifying other HBM scales that could be adapted for use to address the purposes of the HBCVD. One such scale by Champion and Scott (1997) was identified and was deemed appropriate as a framework for item generation. Their scale focused on beliefs regarding a specific disease (breast cancer) and regarding specific actions to prevent or detect this disease (breast self exam and mammography). In their study describing the psychometric development of scales designed to measure beliefs related to mammography and breast self-examination screening in African American females, Champion and Scott (1997) administered six revised scales based on the HBM constructs of susceptibility, benefits, barriers, and self efficacy to 329 African American women. The scales consisted of a susceptibility scale, a breast self-exam (BSE) benefits scale, a BSE barriers scale, a BSE confidence scale, a mammography benefits scale, and a mammography barriers scale. Findings revealed Cronbach alpha reliability coefficients ranging from .65 to .90, and test-retest reliability ranging from .40 to .68. Because of the narrow focus of this instrument (mammography and breast cancer) as opposed to the broader more global focus on beliefs about diabetes in general in the scales based on previous work by Given et al. (1983), Champion and Scott's scale was selected as the framework for the HBCVD item development.

However, Champion and Scott (1997) did not include measures of perceived severity of breast cancer in their Breast Cancer Screening Beliefs Scale because they were working under the assumption that everyone agrees that breast cancer is severe. The author of the current study chose not to make the same assumption about heart attack and stroke and sought exemplars of severity scales that could be helpful in item development for the HBCVD severity subscale. A subsequent study by Wu and Yu (2003) adapted Champion and Scott's Breast Cancer Screening Beliefs Scale for use in Chinese American women which included a severity subscale. Because Wu and Yu's severity subscale was based on Champion and Scott's Screening Beliefs Scale and because the items provided an appropriate framework for the purposes of the HBCVD severity subscale, Wu and Yu's severity subscale scale was also adapted for use in the HBCVD.

Description of the Construct

The Health Beliefs related to Cardiovascular Disease scale (HBCVD) was designed to measure health beliefs in terms of perceived susceptibility to and severity of heart attack and stroke (markers of CVD morbidity and mortality), and perceived benefits of and barriers to healthy diet and exercise behaviors in patients with diabetes. The original scale consisted of five subscales measuring four variables of focus in the HBCVD and current diet and exercise behaviors. The first four subscales measured the following HBM variables: perceived susceptibility to heart attack and stroke, perceived severity of heart attack and stroke, perceived benefits of diet and exercise, and perceived barriers to diet and exercise. These variables have been conceptually defined previously in chapter two. The fifth subscale attempted to measure current diet and exercise behaviors, conceptually defined as eating a healthy diet and exercising for at least 30 minutes most days of the week and operationally defined as the participant's summed score on the diet and exercise behavior subscale.

The additional variables included in the Health Belief Model, self-efficacy and cues to action, have also been measured in the dissertation study, but were not included in the HBCVD because an existing self efficacy scale by Talbot et al. (1997) was identified as appropriate for use in the current study. Cues to action were measured in the larger dissertation study by asking 12 questions developed by the researcher which inquired about exposure to information regarding diabetes and CVD. These cues to action items were not included in the HBCVD because of their variable and fleeting nature and thus inherent problems with measurement (Rosenstock, 2004) which would pose a threat to validity and reliability of the HBCVD.

Test Construction and Description of Test Items

Procedures for Test and Item Development

The HBCVD was developed following an extensive review of the literature and the author's clinical knowledge and experiences with diabetic patients. In addition, an expert panel and a focus group of diabetic patients provided feedback regarding face validity and suggestions for revisions. One important work by Given et al. (1983) provided an excellent starting point for the development of the HBCVD and the final scale was adapted from two HBM instruments that have been developed to measure beliefs related to breast cancer and breast cancer screening behaviors (Champion & Scott, 1997; Wu & Yu, 2003).

Item Development

First, a comprehensive review of the literature was conducted to review existing instruments measuring the same constructs or similar ones in the diabetic population and other populations. A preliminary review of the literature identified no instruments that purported to measure health beliefs of diabetic patients that specifically related to perceptions of susceptibility and severity to heart attack or stroke or perceived benefits of and barriers to diet and exercise to decrease CVD risk.

Based on the literature review and the author's clinical knowledge of diabetes and CVD, 33 scale items were developed for the initial item pool.

In addition to the literature review, a focus group was conducted among a group of ten diabetic patients who attended a local support group meeting. This group was asked to review the first drafts of the instrument and made suggestions for improvements. Once the initial item pool was developed, a panel of experts in the areas of diabetes, CVD, health behaviors, behavior change theories, and cognitive behavior therapies evaluated the items for representativeness, appropriateness, and relevance. The expert panel agreed with the author's definitions of the constructs, evaluated the items for clarity and conciseness, and suggested ways of capturing the construct that may not have occurred to the author (DeVellis, 2003). Several items were revised based on feedback from the expert panel. The final scale items can be found in Table M. 1 of this appendix.

The final sample of items included positively and negatively worded items to address acquiescence and four validity indicators (Omission Rate, Inconsistency Index, Positive Impression, and Negative Impression) as suggested by Bar-On (2004). Scale items were written in such a way to avoid seeming ambivalent, double barreled or loaded, offensive, or too long and they had moderate wording to obtain the greatest degree of variation in responses. Readability statistics were examined using the Microsoft Word function in Windows XP and reading level was identified as grade six. The format for measurement in the HBCVD consisted of a Likert scale with four response options: Strongly Disagree, Disagree, Agree, and Strongly Agree. Responses were weighted from 1 to 4 and scores were summed to create a total scale score as well as individual sub-scale scores with higher scores indicating higher perceptions of the particular belief or greater practice of the health behavior.

Description of Items

The original item pool consisted of 33 items measuring components of the Health Belief Model (perceived susceptibility, severity, benefits, and barriers) and diet and exercise behaviors. As previously noted, two scales measuring health beliefs related to breast cancer screening by Champion and Scott (1997) and Wu and Yu (2003) provided the framework for item development and the HBCVD scale items were adapted from these items and applied to risk for CVD (heart attack and stroke) and diet and exercise behaviors. A comparison of items from the HBCVD as they relate to the Champion and Scott and the Wu and Yu scales can be found in Table M. 1 of this appendix. The first column on the left shows the HBCVD items and the two columns to the right show the items that were adapted from the breast cancer screening scales. Two additional items were added to the barriers subscale based on feedback from support group participants regarding barriers to exercise behaviors: *I have access to exercise facilities and/or equipment* and *I have someone who will exercise with me*. Items measuring current health behavior practices were also included in the original scale. These items were developed by the researcher as a general measure of diet and exercise behaviors.

Table M.1: HBCVD Pilot Scale Items

HBCVD items (adapted from Champion & Scott, 1997 and Wu & Yu, 2003)	**Breast Cancer Screening Beliefs Scale (Champion & Scott, 1997)**	**Mammogram Screening Beliefs Questionnaire items (Wu & Yu, 2003)**
Susceptibility subscale		
It is likely that I will suffer from a heart attack or stroke in the future	It is extremely likely that I will get breast cancer	
My chances of suffering from a heart attack or stroke in the next few years are great	My chances of getting breast cancer in the next few years are great.	
I feel I will have a heart attack or stroke sometime during my life	I feel I will get breast cancer sometime during my life.	
Having a heart attack or stroke is currently a possibility for me	Developing breast cancer is currently a possibility for me	
I am concerned about the likelihood of having a heart attack or stroke in the near future	I am concerned about the likelihood of developing breast cancer in the near future.	
Severity subscale		
Having a heart attack or stroke is always fatal		Ser(1) Getting breast cancer is always fatal.
Having a heart attack or stroke will threaten my relationship with my significant other		Ser(2) Threaten a relationship with her boyfriend or husband.
My whole life would change if I had a heart attack or stroke		Ser(3) Her whole life would change.
Having a heart attack or stroke would have a very bad effect on my sex life		Ser(6) Have a very bad effect on her sex life.
If I have a heart attack or stroke I will die within ten years		Ser(8) Die within 5 years.
Benefits subscale		
26. Increasing my exercise will decrease my chances of having a heart attack or stroke 26. Eating a healthy diet will decrease my chances of having a heart attack or stroke 16. Eating a healthy diet will decrease my chances of dying from cardiovascular disease	Having a mammogram will decrease my chances of dying from breast cancer	
Eating a healthy diet and exercising for 30 minutes most days of the week is the best way for me to prevent a heart attack or stroke	Having a mammogram is the best way for me to find a very small breast lump	
28. When I exercise I am doing something good for myself 29.When I eat healthy I am doing something good for myself	When I do BSE I am doing something to take care of myself	

Table M.1: Continued

HBCVD items (adapted from Champion & Scott, 1997 and Wu & Yu, 2003)	Breast Cancer Screening Beliefs Scale (Champion & Scott, 1997)	Mammogram Screening Beliefs Questionnaire items (Wu & Yu, 2003)
Barriers subscale		
17. I do not know the appropriate exercises to perform to reduce my risk of developing cardiovascular disease 22. I do not know what is considered a healthy diet that would prevent me from developing cardiovascular disease	I don't know how to go about scheduling a mammogram	
18. It is painful for me to walk for more than 5 minutes	Having a mammogram would be painful	
21. I do not have time to exercise for 30 minutes a day on most days of the week 23. I do not have time to cook meals for myself	Having a mammogram would take too much time	
24. I can not afford to buy healthy foods	Having a mammogram costs too much money	
25. I have other problems more important than worrying about diet and exercise	I have other problems more important than getting a mammogram	
Additional Barriers Items		
19. I have access to exercise facilities and/or equipment		
20. I have someone who will exercise with me		
Health Behavior Items		
26. I exercise for at least 30 minutes at least 5 days out of the week		
27. I never exercise		
28. I never eat at fast food restaurants		
29. I am currently trying to lose weight		
30. I eat at fast food restaurants for almost every meal		
31. I eat a well balanced diet		
32. In general, I am a sedentary person		
33. I do not watch what I eat- I eat whatever I feel like		

DATA COLLECTION METHODS

Sample and Setting

This study utilized a convenience sample of 95 adults with type 2 diabetes recruited from an outpatient cardiovascular and diabetes prevention (CVDP) clinic affiliated with a large university hospital in southeast Texas. Each year the clinic treats an average of 526 adult diabetes patients who are referred to the clinic for diabetes education and management. All participants in this study met the following inclusion criteria: 1) self reported clinical diagnosis of type 2 diabetes, 2) age 18 years or older and 3) ability to speak, read and understand English. Prior to administering the scale to the first group of participants, approval to conduct the study was provided by the hospital's Institutional Review Board.

Recruitment and Procedure

Participants were recruited by flyers posted in the CVDP clinic waiting room (Appendix B). Upon checking-in for a scheduled clinic visit, clinic personnel explained the purpose of the study to eligible patients and offered them the opportunity to participate. Study packets were given to interested patients. Study packets included a recruitment letter (Appendix B), contact information form (Appendix C), a demographic and biologic questionnaire (Appendix D), and eight instruments (Appendices E-L). Compensation for participants in this pilot study included a healthy snack and cloth tape measure given to the participant when they requested the questionnaire packet.

Participants did not report any adverse events associated with participation in this study. All participants who were questioned reported that it took approximately 15 minutes to complete the items and that the questionnaire was easy to complete and did not cause any undue burden. The clinic staff also reported that the participant recruitment and data collection procedures were not disruptive to the clinic patients or staff and they agreed to assist with recruitment for the larger dissertation study. As a result, the recruitment procedures and data collection methods were deemed feasible for the larger dissertation study.

The next goal of the pilot study was to obtain preliminary data about the sample population and initial validity and reliability indices. The next section describes the preliminary statistical findings.

RESULTS

Sample Characteristics

A total of 95 adults with diabetes participated in this pilot study. Demographic data obtained revealed that this pilot sample was primarily female (68%), with a mean age of 58 years, married or with life partner (66%), and living with family or friends (69%). The sample consisted of Caucasians (63%), African Americans (16%), Hispanics (15%), Native Americans (3%), Asian or Pacific Islander (3%) and one participant identified themselves as “other” but did not provide a description of their race or ethnicity. Median length of time since diagnosis with diabetes was approximately 10 years.

Construct Validity

To evaluate factor structure among the items in the HBCVD, exploratory and confirmatory factor analysis procedures were conducted using SPSS 11.0 program software. Exploratory factory analysis (EFA) identified five factors with eigen values greater than 2.0. Factor loadings were evaluated for each of the five factors.

Factor one consisted of all six items the author identified as the benefits subscale and each item had a factor loading greater than .70 with no secondary loadings greater than .32. Factor two had a similar factor structure with all five items being a part of the author identified susceptibility subscale. Each item had a factor loading greater than .50 and no secondary loadings greater than .34. The third factor consisted of four of the eight behavioral items and each had primary loadings of .39 or greater and no secondary loadings greater than .36. Factors four and five contained seven of the nine barriers subscale items. Factor four contained four of the items, all of which had primary loadings of .44 or greater and no secondary loadings greater than .30. Factor five contained three of the items. All of which had primary loadings greater than .5 and no secondary loadings greater than .35. Factor six contained two items, one behavior item and one barriers item, while factors seven and eight contained all five of the severity subscale items. Factor seven contained three of the severity items which had primary loadings between .59 and .69 and no secondary loadings greater than .30. Factor eight contained the remaining two items which had primary loadings of .64 and .57 and no secondary loadings greater than .37.

An evaluation of the correlation matrix produced by the SPSS software revealed a number of questionable correlations that were either much lower than expected or in a direction that was not expected. Upon further review of the items, it was noted that three of the items in the behavior subscale were problematic due to inadvertent double negative wording between the question and response options. For example, responses for the behavior question "I never exercise" included always, sometimes, rarely, or never. In addition, feedback from participants written directly on the questionnaire indicated that many of them found these items and response options to be confusing. As a result, the author chose to omit the behavioral subscale from further data analysis and the final HBCVD scale.

After excluding the behavioral items, the HBCVD consisted of 25 items. Based on the results of the EFA which showed that items in each of the four subscales hung together quite well, the next step in evaluating construct validity was to examine factor structure through confirmatory factor analysis (CFA).
Confirmatory Factor Analysis with varimax rotation supported construct validity. Factor loadings are presented in Table M. 2 of this appendix with each factor labeled appropriately according to the subscale within the HBCVD and primary loadings have been highlighted in bold font. When selecting 4 factors in CFA, all but four of the 25 items loaded as expected on each of the four subscales. All items had primary loadings of .34 or greater on one factor and only two items

(hb08 and hb24) had secondary loadings (-.402 and .408 respectively) on a second factor.

The four items that did not load as expected were hb10, hb21, hb23, and hb24. The highest factor loading for hb10 (.513) loaded on the susceptibility subscale. The hb10 question “if I have a heart attack or stroke I will die within 10 years” does not conceptually match the concept of susceptibility but is more consistent with severity. In addition, inter-item correlations between hb10 and the other items in the severity subscale were low (.07-.27) and only two items from the total scale inter-item correlations matrix were correlated greater than .30; these items were hb08 (.33) and hb09 (.45). Because of these findings, the researcher considered deleting this item. However, due to the small sample size (n=80) this item remained in the subscale for further evaluation with a larger sample.

Two other items that were similar in wording also loaded differently than expected; these were hb21 and hb23. These two items were expected to load on the barriers subscale but instead loaded on the severity subscale with primary factor loadings of -.599 for hb21 and -.629 for hb23. Each of these items related to not having the time to exercise (hb21) or cook (hb23) and were negatively associated with the other severity items (-.075 to -.348) in that the higher the perceived severity, the lower the barrier score. Because the hb21 and hb23 items were highly correlated with each other (.588) and moderately correlated with the majority of the other barrier items, the decision was made to retain these items and evaluate their properties with a larger sample.

Finally, item hb24 “I can not afford to buy healthy foods” loaded more strongly on the susceptibility subscale (-.434) than on the barriers scale (.408) contrary to expectations. However, because the loadings were very close in strength, the decision was also made to retain this item and reevaluate with a larger sample.

Reliability

Following evaluation of factor structure which supported the presence of the individual subscales intended in the HBCVD, the reliability of the total scale and each subscale was evaluated using Cronbach's alpha statistics. Analysis of the total scale with the final 25 items revealed a standardized item alpha of .783 and demonstrated adequate inter-item correlations. The alphas for each individual subscale revealed acceptable levels for a new instrument, ranging from .640 to .866 (see Table M. 3 in this appendix). Inter-item correlations within each subscale were also satisfactory (see tables M. 4-7 in this appendix). Finally inter-scale correlations were evaluated (see Table M. 8 in this appendix). All subscales were significantly correlated at the .05 level with the HBCVD total scale ranging from .44 to .67 while only two of the subscales were significantly correlated with each other: susceptibility and benefits ($\alpha = .267$; $p = .014$) and barriers and benefits ($\alpha = .390$; $p = .000$). These preliminary findings provided support for the four factor structure of the HBCVD and revealed at least minimally acceptable alphas for the individual subscales which support the suitability for further evaluation of the HBCVD in the current larger dissertation study.

APPENDIX SUMMARY

In summary, it was deemed that the recruitment procedures and data collection methods were feasible to be applied in the larger dissertation study. In addition, preliminary analyses of the HBCVD revealed promising results that warranted further evaluation in the larger dissertation study.

Table M.2: HBCVD Pilot - Principal Component Analysis with Varimax Rotation (Four Factor Structure)

Scale Items	Factor 1: Benefits	Factor 2: Suscept-ibility	Factor 3: Barriers	Factor 3: Severity
hb01. It is likely that I will suffer from a heart attack or stroke in the future.	.152	**.807**	-.032	-.174
hb02. My chances of suffering from a heart attack or stroke in the next few years are great.	.124	**.742**	-.161	-.037
hb03. I feel I will have a heart attack or stroke sometime during my life.	-.157	**.725**	.080	-.223
hb04. Having a heart attack or stroke is currently a possibility for me.	.237	**.742**	-.050	.128
hb05. I am concerned about the likelihood of having a heart attack or stroke in the near future.	.157	**.667**	-.106	.190
hb06. Having a heart attack or stroke is always fatal.	-.133	-.061	-.038	**.581**
hb07. Having a heart attack or stroke will threaten my relationship with my significant other.	.186	.058	.010	**.690**
hb08. My whole life would change if I had a heart attack or stroke.	*-.402*	.193	.299	**.534**
hb09. Having a heart attack or stroke would have a very bad effect on my sex life.	-.183	.283	.349	**.491**
hb10. If I have a heart attack or stroke I will die within 10 years.	-.177	**.513**	.311	.188
hb11. Increasing my exercise will decrease my chances of having a heart attack or stroke.	**.733**	-.013	.201	.085
hb12. Eating a healthy diet will decrease my chance of having a heart attack or stroke.	**.865**	.142	.091	.033
hb13. Eating a healthy diet and exercising for 30 minutes most days of the week is the best way for me to prevent a heart attack or stroke.	**.823**	.107	.108	.053

Scale Items	Factor 1: Benefits	Factor 2: Suscept-ibility	Factor 3: Barriers	Factor 3: Severity
hb14. When I exercise I am doing something good for myself.	**.910**	.115	.046	-.099
hb15. When I eat healthy I am doing something good for myself.	**.884**	.013	.032	-.123
hb16. Eating a healthy diet will decrease my chances of dying from cardiovascular disease.	**.822**	-.039	.149	-.078
hb17. I do not know the appropriate exercises to perform to reduce my risk of developing cardiovascular disease.	.097	.186	**.655**	.000
hb18. It is painful for me to walk for more than 5 minutes.	.130	-.165	**.448**	-.093
hb19r. I have access to exercise facilities and/or equipment	.195	.012	**.802**	.098
hb20r. I have someone who will exercise with me	-.049	-.109	**.347**	.007
hb21. I do not have time to exercise for 30 minutes a day on most days of the week.	-.077	.230	.245	**-.599**
hb22. I do not know what is considered a healthy diet that would prevent me from developing cardiovascular disease.	.274	-.059	**.501**	-.205
hb23. I do not have time to cook meals for myself.	.247	-.160	.290	**-.629**
hb24. I cannot afford to buy healthy foods.	.272	**-.434**	*.408*	-.241
hb25. I have other problems more important that worrying about diet and exercise.	.109	.093	**.410**	-.340

Primary Factor Loadings in **Bold**
Secondary Factor Loading in *Italics*

Table M.3: HBCVD Pilot Total Scale and Subscale Reliability

	N	No. of Items	Scale Mean	SD	Cronbach's Standardized Item Alpha
HBCVDS Total Scale	68	25	72.13	7.16	.783
Susceptibility Subscale	86	5	13.57	3.19	.866
Severity Subscale	80	5	11.33	2.70	.640
Benefits Subscale	91	6	20.57	2.86	.917
Barriers Subscale	80	9	25.71	4.06	.681

Table M.4: Inter-item Correlations for Pilot Susceptibility Subscale

Item	**Hb01**	**Hb02**	**Hb03**	**Hb04**	**hb05**
Hb01	1.00	--	--	--	--
Hb02	.613	1.00	--	--	--
Hb03	.742	.471	1.00	--	--
Hb04	.662	.605	.540	1.00	--
Hb05	.513	.586	.378	.526	1.00

Table M.5: Inter-item Correlations for Pilot Severity Subscale

Item	Hb06	Hb07	Hb08	Hb09	Hb10
Hb06	1.00	--	--	--	--
Hb07	.432	1.00	--	--	--
Hb08	.194	.377	1.00	--	--
Hb09	.267	.310	.358	1.00	--
Hb10	.070	.083	.247	.274	1.00

Table M.6: Inter-item Correlations for Pilot Benefits Subscale

Item	Hb11	Hb12	Hb13	Hb14	Hb15	Hb16
Hb11	1.00	--	--	--	--	--
Hb12	.755	1.00	--	--	--	--
Hb13	.577	.703	1.00	--	--	--
Hb14	.599	.698	.735	1.00	--	--
Hb15	.453	.626	.641	.812	1.00	--
Hb16	.481	.599	.701	.697	.649	1.00

Table M.7: Inter-item Correlations for Pilot Barriers Subscale

Item	Hb17	Hb18	Hb19	Hb20	Hb21	Hb22	Hb23	Hb24	Hb25
Hb17	1.00	--	--	--	--	--	--	--	--
Hb18	.179	1.00	--	--	--	--	--	--	--
Hb19	.406	.374	1.00	--	--	--	--	--	--
Hb20	.109	.007	.159	1.00	--	--	--	--	--
Hb21	.148	-.146	.004	.218	1.00	--	--	--	--
Hb22	.544	.281	.205	.009	.000	1.00	--	--	--
Hb23	.041	.024	.151	.205	.507	.186	1.00	--	--
Hb24	.159	.265	.313	-.035	.083	.378	.358	1.00	--
Hb25	.199	.190	.178	.071	.341	.225	.397	.179	1.00

Table M.8: Inter-scale Correlations for Pilot HBCVD

		Total	Suscept-ibility Subscale	Severity Subscale	Benefits Subscale	Barriers Subscale
HBCVD Total	Pearson Correlation	1	.495(**)	.444(**)	.671(**)	.653(**)
	Sig. (2-tailed)		.000	.000	.000	.000
	N	68	68	68	68	68
Susceptibility Subscale	Pearson Correlation	--	1	.107	.267(*)	-.014
	Sig. (2-tailed)	--		.359	.014	.904
	N	--	86	75	84	77
Severity Subscale	Pearson Correlation	--	--	1	.055	-.104
	Sig. (2-tailed)	--	--		.632	.390
	N	--	--	80	79	71
Benefits Subscale	Pearson Correlation	--	--	--	1	.390(**)
	Sig. (2-tailed)	--	--	--		.000
	N	--	--	--	91	80
Barriers Subscale	Pearson Correlation	--	--	--	--	1
	Sig. (2-tailed)	--	--	--	--	
	N	--	--	--	--	80

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

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