2003

Adherence to medical regimens in low-income adults with Type 2 diabetes: the influence of perceived control constructs

Erin L. O'Hea
Louisiana State University and Agricultural and Mechanical College, eohea1@lsu.edu

ADHERENCE TO MEDICAL REGIMENS IN LOW-INCOME ADULTS WITH TYPE 2 DIABETES: THE INFLUENCE OF PERCEIVED CONTROL CONSTRUCTS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

In

The Department of Psychology

by
Erin L. O'Hea
B.A., Lafayette College, 1996
M.A., Connecticut College, 1998
December, 2003

ACKNOWLEDGMENTS

As I reflect on the last eleven years that has finally culminated in the earning of a doctorate in clinical psychology, I realize that I would not have made it this far without the influence of two mentors. First, I would like to thank Dr. Brantley for accepting me into his ‘team’ 5 years ago. Without his influence and guidance I would not be the professional I am today. I will forever emulate his approach to life, which is ‘work hard, play hard.’ I appreciate all you have done for me Phil, personally and professionally, and will miss you as I venture away from the nest. Secondly, I would like to acknowledge Dr. Peter Salovey, of Yale University, who has been a mentor and friend to me for the past 7 years. Peter, you have believed in me, guided me, and modeled for me how to be an outstanding teacher, researcher, and person. Even though I have never ‘officially’ been your student, you have always been there for me and throughout the rest of my life I will try to emulate the excellence that pervades your work and your life.

I would also like to acknowledge Dr. Jolene Johnson for funding my dissertation and for being such a caring physician. She truly wants the best for her patients. Further, this project would have been much more difficult, more time consuming, and less fun if I did not have the help of Karen Wood. Karen, I appreciate all the physical and emotional support you provided to me to help me finish my dissertation on time. You are the best friend I have made in over a decade and though we only had 2 years together, I feel like we have been friends since childhood. You are an intelligent, organized, and fun person who makes ‘work’ seem like play, but you always get the job done right. I miss you and hope we will be geographically closer some day.

Finally, and most importantly, I would like to acknowledge my family. Although words will not do justice to all that I have to thank you for, I will start by saying thanks to my mom and dad for all the unconditional support and love they bestowed to me. You two have had the biggest influence in my personal and professional life and I feel very confident in saying that I was truly blessed with great parents. Mom, thanks for modeling kindness, acceptance and tolerance of others, and steadfast organization! Dad thanks for modeling an excellent work ethic, how important the bottom line is, and how to live a simple and rewarding life. And to both of you, thanks for showing Chris and I how to love others and the importance of family. I love you both.

Chris, Dan, and Nicole, you three have also provided me with unconditional support and love, and I appreciate how you have helped me through the rough times in the past few years. Chris, you know we're like one person at times. I could not have asked for a better, more giving, or more fun, sister. I am so glad to be living close to you again, particularly because it means I can be close to mamou! I love you guys.

And last, but definitely not least, I want to thank my husband. Without his love and guidance I would be lost in more ways than one. Ed, without your coaxing and support, I would not have my dissertation finished so early, and I thank you for all that 'nudging!' 'Follow your dreams, live the life you've imagined' is your mantra. You have changed my entire life and I am a better person because of your influence. I admire you so much as a psychologist and a person and couldn't ask for a more wonderful husband to share my life with. Thank you. I love you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Individuals with Type 2 diabetes often do not adhere to their treatment regimens (e.g., exercise, diet, medication, glucose monitoring). Non-adherence results in poor metabolic control, further morbidity and mortality, and increased health care utilization and costs. One common thread among many health behavior theories attempting to explain non-adherence behaviors is the importance of perceived control. This psychosocial variable has most often been conceptualized as ‘health locus of control,’ which refers to the belief that one has the ability to influence or change one’s health outcomes. Inconsistent findings have been reported regarding the relationship of health locus of control and medical regimen adherence in individuals with Type 2 diabetes. These inconsistencies may be related to a need for further research focused on the interaction of internal locus with other perceived control constructs (e.g., self efficacy and outcome expectancy) as well as other types of external loci of control. The present study examined the relationship between internal locus of control, self-efficacy, and outcome expectancy on medical regimen adherence behaviors in low-income adults with Type 2 diabetes. It also investigated the influence of four types of external loci of control, independent and when combined with internal locus of control, on medical regimen adherence in Type 2 diabetic patients. A biological marker, HbA1c, which is considered the most reliable medical indicator for medical regimen adherence behaviors of diabetic patients, was used to measure medical regimen adherence. Multiple regression analyses demonstrate that though self efficacy, in its solidarity, was the best predictor of medical regimen adherence, as indicated by HbA1c levels, the interaction of high internal locus of control and high outcome expectancy was also meaningfully linked to medical regimen

adherence. Further, results suggest that high internal locus of control and low chance locus of control beliefs are significantly related to medical regimen adherence in this sample of low-income patients with Type 2 diabetes.

INTRODUCTION

The number of cases of diabetes mellitus has increased consistently over the past decade (Centers for Disease Control [CDC], 1999). The CDC recently approximated that 15.7 million persons (5.9% of the total population) in the United States have been diagnosed with diabetes (CDC, 1999). Of the patients diagnosed with diabetes, 90% to 95% have been diagnosed with non-insulin dependent diabetes mellitus, also referred to as Type 2 diabetes. In Type 2 diabetes endogenous insulin in individuals becomes metabolically inefficient because of insulin resistance in tissues (Porte & Sherwin, 1997). Type 2 diabetes is often highly correlated with obesity, and other risk factors, including age, gender, and race. The majority of people diagnosed with Type 2 diabetes are overweight, sedentary, and do not adhere to a low-fat diet (ADA, 1998; Porte & Sherwin, 1997). It is most often diagnosed in individuals over the age of 30 years and Type 2 diabetes equally affects females (8.2%) and males (8.2%) in the United States (CDC, 1999).

The prevalence of Type 2 diabetes is extremely high in Blacks when compared to other groups in the United States, particularly Whites (American Diabetes Association [ADA], 1994). Black females are principally at risk for developing diabetes. Prevalence reports conducted by the ADA suggest that Black women have the highest prevalence and mortality rates for Type 2 diabetes in the United States and are the fastest growing group of Americans being diagnosed with the disease (CDC, 1999). The increased risk of Black females for developing Type 2 diabetes is directly related to high rates of obesity, sedentary lifestyle, and high-fat dietary intake commonly found within this population (CDC, 1999).

Health behavior change is the core of treatment for Type 2 diabetes because the risk factors associated with developing this disease are related to poor health behaviors. Patients are advised to follow a strict program of medication, diet, exercise, and blood glucose monitoring. This regimen must be followed on a daily basis for life (Cox & Gonder-Frederick, 1992). The multifaceted nature of this treatment may contribute to poor adherence among individuals with Type 2 diabetes. If individuals do not adhere to these treatment recommendations, their diabetes is not controlled and the risk for developing future health problems increases. For example, diabetes remains one of the leading causes of death in the United States (CDC, 1999; Zimmerman, 1990) and is a risk factor for several other comorbid health conditions, including vascular and neuropathic conditions (Zimmerman, 1990). Specifically, diabetic patients have macrovasular disease death rates that are two to five times higher than that of non-diabetic patients (ADA, 1994). Macrovasular diseases such as atherosclerosis and heart disease are diagnosed at an earlier age and with greater frequency in diabetic patients compared to nondiabetic patients (CDC, 1999). The risk of stroke is also two to five times greater in diabetic samples and 60 to 65% of individuals with diabetes have comorbid hypertension (CDC, 1999). Retinal neuropathy is also a common complication of diabetes. The CDC reports that diabetes is the leading cause of new cases of blindness in individuals from ages 20 to 74 years and is the leading cause of end-stage renal disease (CDC, 1999). Given the high rates of morbidity and mortality associated with poorly controlled diabetes, it is imperative that individuals with diabetes adhere to the treatment recommendations of their health care providers.

Short-term studies of diabetic management in patients with Type 2 diabetes have demonstrated that when adherence to medical regimens is satisfactory, improvements in metabolic control, decreases in health risks, and decreases in complications result (Geraci et al., 1999; Smith, Heckemeyer, Kratt, & Mason, 1997). However, adherence to medical recommendations in diabetic patients is not the norm. A pervasive problem with adherence to medical regimens has been demonstrated for dietary control, regular exercise, glucose monitoring, and medication adherence (Bond & Hussar, 1991; Glasgow, 1991; Mason, Matsuyama, & Jue, 1993; Paes, Bakker, & Soe-Agnie, 1997; Skaer, Sclar, Markowski, & Won, 1993). A lack of adherence to medical regimens not only results in further health complications, as previously illustrated, but is also problematic for other reasons. Patients with poor metabolic control have higher utilization of the health care system. Previous research has demonstrated an increased number of clinic visits, hospital admissions, and emergency room visits by patients with poorly controlled diabetes compared to those with well-controlled diabetes (Bond & Hussar, 1991; Cowen, Jim, Boyd, & Gee, 1981). Further, poor metabolic control and adherence behaviors among diabetics are related to poorer levels of adjustment to their disease (Jacobson et al., 1990) and poorer quality of life (Weinger & Jacobson, 2001).

Given the deleterious health, economic, and quality of life costs associated with non-adherence, it is important for health care providers to use whatever resources are available to improve patient adherence. There is a critical need to identify variables that affect an individual's ability to maintain a diabetic regimen (Kavanagh, Gooley, & Wilson, 1993). Because psychosocial factors are related to nearly every aspect of diabetes treatment, it may behoove health care providers to understand their influence on adherence behaviors.

REVIEW OF LITERATURE

Health Locus of Control

Health behavior theorists have attempted to explain how and why individuals engage in health risk behaviors or adopt healthy behaviors (Conner & Norman, 1996; Weinstein, 1993). Commonly, health behavior theories emphasize the importance of people's perceptions as to whether they are in control of their health or not. In fact, most of the renowned theories of health behavior have in some way incorporated the construct of perceived control (Weinstein, 1993). For example, Ajzen's (1975, 1980) Theory of Planned Behavior states that perceived behavioral control is one of three variables that strongly predict intentions to perform behaviors. The Health Belief Model discusses locus of control in terms of its direct impact on health behaviors (Becker, 1974) and the "Goodness of Fit" hypothesis claims control as an integral part of the appraisal process of coping with stressors, which has an impact upon health behavior choices. Finally, and perhaps most importantly, Rotter (1966) originated the concept of 'Locus of Control (LOC)' in his Social Learning Theory.

LOC has become a well-known construct in the realm of social-health psychology. Rotter coined the term 'LOC' and then developed a scale (i.e., the E-I scale) to measure the construct. At that time, he delineated two forms of LOC (i.e., Internal vs. External) that could influence a person's decision to perform behaviors. Rotter conceptualized LOC as a personality trait, positing that a person develops generalized expectancies, or perceptions of personal control, through experiences in a wide range of situations, and by adulthood, has stabilized these expectations (Rotter, 1954). He defined an external LOC as the belief that outside forces (e.g., chance/luck, powerful others, God) were responsible for how things turned out in a certain situation. Internal control was described as a belief that one has the ability to influence and change situational variables (Rotter, 1966).

Since the seminal works concerning LOC, there has been much debate regarding how it should be conceptualized and operationalized (Wallston, 2001). LOC is posited to vary based on context and has often been defined as 'the belief that one can determine one's own internal states and behavior, influence one's environment, and/or bring about desired outcomes' (Wallston, Wallston, Smith, & Dobbins, 1987, p. 5). It is a construct heavily based on beliefs. Definitions have moved away from LOC denoting a stable personality style and the construct is now viewed in terms of its transient relationship to specific behaviors or situations. Perceptions of control can be accurate or inaccurate, but even if totally based on false perceptions, these perceptions can have a strong impact on behaviors and psychological outcomes (Rodin, 1990).

Internal Health Locus of Control

Research demonstrating the impact of health LOC on behavior has traditionally emphasized the importance of Internal Locus Of Control (ILOC) rather than external LOC. ILOC has been referred to as the pivotal interaction of health beliefs, heath behaviors, and health outcomes (Wallston, Wallston, & DeVellis, 1978; Wallston & Wallston, 1982; Wallston, 2001). For example, high levels of internal control beliefs have been linked with low levels of mortality and fewer activity limitations in medically ill patients (Seeman & Lewis, 1995). Further, Eizenman and colleagues (1998) found that an internal sense of control was linked to positive cognitive, psychological, and physical health outcomes in elderly adults (Eizenman, Nesselroade, Featherman, & Rowe, 1998). Similarly, Weaver and Gary (1996) linked low levels of internal control to decreased exercise and greater levels of depression in Black patients between the ages of 55-91 years. Finally, Van den Akker and colleagues (2001) recently conducted a longitudinal study with 3551 subjects and demonstrated that after adjusting for basic socio-demographic variables, high ILOC is even protective for the occurrence of morbidity (Van den Akker, Buntinx, Metsemakers, van der Aa, & Knottnerus, 2001).

Internal Locus of Control and Adherence Behaviors

Adherence to medical regimens may be greatly affected by an ILOC. How well a patient adheres to a medical regimen depends, in part, on his or her beliefs and cognitions (Bandura, 1997). Thus, the degree to which patients believe they can control health status or outcomes has an impact upon their motivation to perform self-care behaviors (e.g., exercise, diet, taking medications). This relationship has been studied across a number of medical conditions. The common hypothesis has been that individuals with a greater endorsement of ILOC regarding their health status should have better health behaviors than do persons with less internal control beliefs. The rationale behind this theory stems from work suggesting that the perceived control over health may actually serve to promote mental and physical health (Cantor & Hunt, 1987; Taylor & Brown, 1988). Thus, researchers have speculated that individuals who feel in control of their health (i.e., those who have high ILOC) will take more responsibility for their health and will be more likely to perform health behaviors suggested by health care providers than will individuals who do not feel in control of their health (i.e., those who have low ILOC).

However, research on the influence of an ILOC on adherence behaviors has been somewhat disappointing (Maddux, Brawley, & Boykin, 1995; Wallston, 1992). Early studies found internally controlled patients to have better health behaviors such as seeking more information about their illness (Seeman & Evans, 1962; Wallston, Maides, & Wallston, 1976), greater success in weight loss programs (Balch & Ross, 1975; Kincey, 1981; Tobias & MacDonald, 1977), and greater success in smoking cessation programs (Schwebel & Kaemmerer, 1977; Strickland, 1978). Over the years, however, other researches have not found ILOC to be consistently related to successful health behavior change, and reviews of the power of LOC to predict health behaviors have been generally pessimistic (Wallston, 1991; Wallston & Wallston, 1978; Wallston, Wallston, Smith, & Dobbins, 1989).

A similar contradictory trend can be found within the diabetes literature. Although some studies have shown perceived internal control to be associated with better adjustment to diabetes (Burns, Green, & Chase, 1986; Hamburg & Inoff, 1982; Helgeson & Franzen, 1998; Jacobson et al., 1990), better adherence to self-care regimens (Evans & Hughes, 1987; Jacobson et al., 1986), and better metabolic control (Brown, Kaslow, Sansbury, Meacham, & Culler, 1991; Konen, Summerson, & Dignan, 1993; Murphy, Thompson, & Morris, 1997; Reynaert et al., 1995; Stenstrom, Wikby, Andersson, & Ryden, 1998; Surgenor, Horn, Hudson, Lunt, & Tennent, 2000), others have found opposite results. Poorer adjustments to diabetes and poor metabolic control have been found among diabetic patients with high ILOC (Burns et al., 1986; Dunn, Smartt, Beeney, & Turtle, 1986; Edelstein & Linn, 1987; Evans & Hughes, 1987; Hamburg, & Inoff, 1982). Finally, some researchers have neglected to find a link between ILOC and outcomes in diabetic patients (Aikens, Wallander, Bell, & McNorton, 1994; Bunting & Coates, 2000; Coates & Boore, 1995; Kneckt, Syrjala, & Knuuttila, 1999; Liakopoulou, Korvessi, & Dacou-Voutetakis, 1992; Ruzicki, 1984; Tillotson & Smith, 1996).

Perceived Control Over Health: Beyond Internal Locus of Control

Although researchers have speculated about the causes of the inconsistencies in the diabetic research and in other areas of research that have examined LOC, few have found answers. One reason may be that studies examining the construct of ‘control’ have simply examined ILOC to the exclusion of other constructs that may contribute to ‘control’ (Wallston, 1992). Studies simply using a LOC scale to examine perceived control may not fully tap into or appreciate the construct’s multidimensionality. To examine the influence of perceived control on health behaviors, more than LOC may need to be measured. Kenneth Wallston, an expert in the field of health behaviors and LOC, has argued that an LOC is only a portion of a larger and more important construct called ‘perceived control over health,’ which is related to health behaviors.

In fact, up until the past 10 years, definitions provided to define LOC have actually described something broader than LOC. This is evidenced by the definition of LOC provided earlier, which defined it as 'the belief that one can determine one's own internal states and behavior (LOC), influence one's environment (Self Efficacy), and/or bring about desired outcomes (Outcome Expectancy)' (Wallston, Wallston, Smith, & Dobbins, 1987, p. 5). The two latter ideas described in this definition are the core variables in Bandura's Social Cognitive Theory (1986). Once again, Wallston (1992) labels this larger construct, captured in this definition, as 'perceived control over health.' In an important review article, Wallston (1992) verbalized the need for LOC researchers to concurrently assess other types of perceived control constructs when investigating the relationship between control and health behaviors. Specifically, he has argued that LOC, along with Self-Efficacy and Outcome Expectancy, should be investigated because they are the important constructs that constitute perceived control over health (Wallston, 1992). By combining these three constructs, the result is an integration of two social learning theories to predict health behavior; one by Rotter (1966), which sparked the last 30 years of work on health LOC, and one by Bandura (1986), which centers on Self Efficacy and Outcome Expectancy as the two primary determinants of health behavior. This 'revised social cognitive theory' incorporating LOC, Self-Efficacy, and Outcome Expectancy has received negligible attention in the literature (Wallston, 1992; 2001).

Differentiating Perceived Control Constructs

Although the combination of the three control constructs has not been thoroughly studied, most researchers appreciate the difference between them. This is evidenced by the plethora of review articles and book chapters on perceived control that have outlined the three constructs separately, discussed their importance independently and interdependently, and have voiced a need for future research on the interaction of the three constructs (Rodin, 1990; Maddux et al., 1995; Talbot, Nouwen, Gingras, Gosselin, & Audet, 1997; Wallston, 2001). Collectively, *health LOC* is defined as the belief that one has control over one's health. While Self Efficacy and Outcome Expectancy are also related to beliefs related to one's health, they are quite distinct from LOC (Maddux et al., 1995; McCaul, Sandgren, O'Neill, & Hinsz, 1993; Rodin, 1990; Wallston, 1992). *Self Efficacy (SE)* is defined as confidence that one can perform a particular behavior. A person who believes he is capable of performing a given behavior (e.g., following a diabetic diet) is more likely to perform that behavior (Bandura, 1997). A person's SE for a given behavior is purported to dramatically affect his or her self-motivation for performing that behavior (Bandura, 1997). If a person feels capable of achieving a goal, then he is likely to work harder and give up less easily compared to a person who has low SE (DeVellis & DeVellis, 2001). By these definitions, it should be clear that one's LOC and SE are not necessarily related. For example, a person may believe he has control (ILOC) of his diabetes (e.g., he believes that his behaviors will affect his glycemic control), but may not feel confident (low SE) that he can perform the behaviors to control his blood sugar (e.g., eat a low fat diet, take medication, exercise daily).

Outcome Expectancy (OE) must also be considered separately. *OE* is defined as the attitude that a behavior will produce a desired effect or, more within health behavior models, the belief that following medical regimen recommendations will actually result in improved health outcomes (Maddux et al., 1995; McCaul et al., 1993; Rodin, 1990; Wallston, 1992). Researchers have recently demonstrated the importance of expectations of behavioral outcomes (Anderson, Winett, & Wojcik, 2000; Hallam & Petosa, 1998; Morrill, Ickovics, Golubchikov, Beren, & Rodin, 1996). The sense that a behavior will result in desired outcomes, more so than actual outcomes, influences the likelihood that a behavior will be performed (Bandura, 1997). Although OE can be related to both LOC and SE (Bandura, 1977; Rodin, 1990), it may contribute to behavior independently of LOC and SE (.Bandura, 1997; DeVellis & DeVellis, 2001; Maddux et al., 1995). That is, a person may believe that he primarily controls or does not control his diabetes (ILOC), that he can adhere to his medical regimen if he desires (high SE), but may not perform the behaviors because he does not believe taking his medication, dieting, and exercising will result in glycemic control (low OE). Thus, despite high ILOC and SE, low OE of health behaviors may contribute to poor adherence behaviors.

<u>Internal Locus of Control and Self Efficacy.</u> Independently, a number of studies have found a positive relationship between SE and adherence with medically recommended health behaviors (Bandura, 1997; Conn, 1998; Maddux et al., 1995; O'Leary, 1985). Greater SE is positively related to the promotion of health behaviors such as exercise (Brawley & Rodgers, 1993; Kaplan, Atkins, & Reinsch, 1984; McAuley, 1991, 1994), smoking cessation (Bagozzi & Edwards, 1998; Haukkala, Uutela, Vartiainen, Mcalister, & Knekt, 2000), condom use (DiIorio, Dudley, Soet, Watkins, & Maibach, 2000; Fishbein et al., 2001; O'Leary, Goodhart, Jemmott, & Boccher-Lattimore, 1992), and breast self-examinations (Alagna, Morokoff, Bevett, & Reddy, 1987; Rippetoe & Rogers, 1987). Previous research also suggests that high rates of SE enhances adherence to diabetic control regimens (Glasgow et al., 1989; McCaul, Glasgow, & Schafer, 1987); however, many of these studies have methodological problems (Maddux et al., 1995). One of the most serious mistakes repeatedly made is using OE scales to measure SE (Crabtree, 1986; Grossman, Brink, & Hauser, 1987; Padgett, 1991). On the other hand, some methodologically sound studies that have accurately measured SE have found it to be a good predictor of adherence with various aspects of a diabetic regimen (Glasgow et al., 1989; McCaul et al., 1987).

Previous research with medical samples outside of diabetes has found an interaction between SE and LOC (Brownell & Cohen, 1995; McCaul et al., 1993; Ricker, Delamater, &

Hsu, 1998). For example, an internal perceived illness control and high SE has been linked to better dietary regimen adherence (Brownell & Cohen, 1995), regimen adherence in cystic fibrosis (Ricker et al., 1998), compliance with fluid regimens in patients end-stage renal disease (Schneider, Friend, Whitaker, & Wadhwa, 1991), pain tolerance (Litt, 1988), and adherence to exercise programs (Chen, Neufeld, Feely, & Skinner, 1999). Although there has been some support for the role of SE and ILOC in predicting medical regimen adherence in Type 1 diabetics (Glasgow, Toobert, Hampson, & Wilson, 1995; Talbot et al., 1997), this interaction has not been well researched with Type 2 diabetics. Findings with other medical populations, dealing with similar behavior changes, suggest that there may be an interaction effect for ILOC and SE on adherence to diabetic regimens in Type 2 diabetics.

Internal Locus of Control and Outcome Expectancy. OE has not received as much research attention as has SE. The small amount of work that has systematically evaluated this variable has found OE to be positively related to health behaviors such as condom use (Morrill et al., 1996), nutritional behavior (Anderson et al., 2000), and exercise (Hallam & Petosa, 1998; Rodgers & Brawley, 1996). Also, unlike SE, the relationship between OE and adherence behaviors in diabetic patients has not been well established. Researchers have found outcome expectancies to predict compliance among diabetics (McCaul et al., 1987), but not as well as have SE or LOC (Maddux et al., 1995; Wallston, 1992). Finally, a link between OE and LOC has also not been well researched. Over the past few years, researchers have stressed the importance of differentiating between the two constructs, however, literature measuring both variables is scarce (Maddux et al., 1995). However, two studies within the pain literature demonstrated that a low ILOC is related to low OE among patients coping with pain (Melding, 1995; Wells, 1994). Although both of these studies were conducted in patients with chronic pain, not in diabetic patients, they have important findings; external health LOC related to pain is correlated with weak beliefs that an intervention will produce a desired outcome. Extrapolating these findings to other health behaviors, it is hypothesized that external LOC would be related to poorer OE for adhering to medical treatment recommendations.

Internal Health Locus of Control, Self-Efficacy, and Outcome Expectancy. Only a limited number of studies have examined moderators of ILOC and health behaviors (Wallston, 1992; Wallston, 2001), and there have been no studies to date that have conjointly examined the three most salient constructs of control (i.e., ILOC , SE, and OE) in relation to medical regimen adherence behaviors (Maddux et al., 1995; Wallston, 1992). Therefore, there has also been no work in this area among diabetic patients. The present study will be the first of its kind to perform an evaluation of these three constructs in relation to adherence behaviors and will do so in a diabetic population.

In summary, it has been established that SE is positively related to adherence behaviors in diabetics. It has also been established that high SE is correlated with ILOC in relation to the adoption of health behaviors; however, this relationship has not been widely researched in diabetic populations. Further, although some limited research has linked high ratings of OE to better health behaviors, this construct has not received much attention regarding its relationship to diabetic adherence behaviors. Finally, the interaction of OE and ILOC, and the relationship because ILOC, SE, and OE is scarce in the medical literature.

External Health Loci of Control

Another problem that is apparent when reviewing the health LOC literature related to adherence behavior is the neglect of external LOC (Mackenbach, Borsboom, Nusselder, Looman, & Schrijvers, 2001). External health LOC is the sense that one's health outcomes or health status is reliant upon external forces. External health LOC has most often been assessed using the Multidimensional Health LOC (MHLC) scale, which will be discussed in detail later in the present paper (Wallston, Stein, & Smith, 1994). This most recent version of this scale categorizes external LOC into 4 types of external beliefs; that God, health care providers, powerful others, or chance/fate influences health outcomes. External LOC beliefs are not seen as mutually exclusive from each other or as diametrically opposed to ILOC. On the contrary, research has shown that individuals can have high LOC across a few different types of LOC (Peyrot & Rubin, 1994; Sensky & Petty, 1989; Stenstrom & Andersson, 2000; Wallston et al., 1994; Wallston et al., 1999). Although the MHLC scale, and other scales, have been validated across numerous illnesses, studies focusing on health LOC often measure internal control to the exclusion of external control (Shapiro et al., 1996; Wallston, 1989). This neglect is surprising given the long established validity of conceptualizing the construct of LOC as multidimensional and not simply unidimensional (Shapiro, Schwartz, & Astin, 1996). It is also surprising because external LOC beliefs are commonly found amongst medical patients, particularly in the proposed study's population (i.e., low-income). Some individuals are often prone to blaming external forces for their own poor health behaviors or outcomes (Oprendek & Malcarne, 1997; Perrig-Chiello, Perrig, & Staehelin, 1999). Further, previous research has demonstrated that low-income, Black individuals with diabetes report significantly stronger external health LOC than do middle class, White, diabetic patients (Bell, Summerson, & Konen, 1995). Finally, patients with Type 2 diabetes, compared to Type 1 diabetes, report very strong perceptions of external control (Konen et al., 1993). For these reasons, external LOC should be considered, as should be ILOC , when investigating perceived control influences on adherence behaviors in low-income individuals with Type 2 diabetes.

Studies investigating the role of a unidemensional construct of external LOC suggest it is related to poor health behaviors and deleterious outcomes in patients with chronic illness (Mackenbach et al., 2001). Patients with various chronic illnesses, with high external LOC , report poorer physical functioning than do those with weaker external LOC (Mackenbach et al., 2001). Further, diabetic patients with high external LOC endorsements have shown poor short-term and long-term medical regimen adherence behaviors (Schwartz, Coulson, Toovey, Lyons, & Flaherty, 1991). Finally, external beliefs have been linked to an increased development of health problems among healthy subjects (Van den Akker et al., 2001).

A few trends have also been found in studies conceptualizing external LOC as multidimensional (i.e., chance, health care provider, powerful others, and God). The most consistent finding has been that a strong attitude that chance determines health outcomes is significantly correlated with poor health-related outcomes among diabetics, such as poor glycemic control (Peyrot & Rubin, 1994; Sensky & Petty, 1989; Stenstrom & Andersson, 2000) and irrational health beliefs (Christensen, Moran, & Wiebe, 1999). It has also been posited that adherence behaviors among diabetic patients are poor if patients have strong beliefs in the influence of powerful others on their health outcomes (Schlenk & Hart, 1984); however, unlike the influence of chance on health outcomes, this finding has not been replicated. Finally, research has shown that LOC in God over one's health may be negatively correlated with adjustment to disease (Chaplin et al., 2001; Wallston et al., 1999), but not correlated to health behavior medical outcomes such as HbA1c. These findings should be interpreted with caution, given that research with the God scale is relatively new and has not been performed in different cultures such as southern Blacks. Before conclusions can be drawn about the relationship between God LOC and health behaviors, particularly within the Black culture, more research is needed.

The intercorrelations of ILOC with the four primary external LOC beliefs has been examined in only a limited amount of studies with chronically ill populations (Wallston, Stein, & Smith, 1994; Chaplin et al., 2001; Wallston et al., 1999). ILOC is usually positively correlated with health care provider beliefs (Wallston et al., 1994; 1999). If a patient has a strong sense that she controls her health, she is also more likely to believe her physician will have control over her health. Both ILOC and health care provider LOC, have been linked with positive health behaviors (Peyrot & Rubin, 1994; Sensky & Petty, 1989; Stenstrom & Andersson, 2000). Conversely, ILOC is usually negatively related to chance health LOC (Wallston et al., 1994; 1999). In other words, individuals with a strong ILOC often report weak beliefs in the power of chance to control their health. Finally, previous research has failed to demonstrate a positive or negative relationship between ILOC and the two other external scales (i.e., powerful others or God). The present study will attempt to replicate these intercorrelations (Wallston et al., 1994; 1999).

Although the relationships between internal control and external LOC have been established, the interaction between external and internal beliefs has only been systematically examined in one study. Stenstrom and colleagues (1998) published a study that examined the interactions of internal locus of control beliefs with external beliefs and their relationship with diabetic adherence in Type 1 diabetic patients. The authors examined the interactions by artificially dichotomizing patients' scores on the original MHLC; thus, each patient was either rated as high or low in ILOC, chance LOC, and healthcare providers LOC. The authors then categorized patients as one of eight possible combinations of LOC ratings. Their results suggested that individuals who were high ILOC and low chance LOC had the best adherence to their diabetic regimen, as indicated by low HbA1c levels. Although this study had novel and interesting findings, there were a few limitations to the investigation. First, the authors artificially dichotomized individuals' LOC ratings. There are many problems with artificial dichotomy including the primary complaint that individuals who have scores in the center of the continuum are placed in the high or low category based on arbitrary guidelines. Another problem with this study was that the authors do not provide demographic information regarding income level, education level, or racial characteristics of the sample. Finally, the MHLC scale only examined chance and powerful others LOC and did not investigate healthcare providers and God external LOC beliefs.

The present study attempted to rectify these limitations found in the Stenstrom study by evaluating the interaction of internal and external LOC without artificially dichotomizing the data, sampling patients with specific demographic characteristics, and by using a LOC scale that queries healthcare provider and God LOC beliefs as well as chance and powerful others.

The Assessment of Control Constructs

Patients' perceptions of control, SE, and OE can be derived from various methods. To achieve a methodologically sound study, the present project used only standardized measurement tools. A wide range of assessment tools are available to choose from to measure ILOC, SE, and OE (Wallston, 1989). The following scales were chosen because they meet four criteria; 1) good psychometric properties, 2) used and validated in diabetic medical populations, 3) under a 5th grade reading level, and 4) disease specific for diabetes-related adherence behaviors (Bradley, 1994). The fourth criteria stems from research suggesting specificity is important in using measurement tools to predict behavior. Level of Specificity theory, developed by Ajzen and Fishbein (1980), posits that the degree of specificity in the measurement method should agree with the degree of specificity in the phenomenon of interest. Thus, when studying general health outcomes, a general measure should be used, whereas when measuring specific health outcomes (e.g., glycemic control in Type 2 diabetics), a specific assessment tool that taps into beliefs about controlling diabetes should be used (Kohlmann et al., 1993). Many researchers have argued that generalized control expectancies are of little use in predicting specific behavior outcomes

(Fishbein & Ajzen, 1985; Lefcourt, Martin, & Saleh, 1984). The following three scales were used to measure perceived control constructs related to diabetic regimen adherence.

Internal and External Loci of Control

LOC is most often conceptualized as an independent variable in psychological research and is often measured by paper and pencil scales (Wallston, 2001). Rotter's original I-E scale was one of the most frequently used scales and was applied to many behaviors, including health behaviors (Wallston & Wallston, 1978); however, it was not until the first health LOC scale (HLC) was created by Wallston and colleagues (1976) that the impact of perceived illness control on health behaviors was truly appreciated. The original health LOC scale was designed to cover a wide range of health-related behaviors and health-related situations, which made it sometimes difficult to predict specific health behaviors (Wallston, Wallston, Kaplan, & Maides, 1976). The original HLC scale was revised into the Multidimensional Health LOC (MHLC) scale because factor analyses demonstrated external LOC was multidimensional (Wallston et al., 1994). Specifically, researchers demonstrated three distinct types of external health LOC 1) external-chance/fate, 2) external-powerful others, and 3) external-health care providers. Further, in the past few years, the same researchers added another 6 items to the MHLC scale that tapped into belief about God controlling one's health outcomes (Wallston et al., 1999).

The God LOC Scale was created because there is little known about how deferring to God or a higher being affects health behaviors (Wallston et al., 1999). This is an important area to investigate because research shows that 94% of adults in the United States believe in God, 90% pray to God, and a majority participates in religious practices (Park & Cohen, 1992). Though religious values seem to be pervasive throughout American culture, religiously based health beliefs have not received attention. One reason for this insufficiency is a lack of measurement tools to study this construct. Recently, Wallston and colleagues (1999) developed the first scale to measure religiously based health beliefs that could be applied to a specific disease state (Wallston et al., 1999). Because the authors of this scale are also the creators of the MHLC scale, it was designed to be used with the MHLC, form C. The God Health LOC (GHLC) scale measures the extent that an individual believes that God exerts control over a specific disease. It has been validated with two medical populations. Given the novelty of this scale, there has been no research published using this scale in conjunction with the MHLC in diabetic populations. Further, there has been limited research that has linked GHLC scores with medical outcomes such as indices of medical regimen adherence (e.g., HbA1C's in diabetics) to determine the relationship between the scale and health behaviors. When used in its most recent form, the MHLC is now a 24-item scale, which is a disease-specific scale and consists of five subscales measuring internal and four types of external LOC (Wallston et al., 1994; Wallston et al., 1999). The MHLC is the most widely used scale to measure perceived health LOC and has been used across a wide range of medical populations, including diabetes (Bradley, 1994).

Self-Efficacy

The measurement of SE has received much attention in the past few years (DeVellis & DeVellis, 2001). SE is usually measured by asking people 'how confident are you that you can do X behavior?' Most responses are based on Likert scale options that indicate degree of confidence in ability to carry out a behavior. Like the measurement of similar constructs, avoidance of ambiguity, use of multiple rather than single indicators, and sensitivity to level of specificity is important when assessing SE (DeVellis & DeVellis, 2001; Maddux et al., 1995). Most recently, level of specificity has become a salient topic related to measuring SE. There has been a movement toward acknowledging that SE is not a unitary construct but an attribute that will vary within the same individual across many domains (DeVellis & DeVellis, 2001).

Therefore, it is important that SE be measured in correspondence with a specific behavior in mind and not in broad terms.

Many researchers have followed Bandura's original suggestions concerning how to accurately assess SE. SE has been assessed across a wide range of behaviors (DeVellis & DeVellis, 2001) and many researchers have used scales created specifically for their research project. When available, however, it is prudent for researchers to use previously validated measurement tools. Recently a group of researchers developed and validated a 7-item scale to assess SE regarding adherence to diabetic regimens (Talbot et al., 1997), which was used in the present study.

Outcome Expectancy

OE refers to a person's attitude that performing a certain behavior will result in a desired outcome. Although OE has been previously mistaken for LOC and SE (Devins et al., 1982), it is now accepted that the constructs are separate (DeVellis & DeVellis, 2001; Kirsch, 1995; MacLeod, 1999). Studies that have examined predictors of health behaviors have found LOC and OE to have unique contributions to models of behavior (Hofstetter, Sallis, & Hovell, 1990; Morrill et al., 1996; Ollendick & Schmidt, 1987). Whereas an ILOC refers to whether individuals feels in control of their health outcomes, OE involves the feeling that performing certain health behaviors will actually result in a desired outcome. For example, a diabetic woman may believe that she is in control of her diabetes (high internal control), but not feel that performing the recommended health behaviors (e.g., eating right, exercising, taking medication) will result in better health. Conversely, another woman may not feel in control of her diabetes (low internal control), but have a positive OE that performing her diabetic care behaviors will result in better health.

In order to measure OE, a researcher must ask questions that tap into anticipated outcomes. To accurately assess anticipated outcomes, questions regarding the importance of performing a behavior in relation to certain outcomes are often presented. Although many researchers create their own scale to measure OE (Fishbein et al., 2001), recently a group of researchers created and validated a 6-item scale that assesses OE regarding adherence to diabetic regimens (Talbot et al., 1997) that was used in the present study.

PURPOSE OF STUDY

Summary

Patients with Type 2 diabetes often do not adhere to their treatment regimen (e.g., exercise, diet, medication, glucose monitoring) prescribed by their physicians. Inadequate adherence results in poor metabolic control, further morbidity and mortality, and increased health care utilization and costs. It is imperative to understand the contribution of various psychosocial factors to non-adherence in diabetic patients to promote better self-care. Health behavior models attempt to predict how certain variables will affect health behaviors and one common thread among theories is the importance of perceived control. The amount of control patients believe they have regarding illnesses [i.e., health locus of control (LOC)] can influence adherence to medical regimens. Although some research has investigated internal health locus of control (ILOC) in relation to medical treatment adherence in Type 2 diabetic patients, inconsistent findings have been reported. These inconsistencies may be related to a need for further exploration of the interaction of ILOC with other perceived control constructs [i.e., self-efficacy (SE) and outcome expectancy (OE)], as well as with other external LOC constructs. Knowledge of the perceived control constructs, such as ILOC, SE, OE, and types of external LOC, and their influence on health related outcomes is important in that they may provide valuable information for clinical interventions, which may lead to better adherence and medical outcomes among Type 2 diabetic patients.

First, this study examined the relationship between ILOC, SE, and OE in relation to medical regimen adherence behaviors in low-income patients with Type 2 diabetes. Further, the interactions of perceived control constructs with ILOC were evaluated. The two main constructs of Bandura's Social-Cognitive theory, SE and OE, were expected to interact with ILOC to influence general diabetes adherence behaviors. SE has been linked to health behaviors in its solidarity and in conjunction with ILOC, but this link has not been thoroughly researched in diabetic populations. Further, OE has also been positively linked with good health behaviors; however, research on this construct is scant in comparison to SE, and the interaction of OE and ILOC has not been examined in relation to adherence behaviors.

This study also examined the influence of four types of external LOC, independently and when combined with ILOC, on medical regimen adherence behaviors in a sample of low-income patients with Type 2 diabetes. Most health LOC research has targeted internal control to the exclusion of external control influences. Previous research has demonstrated that external health LOC beliefs have been found among medical patients with chronic illnesses, particularly patients who are Black and those with Type 2 diabetes. Further, external LOC beliefs have been linked to poor adherence behavior among general medical patients. Specifically, a strong sense that chance impacts health outcomes is associated with poor adherence behaviors. The influences of other types of external health LOC (i.e., health care provider, powerful others, and God) on health behaviors have not been as well established in patients with Type 2 diabetes, and there has been only one previous investigation of the interaction of ILOC with external LOC beliefs in relation to medical regimen adherence behaviors.

Finally, it should be noted that pervasive through the perceived control and adherence behavior literature is a lack of use of diabetes-specific scales. Instead, broadband scales asking questions about general health control perceptions (e.g., how much control do you feel you have over your health?) have been used. This is a salient issue because diabetes-specific scales are the most appropriate to use if one is targeting diabetes-specific outcomes (Ajzen & Fishbein, 1980). Also, throughout the literature there is little research on low-income, minority patients with diabetes, with research conclusions based on work with White, middle class individuals. Given that the majority of Type 2 diabetics in the United States are of low-income and Black, this is a large oversight and research is needed that samples Blacks as well as individuals from various economic levels. The present study was the first to examine perceived control constructs in a low-income, predominantly minority, Type 2 diabetic population. It was also the first investigation to use the MHLC external scales, with the additional God subscale, in a low-income population. Finally, this was the first study to use the MHLC external scales, with the additional God subscale, in a Type 2 diabetic population. To answer the primary questions in this study, a biological marker, HbA1c, the gold standard of medical indicators for adherence behaviors among diabetic patients, was used to indicate gradations of medical regimen adherence.

Research Questions and Hypotheses

The following questions were addressed:

Question 1. Are internal locus of control, self-efficacy, and outcome expectancy separate constructs?

Hypotheses: Based on previous research, it was hypothesized that ILOC, SE, and OE are separate constructs. This was determined by examining the correlations between the three variables with stronger correlations (closer to 1) indicating more overlap between the constructs.

Question 2. Type and strength of relationship between internal locus of control, self-efficacy, and outcome expectancy (see Table 1)?

Hypotheses: Based on previous research, it was hypothesized that ILOC would be positively, but moderately, correlated with greater ratings of SE and OE. Further, it was expected that SE and OE would be positively, but moderately, correlated (see Table 1).

Table 1: Hypothesized Relationships Between Internal Health LOC, SE, and OE

Perceived Control Construct	**ILOC**	**SE**	**OE**
ILOC		+	+
SE			+
OE			

+ = Positive correlation expected

Question 3. Which variables (internal locus of control, self-efficacy, and outcome expectancy) are the best predictors of medical regimen adherence (HbA1c) in low-income patients with Type 2 diabetes?

Hypotheses: It was hypothesized that all three constructs would be related to HbA1c levels. However, SE was expected to be the best predictor of HbA1c, with higher levels of SE related to better control of diabetes. ILOC was postulated to be the second strongest predictor, and OE to be the variable most weakly related to medical regimen adherence.

Question 4. Do interactions of the three control variables contribute significant variance in predicting medical regimen adherence (HbA1c) beyond the main effects of the three constructs, in low-income patients with Type 2 diabetes?

Hypotheses: It was expected that the interactions of the three constructs would account for additional significant variance beyond the variance accounted for by the main effects of ILOC, SE, and OE in predicting HbA1c.

Question 5. Which of the six predictor variables, including interaction variables, accounts for the most variance in predicting HbA1c levels?

Hypotheses: There have been no studies in the literature examining the interaction of ILOC, SE, and OE. Thus, a hypothesis could only be made based on theory and not on previous empirical support. Based on theories that purport higher levels of ILOC beliefs (Rotter, 1966), as well as greater feelings of SE and OE, are related to better adherence behaviors, it was posited that a three way interaction of high endorsements of ILOC, SE, and OE would be the strongest predictor of HbA1c.

Question 6. What is the type and strength of relationship between self-efficacy, outcome expectancy, and the four types of external loci of control?

Hypotheses: It was expected that SE and OE would both be negatively correlated with chance LOC, God LOC, and powerful others LOC. However, based on previous research demonstrating that healthcare provider LOC is often positively related to ILOC and positive health behaviors, positive correlations were expected for SE, OE and healthcare provider LOC.

Question 7. What is the type and strength of relationship between the five types of loci of control including internal, chance, powerful others, health care provider, and God (see Table 2)?

Hypotheses: It was expected that the results for this study would be a replication of previous work that has examined the relationships between the five LOC subscales. Table 2 illustrates the expected relationships between the five types of health LOC.

Table 2: Hypothesized Relationships Between 5 Dimensions of Health LOC

Subscales	**Internal**	**Chance**	**Health Care Providers (HCP)**	**Powerful Others (PO)**	**God**
Internal		-	+	NC	NC
Chance			NC	+	+
HCP				+	NC
PO					+
God					

+ = positive correlation expected
- = negative correlation expected
NC = No correlation expected

Question 8. Which of the five types of loci of control contribute the most variance to predicting medical regimen adherence (HbA1c)?

Hypotheses: Based on previous literature, ILOC was expected to have the strongest relationship with HbA1c. Research has also shown that a strong belief in the power of chance to influence health outcomes is related to adherence behaviors in diabetic patients. Therefore, chance LOC was expected to be the second strongest variable related to HbA1c levels. God LOC was expected to be the third strongest variable. Finally, external beliefs in health care providers were expected to have the fourth strongest influence and powerful other LOC would have the least influence on HbA1c.

Question 9. Do the interactions of internal control beliefs with the four external loci of control scales contribute significant variance in predicting medical regimen adherence (HbA1c), beyond the main effects of the five loci of control independent variables?

Hypotheses: The interactions of the internal control scale with the external control scales were expected to account for additional significant variance beyond the variance accounted for by the main effects.

Question 10. Which predictor variables (i.e., internal, chance, powerful others, health care providers, God, internal *x* chance, internal *x* powerful others, internal *x* health care providers, and internal *x* God) accounts for the most variance in predicting HbA1c?

Hypotheses: The literature is not adequate to predict the interaction of the external scales with ILOC in relation to adherence behaviors in low-income Type 2 diabetic patients. Therefore, this analysis was predominantly exploratory in nature. However, as previously discussed, high ratings of chance LOC are related to poor adherence behaviors, whereas high ratings of ILOC are related to good adherence behaviors. Thus, it was hypothesized that the interaction of high ILOC and low chance LOC scores would account for the most variance in HbA1c compared to other predictor variables.

METHODS

Participants

Participants for the present study were recruited from the Diabetes Disease Management Clinic at Earl K. Long Medical Center. This program consists of outpatient diabetes care management provided by a team of health care professionals, including a primary care physician, diabetes nurses, diabetes educators, and nutritionists. Patients who had been diagnosed with Type 2, non-insulin-dependent diabetes, prescribed medication to treat their diabetes, were attending a routine, 3-month, follow-up visit, and who were over the age of 18 years were recruited for this study. Only participants attending 3-month, routine visit were approached to participate. In order to attend a 3-month visit, patients must have had recent (past 2-3 months) blood work performed at the EKL Hospital blood laboratory. Patients were excluded if they were under the age of 18, had been diagnosed with Type I, insulin-dependent diabetes, did not have a recent (i.e., past 2 months) HbA1c level recorded in their medical chart, were not attending a standard, 3-month, follow-up visit, were not being treated pharmacologically, or if they could not orally comprehend at a 5^{th} grade level as indicated by the Woodcock Johnson-Oral Comprehension test.

Measures

Demographic Questionnaire

A demographic questionnaire was administered to all participants in order to collect the following information: name, hospital number, type of diabetes (I or II), time since diabetes diagnosis, date of birth, sex, marital status, age, race, and highest level of education completed.

Woodcock Johnson- Oral Comprehension

The Oral Comprehension section of the Woodcock-Johnson III –Test of Achievement (Woodcock, McGrew, & Mather 2001) was used to determine if participants' comprehension abilities were adequate to understand the questions contained in the study questionnaires. The Woodcock Johnson III is a standardized test of achievement that was revised in 2001. Oral comprehension is a subtest of the Woodcock Johnson that tests oral language. Oral language is measured by the ability to comprehend a short passage and subsequently supply the missing word using syntactic and semantic cues. The oral cloze procedure requires the use of listening, reasoning, and vocabulary abilities. The test begins with simple analogies and associations and progresses to more complex passages. Oral Comprehension has a median reliability of .80 in the age range of 5 to 19 years and .89 in the adult range. For the purposes of the present study, participants had to demonstrate at least a 5th grade oral comprehension level. Patients were provided question items 1-13 and had to answer them correctly to demonstrate a 5th grade comprehension level. This cut-off was determined because the scales being used in the present study have a 5th grade reading level. Patients who did not pass the comprehension test (n=3) were not included in the study and their participation was immediately terminated. However, they were still paid five dollars for their time.

The Multidimensional Health Locus of Control Scale

The Multidimensional Health LOC scale (MHLC-Form C; Wallston et al., 1994) was administered to the patients. This scale is a revised version of the original MHLC scale by Wallston, Wallston, & Devillis (1978). This MHLC consists of 18 items and taps into beliefs that the patient controls his or her own health. Responses are based on a 6-point Likert scale with answers ranging from 1=strongly disagree to 6=strongly agree. The internal and external/chance subscales consist of 6 items and scores range from 6 to 36, with greater scores indicating stronger belief in the specific LOC. The external/powerful others and external/health care providers subscales consist of three items with scores ranging from 3 to 18, with higher scores indicating stronger belief in that type of LOC. The scale has adequate internal consistency with cronbach alphas ranging from .70 to .87 (internal = .87; chance = .82; powerful others = .70; health care providers = .71). Research with this scale has also demonstrated adequate test-retest reliability ($\underline{r}$ = .80) and good concurrent validity with other measures of health LOC ($\underline{r}$ = .59). This scale has been adapted for various specific diseases including diabetes (Wallston et al., 1994), which was used in the present study.

The God LOC Scale (GLHC - Wallston et al., 1999) was developed to assess the extent of an individual's belief that God controls his or her health status. The GLHC consists of 6 items and was created to be used along with the MHLC scale, Form C; thus it is a disease-specific scale. Responses are based on a 6-point Likert scale ranging from 1=strongly disagree to 6=strongly agree. Total raw scores range from 6 to 36, with higher scores indicating greater endorsement that God controls health outcomes. Initial studies have demonstrated good reliability and validity in patients with various chronic illnesses such as rheumatoid arthritis (Wallston et al., 1999). Internal consistency estimates for the scale ranged between .87 and .94. The GLHC scale was compared to the four other subscales of the MHLC and results indicate adequate independence of the five total scales. Recently published data supports the contention that the GLHC scale accounts for additional variance that the other MHLC subscales do not measure (Chaplin et al., 2001). The authors of the GLHC scale suggest integrating the 6 items of the scale into the 18-item, Form C, MHLC scale, which creates a final LOC scale that is 24 items in length (Wallston et al., 1999).

The Multidimensional Diabetes Questionnaire

The Multidimensional Diabetes Questionnaire (MDQ; Talbot et al., 1997) is a scale designed to assess diabetes-related social and cognitive factors. The questionnaire consists of three subsections that measure 1) perceptions of diabetes and related social support, 2) positive and misguided reinforcing behaviors related to self-care activities, and 3) SE and OE related to diabetic treatment. Although the MDQ in its entirety was administered for the present study, only section three of the MDQ (SE and OE subscales) was used to answer the present research questions. The SE scale is comprised of 7 items and measures patients' confidence in their ability to perform behaviors specific to diabetes self-care activities (diet, exercise, medication, blood glucose monitoring, and general diabetes management). Responses are based on a scale of 0 (not at all confident) to 100 (very confident). This scale possesses good internal consistency (cronbach alpha = .89) and has adequate external validity in relation to self-report adherence behaviors such as diet (r = .58), exercise (r =.48), and HbA1c levels (r =.28) among diabetic patients.

The OE scale is 6 items and assesses patients' perceptions of the effects of diabetes self-care behaviors on metabolic control and the prevention of complications. Responses are based on a scale of 0 (not at all important) to 100 (very important). The OE scale is also internally consistent (cronbach alpha =.86) and is significantly correlated with diet (r = .23) and exercise (r =.33) behaviors among diabetic patients, though not as strongly as is SE. Finally, correlations between SE and OE scales were low to moderate, indicating they can be accurately conceptualized as distinct but somewhat correlated dimensions (Talbot et al., 1997).

Biological Marker of Medical Regimen Adherence – HbA1c

Adherence to medical regimen in diabetics was measured by the patient's metabolic control, which was determined by glycosylated hemoglobin levels. Glycosylated hemoglobin, or HbA1c, is a biological marker that reflects blood glucose levels over the previous 2-3 months (Gonen, Rubenstein, Rochman, Tanega, & Horwitz, 1977). Hemoglobin is the main component of red blood cells and is a protein that carries oxygen in the blood system (Porte & Sherwin, 1997). When a diabetic patient's blood sugar becomes elevated, the glucose adheres to the hemoglobin, resulting in glycosylated hemoglobin or HbA1c. The new hemoglobin, with attached glucose, is permanent and easy to detect with blood tests (Porte & Sherwin, 1997). A laboratory technique called electrophoresis is performed on blood draws from patients with diabetes. This test separates HbA1c from normal hemoglobin (Porte & Sherwin, 1997). Medical regimen adherence, or glycemic control, over the past 2 to 3 months is indicated by the percentage of HbA1c present compared to normal hemoglobin. These percentages indicate how much hemoglobin has been altered as a result of high blood sugar levels over the past 2 to 3 months. HbA1c levels can only predict glycemic control for the previous 2 to 3 months because the average life span of hemoglobin is approximately 90 days. After 90 days, most hemoglobin will die and new hemoglobin will be formed (Porte & Sherwin, 1997). Thus, if a patient adheres to the medical recommendations and the glucose remains in relative control for 90 days, there will be very low levels of HbA1c in the blood (Porte & Sherwin, 1997). This test for HbA1c is considered an accurate indicator of long-term blood glucose control (Gonen et al., 1977).

The normal range of HbA1c in individuals without diabetes is between 4 – 6 %. A person with diabetes with HbA1c between 4 – 7 % is considered to have good metabolic control; thus good adherence to the diabetic regimen. Results greater than 8% are considered poor or subnormal control (Kavanagh et al., 1993). Finally, 12% and above is considered very poor control (Porte & Sherwin, 1997).

The present researcher collected preliminary pilot data from EKL hospital's internal medicine clinic. A list of HbA1c levels from 1218 Type 2 diabetic patients who attended EKL primary care clinics, and who were on pharmacological agents over the past 12 months, was compiled. Results suggest that out of 1218 patients, 742 (61%) individuals had HbA1c levels under 8% and were considered 'controlled' by their primary care physician at EKL hospital. The remaining 476 (39%) had HbA1c levels greater than 8%, and thus were labeled uncontrolled diabetics by their primary care physician at EKL hospital. Finally, HbA1c levels range in the present diabetic population from below 7% to greater than 12%. HbA1c was treated as a continuous variable in the present study.

Procedure

The primary investigator and two research assistants who were also clinical psychology graduate students collected data from the Internal Medicine and Family Practice clinics at EKL Hospital. The two diabetic clinics' daily appointment lists were reviewed briefly to determine which patients were attending 3-month follow up visits. Patients meeting the inclusion criteria of attending follow up visits were approached in the waiting room of the clinics. If the patient was over 18 years of age, the researcher informed the patients about the nature of the study, time commitment, and monetary compensation that would occur if they were eligible for the study. If patients agreed to participate, they were asked to meet the researcher in the waiting room at the completion of their medical appointments. After their medical appointments were completed participants were asked to provide informed consent. All participants were told that the present study was designed to examine the impact of perceptions of health control on adherence of medical regimens in Type 2 diabetic patients. The researcher explained the inclusion criteria to the participants and informed them that if they failed to meet any of the inclusion criteria (e.g., the oral comprehension requirement), their participation would be terminated. Further, the researcher explained limits of confidentiality. Participants were also informed that their medical chart would be examined and HbA1c levels extracted if they agreed to participate. Finally, participants were told that they had the right to withdraw from the study at any time without penalty, and were able to refuse participation with no risk for detrimental consequences on their medical care. Patients were provided with a copy of the informed consent packet, which contained the researchers' contact information.

After consent was given, participants were briefly interviewed and the oral comprehension portion of the Woodcock Johnson-III was administered. For the purposes of the present study, participants had to demonstrate at least a 5th grade oral comprehension level by answering items 1-13 correctly on the comprehension test. This cut-off was determined because the scales being used in the study have a 5th grade reading level. Patients who did not pass the comprehension test (n=3) were not included in the study and their participation was immediately terminated; however they were still provided five dollars for their time. Patients who demonstrated a 5th grade oral comprehension level went on to complete the other three self-report scales. After the data were collected, the researcher queried the patient about their impressions of the study and provided ample time for the patients to discuss or ask questions about medical regimen adherence and living with Type 2 diabetes. The patients were then paid five dollars and were free to leave the hospital. Finally, the researcher reviewed the patients' medical charts and recorded the most recent HbA1c level.

RESULTS

Descriptive and Frequencies

Demographic Characteristics

One hundred and thirty three patients were approached to participate in the present study. Out of these patients, 8 people refused to participate, 3 did not pass the oral comprehension section of the Woodcock Johnson, and only 13 did not have recent blood work recorded in their medical chart. A total of 109 patients participated in the study. Out of these 109 participants, 26% were male (n=28) and 74% were female (n=81). The average age of the patients was 52 years old (SD = 11.16) and the average years of formal education was 11.5 years (SD = 2.2). Seventy four percent of the participants were Black (n=81), while 26% were White (n=28). Twenty nine percent were single (n=32), 38% were married (n=41), 21% were separated or divorced (n=22), and 13% were widowed.

Patient report, a review of the medical charts, as well as physician corroboration, confirmed the following data regarding patient medical information: All patients who participated in this study were diagnosed for at least one year with Type 2 diabetes mellitus; the average time since diagnosis was approximately 8 years (SD=7.25); 100% were taking medication. Finally, the mean HbA1c level for the present sample was 8.31 (SD=7.27), with reported levels ranging from 4.9 to 15.1 (see Table 7).

Pearson Product Moment Correlations were performed to determine the relationships between the three continuous demographic variables (i.e., age, time since diagnosis, and education level) and the psychological constructs used in the present study (i.e., self efficacy, outcome expectancy, ILOC, God, chance, healthcare providers, and powerful others LOC). Pearson r product moment correlations are presented in Table 3. Age was only significantly correlated with SE. The relationship was positive suggesting that older age is related to greater confidence that one can follow a diabetic medical regimen (i.e., diet, exercise, medication, glucose monitoring). Time since diagnosis was not related to any of the psychological constructs; however, education level was meaningfully related to two of the external LOC scales. External chance and powerful others LOC was negatively correlated with education level indicating that as education level increases, beliefs that chance and other people control health or diabetes decreases.

Table 3

Intercorrelations Between Continuous Demographic Variables and Self-Efficacy, Outcome Expectancy, and Five Loci of Control Scales

	Scales						
Demographic Variable	SE	OE	ILOC	God	Chance	HCP	PO
1.Age	.24*	.13	.14	-.01	-.04	.12	.06
2.Time Since Dx	-.15	-.13	-.10	.10	-.01	.11	.05
3.Education	-.13	.08	.04	-.16	-.27**	.03	-.24*

** $p < .01$ level
* $p < .05$ level

Independent t-tests were performed to determine if race or gender differences existed for SE, OE, or the five types of LOC (i.e., internal, God, chance, healthcare providers, and powerful others). Gender (see table 4) differences in SE, OE, or LOC beliefs were not found. However, racial differences were found; though only one difference was significant at a .05 alpha level. A significant difference was found between Blacks and Whites concerning their belief that God is in control of their diabetes (see Table 5). The means indicate that Blacks have a stronger belief in God LOC than Whites in this sample.

Finally, multivariate analyses of variance (MANOVAs) were performed to determine if marital status was significantly related to SE, OE, or the five types of LOC (i.e., internal, God,

Table 4

Gender Differences in Mean Ratings of Self-Efficacy, Outcome Expectancy, and Loci of Control

Scale	Means (SD)		T-Test Results	
	Male (n= 28)	Female (n= 81)	t (107)	p
1. SE	66.71(22.95)	67.50(21.50)	-.16	.87
2. OE	92.53(10.15)	92.35(13.73)	.06	.95
3. ILOC	4.61(1.18)	4.52(.98)	.38	.71
4. God	3.21(1.28)	3.02(1.37)	.64	.52
5. Chance	2.54(.82)	2.48(1.09)	.24	.81
6. Healthcare	5.17(.88)	5.01(.85)	.82	.42
7. Pow. Others	2.56(1.26)	2.43(1.09)	.53	.60

** $p < .01$ level
* $p < .05$ level

Table 5

Racial Differences in Mean Ratings of Self-Efficacy, Outcome Expectancy, and Loci of Control

Scale	Means (SD)		T-Test Results	
	Black (n=81)	White (n=28)	t (107)	p
1. SE	69.32(22.03)	61.48(20.27)	1.65	.10
2. OE	92.13(13.93)	93.18(9.29)	-.37	.71
3. ILOC	4.45(1.05)	4.82(.97)	-1.66	.09
4. God	3.21(1.33)	2.64(1.32)	1.96	.05*
5. Chance	2.57(1.02)	2.27(1.04)	1.37	.18
6. Healthcare	4.96(.87)	5.31(.80)	-1.86	.06
7. Pow. Others	2.42(1.17)	2.58(1.02)	-.66	.51

* $p < .05$ level

chance, healthcare providers, and powerful others). Significant differences were not found for SE ($\underline{F}$(3, 108) = 1.20, $\underline{p}$=.32), OE ($\underline{F}$(3, 108) = 1.31, $\underline{p}$=.28), ILOC ($\underline{F}$ (3, 108) = 1.07, $\underline{p}$=.36), God ($\underline{F}$ (3, 108) = .40, $\underline{p}$=.75), chance $\underline{F}$(3, 108) = .10, $\underline{p}$=96), healthcare providers ($\underline{F}$(3, 108) = .67, $\underline{p}$=.57), or powerful others ($\underline{F}$ (3, 108) = .31, $\underline{p}$=.82, LOC).

Preliminary Analyses

Pearson product moment correlations were performed to determine if any of the continuous demographic variables were significantly correlated with the dependent variable (i.e., HbA1c). Results showed that HbA1c was not significantly correlated with time since diagnosis ($\underline{r}$ =.11, $\underline{p}$ = .27) or education level ($\underline{r}$ = .06, $\underline{p}$ = .52). However, age was significantly, negatively correlated with HbA1c ($\underline{r}$ = -.36, $\underline{p}$ < .0001); older patients were more likely to have lower HbA1c levels, indicating better adherence to their medical regimens (see Table 6). Age was also meaningfully related to education level and time since diagnosis in that older age was related to less time since diagnosis and lower education level. That is, patients who were older were more likely to have lower HbA1c levels, to have been diagnosed for shorter periods of time, and to have lower education levels.

Next, independent t-tests were performed to determine if categorical demographic variables were meaningfully related to HbA1c. HbA1c was not significantly related to sex $\underline{t}$ (107) =.71, $\underline{p}$=.48, or race $\underline{t}$ (107) = 1.95, $\underline{p}$=.06. Finally, an Analysis of Variance (ANOVA) was conducted to test differences if HbA1c levels differed significantly based on marital status. Results were not significant $\underline{F}$ (3, 108) = .146, $\underline{p}$=.93. Means and standard deviations were calculated for the 5 health LOC subscales (i.e., internal, god, chance, powerful others, and healthcare providers), SE, and OE. Please see Table 7 for means and standard deviations of these psychological variables.

For the each of the health LOC scales, higher scores indicate greater feelings that

Table 6

Intercorrelations Between Age, Time Since Diagnosis, Education, and HbA1c

Variable	1	2	3	4
Patients (N=109)				
1. Age	--	.24*	-.22*	-.36**
2. Time Since Dx		--	-.12	.10
3. Education			--	.06
4. HbA1c				--

** $p < .01$ level
* $p < .05$ level

Table 7

Descriptive Statistics for HbA1c, Self-Efficacy, Outcome Expectancy, and Five Locus of Control Scales

Variable	Mean (SD)	Minimum	Maximum
1. HbA1c	8.38 (7.27)	4.9	15.1
2. SE	67.29 (21.77)	15 (0)	100 (100)
3. OE	92.40 (12.85)	23 (0)	100 (100)
4. Healthcare Providers LOC	5.05 (.86)	2 (1)	6 (6)
5. ILOC	4.54 (1.04)	1 (1)	6 (6)
6. God LOC	3.07 (1.34)	1 (1)	6 (6)
7. Chance LOC	2.50 (1.03)	1 (1)	5 (6)
8. Powerful Others LOC	2.46 (1.13)	1 (1)	6 (6)

diabetes is controlled by said subscale (see Table 7). For example, higher averages for the God subscale (i.e., 5.5) indicates that patients strongly believe that God controls their diabetes and if they get better or worse physically. In Table 7, the health LOC subscales are presented in rank order of highest averages (i.e., health care providers) to lowest averages (i.e., powerful others). Higher scores for SE indicates greater confidence for performing health behavior recommendations to manage diabetes. Finally, higher scores for the OE variable indicates stronger attitudes that performing the health behavior recommendations prescribed by their physicians will actually result in diabetic control and decreased health complications.

Primary Analyses

For all the following regression analyses an apriori acceptance p value <.01 was used. This value was chosen instead of a .05 acceptance value to decrease the likelihood of Type I error, since there were many analyses performed to answer the research questions. Further, for all regression analyses, age was statistically controlled due to its significant relationship with the criterion variable, HbA1c.

Question 1. Are internal locus of control, self-efficacy, and outcome expectancy separate constructs?

Pearson Product-Moment Correlations were performed to determine the relationships between ILOC, SE, and OE. As Table 8 illustrates, hypothesis one that the three variables are separate constructs was supported.

Question 2. Type and strength of relationship between internal locus of control, self-efficacy, and outcome expectancy?

Hypothesis 2 that the three constructs would be significantly, positively, but moderately correlated, was also supported (see Table 8). This is congruent with previous research that has found average correlations between ILOC, SE, and OE to range between .30 and .50 (Talbot et al., 1997).

A simultaneous multiple regression analysis was performed with HbA1c as the criterion variable and ILOC, SE, and OE as the predictor variables. Age was controlled for in this analysis and accounted for 11% of the variance found in the model and had a -.27 partial correlation

Table 8

Intercorrelations Between Internal Locus of Control, Self-Efficacy, and Outcome Expectancy

Scale	1	2	3	4
	Patients (N=109)			
1. ILOC	--	.27*	.25	-.20*
2. SE		--	.31*	-.44*
3. OE			--	-.13
4. HbA1c				--

* $p < .01$ level

Question 3. Which variables (internal locus of control, self-efficacy, and outcome expectancy) are the best predictors of medical regimen adherence (HbA1c) in low-income patients with Type 2 diabetes?

coefficient with the criterion variable. The regression model was significant $R = .52$; $R^2 = .27$; $SE = 2.06$ with the R^2 indicating that the combination of the three variables accounts for 27% of the variance of HbA1c levels in this sample. Also, the partial correlation coefficients and the Beta values (see Table 9) indicate that SE had the strongest relationship with HbA1c levels, which is consistent with our hypothesis for question three. ILOC had the second strongest relationship with HbA1c and OE had the weakest relationship with HbA1c (see Figure 1).

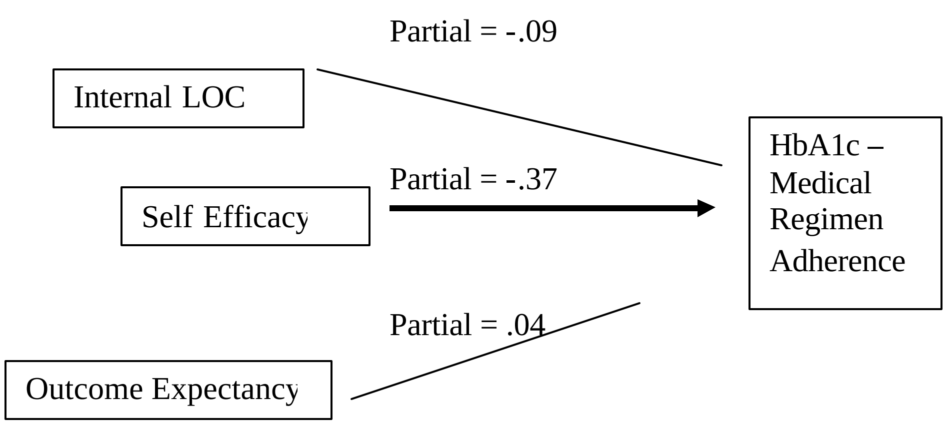

Figure 1: Self-Efficacy, Internal Locus of Control, and Outcome Expectancy in Predicting HbA1c

Table 9

Summary of Simultaneous Regression Analysis for Perceived Control Variables Predicting Adherence to Medical Regimens (i.e., HbA1C levels) (N=109)

Variable	B	SE	Beta	Partial
ILOC	-.18	.20	-.08	-.09
SE*	-3.98	.01	-.37	-.37
OE	6.63	.02	.04	.04

Note: $R = .52$; $R^2 = .27$; $SE = 2.06$ ($p < .01$).
* $p < .01$ level

Question 4. Do interactions of the three control variables contribute significant variance in predicting medical regimen adherence (HbA1c) beyond the main effects of the three constructs, in low-income patients with Type 2 diabetes?

In order to examine the interaction of the three perceived control variables and their relationships with HbA1c, the interaction variables had to be created. First, the three perceived control variables were standardized, or centered, into Z scores, as recommended by Aiken and West (1991). ‘Considerable multicolinearity can be introduced into a regression equation with an interaction when the variables are not centered…centering predictor variables will often help minimize these problems’ (Aiken & West, 1991, pp. 34-35). Next, the centered perceived control variables were multiplied by each other to create the following 3 interaction variables; 1) ILOC X SE, 2) ILOC X OE, and 3) ILOC X SE X OE. Table 10 illustrates the intercorrelations between the 6 variables.

A hierarchical multiple regression consisting of two blocks was then performed to determine if the interaction variables accounted for a significant variance in predicting HbA1c levels, above the main effects of the three perceived control variables. For this regression, HbA1c was the criterion variable and the first block entered consisted of ILOC, SE, and OE. The second block entered consisted of the three interaction variables. Age was controlled for in this

Table 10

Intercorrelations Between Internal Locus of Control, Self-Efficacy, and Outcome Expectancy and Their Interaction Variables

Scale	1	2	3	4	5	6
Patients (N=109)						
1. ILOC	--	.27	.26	-.31	-.25	.35
2. SE		--	.31	-.21	-.21	.32
3. OE			--	-.22	-.55	.47
4. ILOC X SE				--	.37	-.36
5. ILOC X OE					--	-.64
6. ILOC X SE X OE						--

analysis and accounted for 11% of the variance found in the model and had a -.27 partial correlation coefficient with the criterion variable. As evidenced in Table 11, the $\underline{R}^2$ change of 6% from step one to step two was significant. The hypothesis that the interaction variables would account for additional variance was supported (see Figure 2). However, the interaction of ILOC x OE was the only significant interaction suggesting that this variable is accounting for the additional variance that is accounted for by adding the interaction variables. This was not consistent with the present researcher's hypothesis that the three-way interaction would account for the additional variance. Further, partial correlation coefficients indicate that self efficacy shared 37% of its variance with HbA1c, suggesting it is the strongest predictor of medical regimen adherence. However, the interaction of ILOC and OE was also significant and its partial correlation coefficient was .24 suggesting the interaction of these two variables shares a moderately strong relationship with HbA1c (see Figure 2).

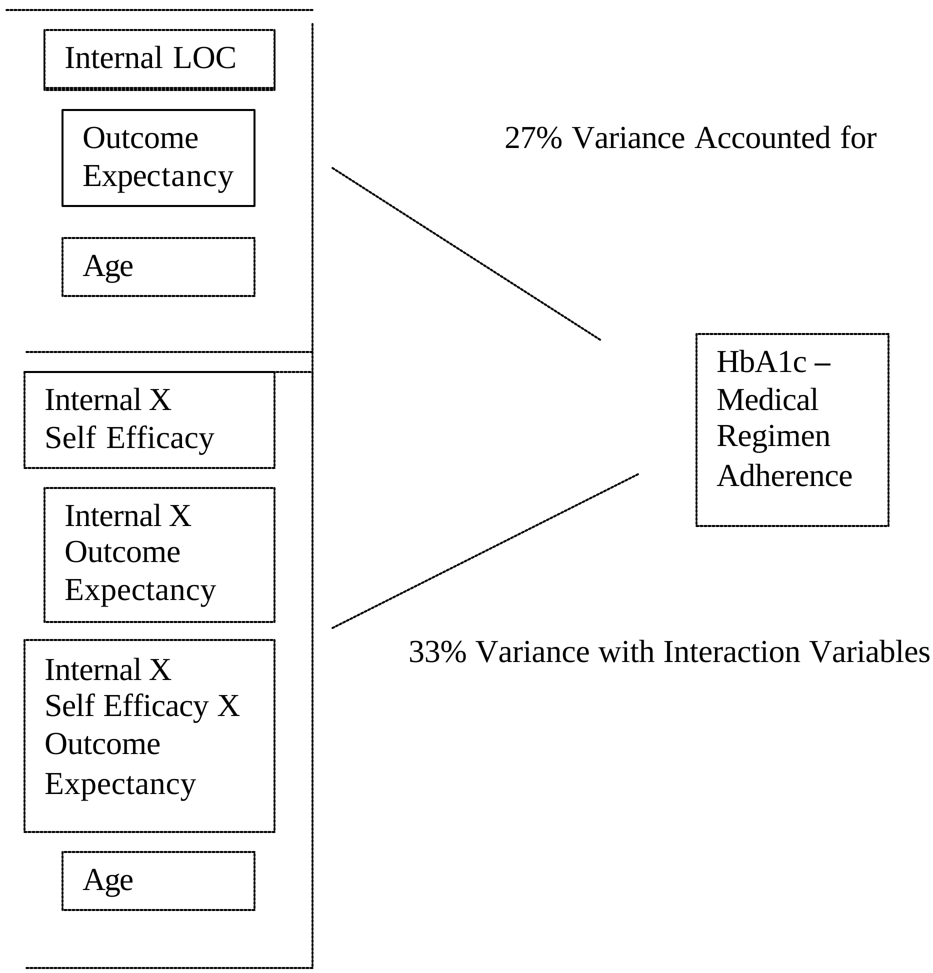

Figure 2: Additional Variance Accounted for by Perceived Control Interaction Variables in Predicting HbA1c

Question 5. Which of the six predictor variables, including interaction variables, accounts for the most variance in predicting HbA1c levels?

A forward multiple regression analysis was performed to answer question 5. For this analysis, HbA1c level was used as the criterion variable and the predictor variables were 1) ILOC, 2) SE, 3) OE, 4) ILOC *x* SE, 5) ILOC *x* OE, and 6) ILOC x SE x OE, which were entered in this respective order. Age was controlled for in this analysis and accounted for 11% of the variance found in the model and had a -.27 partial correlation coefficient with the criterion variable. The overall model was significant and accounted for 24% of the variance in predicting HbA1c levels (see Table 12). Out of the six variables, once again, self-efficacy independently,

Table 11

Summary of Hierarchical Regression Analysis for Perceived Control Variables Predicting Adherence to Medical Regimens (i.e., HbA1C levels) (N=109)

	Variable	B	SE	Beta	Partial
Step 1					
	ILOC	-.18	.20	-.08	-.09
	SE*	-3.98	.01	-.37	-.37
	OE	6.63	.02	.04	.04
Step 2					
	ILOC	-.10	.21	-.04	-.05
	SE*	-.86	.22	-.36	-.37
	OE	.43	.24	.18	.17
	ILOC X SE	3.32	.18	.02	.02
	ILOC X OE*	.53	.22	.29	-.24
	ILOC X SE X OE	1.20	.15	.01	.01

Note: $R = .52$, $R^2 = .27$, $SE = 2.06$ ($p < .01$) for Step 1;
Note: $R = .57$, $R^2 = .33$, $SE = 2.01$ ($p < .01$) for Step 2;
Note: $\Delta R^2 = .06$ from Step 1 to Step 2 ($p < .01$).
* $p < .01$ level

and the interaction of ILOC and OE were the only two variables with a significant relationship to HbA1c. ILOC, OE, ILOC x SE, and ILOC x SE x OE were all excluded from the model (see Figure 3).

Beta values indicated the strength of the relationship between each predictor variable and HbA1c, with the other variables in the regression controlled for. Self-efficacy shared the greatest amount of unique variance with HbA1c (-.36), while the interaction of ILOC x OE shared the second greatest amount of unique variance with HbA1c (-.23). Thus, the answer to question 5

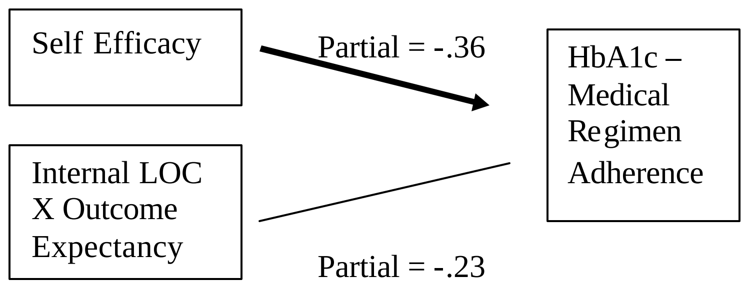

Figure 3: Self-Efficacy and Interaction of Internal Locus of Control and Outcome Expectancy in Predicting HbA1c

was that SE is the strongest predictor of medical regimen adherence. Further, the only interaction variable that was related to HbA1c was the interaction of ILOC x OE. An evaluation of the raw data as well as the Scatterplot graphs (Aiken & West, 1991) demonstrated the direction of the interaction of these two variables and its relationship with HbA1c (see Figure 4). Results suggest that when high ratings of ILOC interact with concurrent strong feelings of OE, individuals are more likely to have lower HbA1c levels. In other words, individuals with concordant higher ratings of ILOC and OE were likely to be more adherent to their diabetic regimen, as evidenced by lower HbA1c levels.

Question 6. What is the type and strength of relationship between self-efficacy, outcome expectancy, and the four types of external loci of control?

Pearson Product-Moment Correlations were performed to determine the intercorrelations between SE, OE, and the four external LOC subscales (i.e., God, chance, healthcare provider, and powerful others). Results suggest that although SE and OE were negatively correlated with chance, God, and powerful others LOC, and were positively correlated with healthcare provider LOC, the correlations were weak and not statistically significant.

Question 7. What is the type and strength of relationship between the five types of loci of control including internal, chance, powerful others, health care provider, and God?

Pearson Product Moment Correlations were performed on the five types of LOC. As anticipated by the present researcher, ILOC was significantly correlated with God LOC and

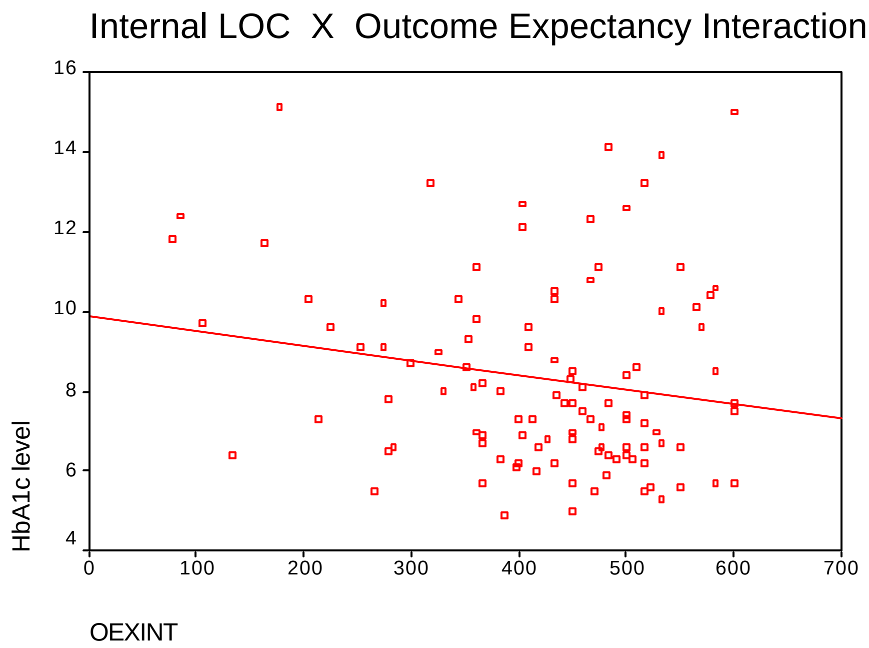

Figure 4: Scatterplot of Interaction of Internal Locus of Control and Outcome Expectancy in Predicting HbA1c

Table 12

Summary of Forward Multiple Regression Analysis for Perceived Control Variables Predicting Adherence to Medical Regimens (i.e., HbA1C levels) (N=109)

Variables Included in Model	B	SE	Beta	Partial
SE*	-.80	.20	-.34	-.36
ILOC X OE*	.37	.16	.20	-.23

Note: $R = .55$; $R^2 = .30$; $SE = 2.00$ ($p < .01$).
*$p < .01$ level

healthcare provider LOC. ILOC was significantly correlated with both of these external LOC scales but in different directions (see Table 14). ILOC was negatively correlated with God LOC and positively correlated with healthcare provider LOC. God LOC was significantly, positively related to the powerful others and chance subscale scores. Finally, chance LOC was significantly and positively related to powerful others LOC.

Table 13

Intercorrelations Between Self-Efficacy, Outcome Expectancy, and External Locus of Control Scales

Scale	Chance	God	PO	HCP
		Patients (N=109)		
SE	-.01	-.07	-.07	.14
OE	-.07	-.12	-.15	.12

* p < .01 level

Question 8. Which of the five types of loci of control contribute the most variance to predicting medical regimen adherence (HbA1c)?

A simultaneous multiple regression was performed in order to answer question 8 regarding which of the five types of locus of control is the strongest predictor of HbA1c level. Once again, HbA1c was the criterion variable while ILOC, God, chance, healthcare provider, and powerful others LOC were the predictor variables (see Table 15). Age was controlled for in this analysis and accounted for 13% of the variance found in the model and had a -.37 partial correlation coefficient with the criterion variable. This model was not significant, R = .41; R^2 = .17; SE = 2.21, and the R^2 showed that only 17% of the variance of HbA1c levels in our sample could be explained by ratings on the five LOC scales. Further, only age, the confounding variable, was significant in the model, while none of the 5 loci of control variables were significant.

Question 9. Do the interactions of internal control beliefs with the four external loci of control scales contribute significant variance in predicting medical regimen adherence (HbA1c), beyond the main effects of the five loci of control independent variables?

In order to examine the interaction of the locus of control variables the variables were standardized, or centered, into Z scores, as recommended by Aiken and West (1991). Next, the

Table 14

Intercorrelations Between Internal, God, Chance, Healthcare Provider, and Powerful Others Loci of Control

Scale	1	2	3	4	5	6
			Patients (N=109)			
1. ILOC	--	-.30*	-.15	.42*	-.02	-.20*
2. God LOC		--	.46*	-.02	.30*	.12
3. Chance LOC			--	-.20	.51*	.09
4. Healthcare Providers LOC				--	.05	-.07
5. Powerful Others LOC					--	.10
6. HbA1c						--

* $p < .01$ level

centered external LOC variables were each multiplied by ILOC to create the following 4 interaction variables; 1) ILOC X God, 2) ILOC X Chance, 3) ILOC X Healthcare Provider, and 4) ILOC X Powerful Others. Finally, the intercorrelations were performed for the centered variables in order to determine multicollinearity (see Table 16).

Table 15

Summary of Simultaneous Regression Analysis for Locus of Control Variables Predicting Adherence to Medical Regimens (i.e., HbA1C levels) (N=109)

Variable	B	SE	Beta	Partial
ILOC	-.35	.24	-.16	-.15
God LOC	6.81	.19	.04	.04
Chance LOC	-2.83	-.10	-.01	-.01
Healthcare Providers LOC	8.85	.29	.03	.03
Powerful Others LOC	.23	.22	.11	.10

Note: $R = .41$; $R^2 = .17$; $SE = 2.21$ ($p > .01$). * $p < .01$ level

Next, in order to answer question 9, if adding the interaction variables accounted for more variance in predicting HbA1c levels above the main effects, a hierarchical multiple regression analysis was performed. The criterion variable was HbA1c and the first block entered consisted of the 5 types of locus of control. The second block consisted of the 4 interaction variables including ILOC X God, ILOC X chance, ILOC X healthcare providers, and ILOC X powerful others (see Table 17). Age was controlled for in this analysis and accounted for 13% of the variance found in the model and had a -.37 partial correlation coefficient with the criterion

Table 16

Intercorrelations Between Locus of Control Variables and Their Interaction Variables

Scale	1	2	3	4	5	6	7	8	9
				Patients (N=109)					
1. ILOC	--	-.30	-.15	.42	-.02	.20	.25	-.35	.05
2. God LOC		--	.46	-.02	.30	.01	-.09	.08	.04
3. Chance LOC			--	-.20	.51	-.09	.01	.20	.02
4. Healthcare Providers				--	.05	.10	.26	-.50	.09
5. Powerful Others LOC					--	.04	.02	.07	-.15
6. ILOC X God LOC						--	.58	.08	.29
7. ILOC X Chance LOC							--	-.31	.37
8. ILOC X Healthcare								--	.13
9. ILOC X PO LOC									--

variable. Results support the a priori hypothesis. The first step of the regression demonstrated an $\underline{R}^2$ of .17; however, after the second step was run in the regression, which included the interaction of ILOC with the four external scales, the $\underline{R}^2$ increased to .31 (see Table 17). By adding the interaction variables, an additional 14% of the variance in HbA1c levels was accounted for, which was not accounted for by the main effects alone (see Figure 5).

Further, the results suggest that the additional variance by the interactions could be attributed to the interaction of high ILOC and low chance LOC, which was also consistent with the a priori hypothesis. The interaction of ILOC and chance LOC is the only significant interaction variable in the regression. Further, partial correlations suggest the ILOC x Chance interaction is moderately related (-.26) to the criterion variable, HbA1c (see Figure 5).

<u>Question 10. Which predictor variables (i.e., internal, chance, powerful others, health care providers, God, internal *x* chance, internal *x* powerful others, internal *x* health care providers, and internal *x* God) accounts for the most variance in predicting HbA1c?</u>

A forward multiple regression analysis was performed to answer question 10. HbA1c level was the criterion variable and the centered predictor variables were 1) ILOC, 2) God LOC, 3) chance LOC, 4) healthcare provider LOC, 5) powerful others LOC, 6) ILOC x God LOC, 7) ILOC x chance LOC, 8) ILOC x healthcare provider LOC, and 9) ILOC x powerful others LOC. Once again, age was controlled for in this analysis and accounted for 13% of the variance found in the model and had a -.37 partial correlation coefficient with the criterion variable. The model was significant at a .01 level and accounted for 24% of the variance. Results showed that the only predictor variable that was included in the model was the interaction of ILOC x chance LOC, while all other predictor variables were excluded from the regression model (see Figure 6). This supports the a priori hypothesis that the interaction of ILOC and Chance LOC would be the strongest predictor of HbA1c (see Table 18). Further, scatterplot graphs (see Figure 7) and an evaluation of the data (Aiken & West, 1991) suggest that the interaction of a high rating of ILOC and a low endorsement of chance LOC is related to HbA1c. That is, individuals with high internal beliefs and low chance LOC beliefs were likely to be adherent to their medical regimens.

Table 17

Summary of Hierarchical Multiple Regression Analysis for Locus of Control Variables for Predicting Adherence to Medical Regimens (i.e., HbA1C levels) (N=109)

Variable	B	SE	Beta	Partial
Step 1				
ILOC	-.35	.24	-.16	-.15
God LOC	6.81	.19	.04	.04
Chance LOC	-2.83	-.10	-.01	-.01
Healthcare Providers LOC	8.85	.29	.03	.03
Powerful Others LOC	.23	.22	.11	.10
Step 2				
ILOC	-.27	.24	-.11	-.11
God LOC	1.28	.25	.01	.01
Chance LOC	1.75	.28	.01	.01
Healthcare Providers	6.35	.25	.03	.03
Powerful Others LOC	.37	.24	16	.15
ILOC X God LOC	-.24	.25	-.12	-.10
ILOC X Chance LOC*	-.71	.27	-.35	-.26
ILOC X Healthcare	-.28	.18	-.17	-.15
ILOC X PO LOC	-.26	.20	-.13	-.13

Note: $R = .41$, $R^2 = .17$, $SE = 2.20$ ($p < .01$) for Step 1;
Note: $R = .55$, $R^2 = .31$, $SE = 2.06$ ($p < .01$) for Step 2;
Note: $\Delta R^2 = .14$ from Step 1 to Step 2 ($p < .01$).
* $p < .01$ level

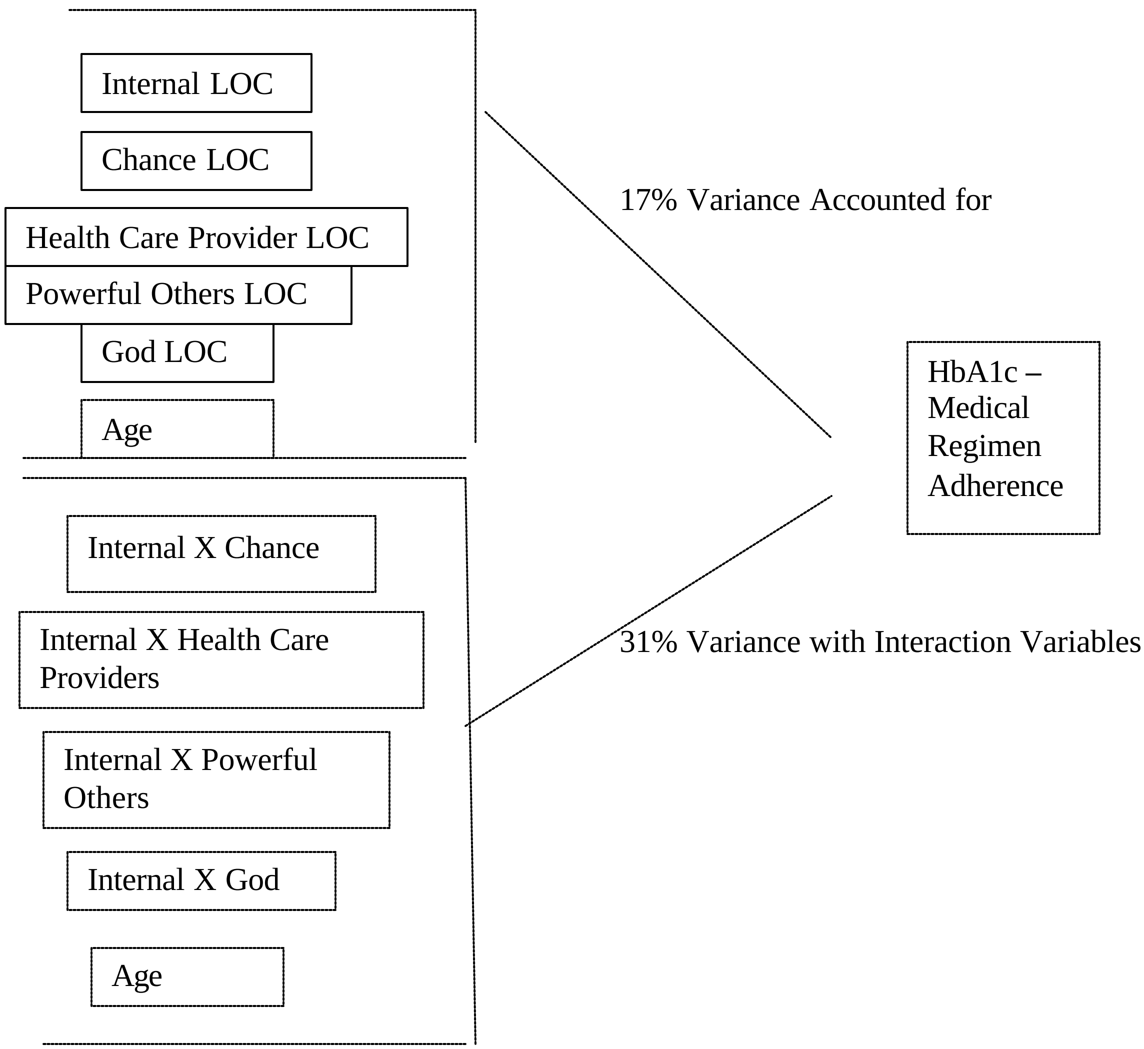

Figure 5: Additional Variance Accounted for by Locus of Control Interaction Variables in Predicting HbA1c

Table 18

Summary of Forward Multiple Regression Analysis for Locus of Control Variables Predicting Adherence to Medical Regimens (i.e., HbA1C levels) (N=109)

Variable Included in Model	B	SE	Beta	Partial
ILOC X Chance LOC*	-.68	.18	-.33	-.35

Note: $R = .48$; $R^2 = .24$; $SE = 2.08$ ($p < .01$)
* $p < .01$ level

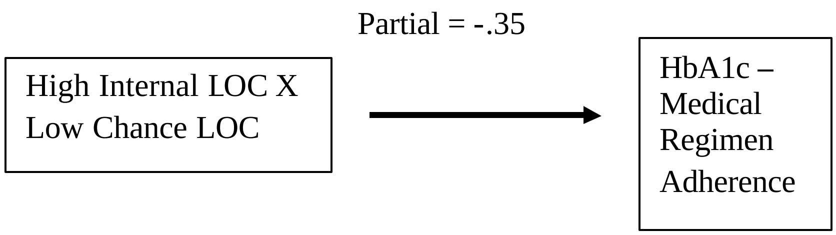

Figure 6: Interaction of Internal and Chance Locus of Control in Predicting HbA1c

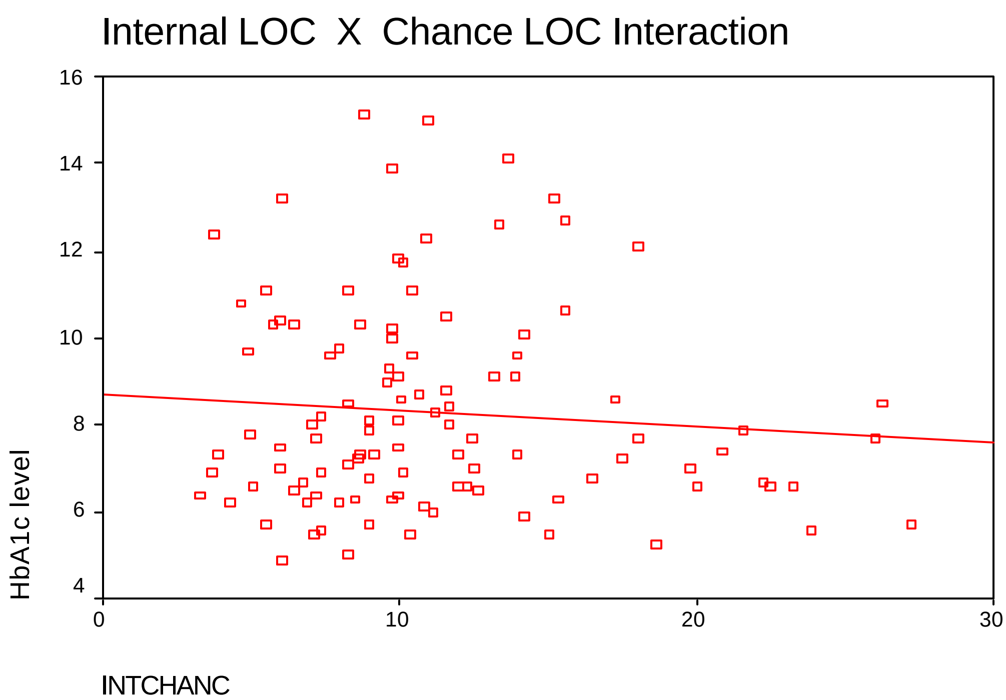

Figure 7: Scatterplot of Interaction of Internal and Chance Locus of Control in Predicting HbA1c

DISCUSSION

The present study examined the relationship between multiple perceived control constructs and medical regimen adherence in medical patients with Type 2 diabetes. Specifically, the relationship between health LOC constructs (i.e., internal, God, chance, healthcare providers, & powerful others), and constructs taken from Bandura's Social Learning Theory (i.e., self efficacy and outcome expectancy) were evaluated in relation to HbA1c, a biological indicator for adherence behaviors among diabetic patients. A variety of statistical analyses were employed to answer ten research questions related to this area of interest. The following is an interpretation of the findings related to those primary research questions, as well as a discussion relating the present findings with previous research. Finally, practical implications of this study will be reviewed.

Internal Locus of Control, Self-Efficacy, and Outcome Expectancy

Separating the Constructs

Internal Locus of Control (ILOC), Self Efficacy (SE), and Outcome Expectancy (OE) were measured and treated as separate constructs in this study. There have been very few studies examining the three constructs simultaneously, but some researchers have argued they are actually the same construct. The present results show empirical support that ILOC, SE, and OE are indeed separate constructs and related differently to health behaviors. As table 8 illustrates, ILOC was only weakly to moderately correlated with SE (r=.27) and OE (r=.25), suggesting that, even though the variables are related, each construct taps into a different aspect of perceived control. The present findings offer support for theorists in the past who have argued these constructs are different entities (Godding & Glasgow, 1985; Litt, 1988; Marshall, 1991; Wallston, 1992). Further, as hypothesized, all three variables were positively, but moderately (range of .25 to .31), correlated. This is congruent with previous research that has found average correlations between perceived control constructs to range between .30 and .50 (Talbot et al., 1997). Positive correlations between these constructs indicate that individuals who have higher ILOC related to their diabetes are more likely to have greater confidence in their ability to follow their doctor's treatment recommendations for diet, exercise, medication, and glucose monitoring. Further, those individuals with greater ILOC were more likely to believe that actually performing said behaviors would result in better-controlled diabetes and better health outcomes.

While SE measured the patients' confidence to follow their medical regimens, ILOC assessed their actual beliefs regarding who is in control of their health outcomes. Finally, OE measured the patients' general beliefs that following their medical regimens would result in improved health outcomes. As evidenced in table 7, patients in the present sample differed significantly in their ratings of these three perceived control constructs. In general, this sample had a relatively strong belief in ILOC. The mean score, out of a possible maximum of 6, was 4.54 (SD=1.04), indicating that they believed they had some role in controlling their diabetes. Patients also had very high ratings of OE (M=92.40); however, patients reported relatively lower ratings of SE (M=67.29). These trends indicate that even though patients believed they were partially responsible for their diabetes (ILOC) and believed that following their medical regimen would lead to better controlled diabetes, they did not have high confidence that they could actually follow their healthcare providers' recommendations to reap these benefits (SE). This is a particularly important finding because although patients had the relatively lowest ratings of SE, compared to the other two control constructs, SE was the most salient predictor for HbA1c levels. In other words, even though patients may have had strong feelings of ILOC and OE, their feelings of confidence (SE) were ultimately the determining factor as to whether they did or did not adhere to their medical regimen, which is discussed below.

Medical Regimen Adherence

ILOC, SE, and OE were expected to all be positively related to medical regimen adherence. Given that lower levels of HbA1c indicated better adherence, negative correlations between the three scales and HbA1c were expected. As predicted, all three variables were negatively correlated with HbA1c; however, only ILOC and SE were statistically significant (see Table 8). Further, as indicated by the simultaneous regression (see Table 9), SE demonstrated the strongest relationship with HbA1c, ILOC was the second strongest related, while OE demonstrated the weakest relationship with medical regimen adherence.

Self-Efficacy and HbA1c. Patients' ratings of how confident they felt that they could follow their physician's recommendations for taking care of their diabetes was the only variable related to HbA1c in the regression analysis (see Table 9) and was significantly related to HbA1c in the zero order correlations (see Table 8). This is consistent with previous research that has repeatedly found SE to be one of the strongest psychosocial variables related to health behavior. Greater SE is related to adhering to exercise programs (Brawley & Rodgers, 1993; Kaplan, Atkins, & Reinsch, 1984; McAuley, 1991, 1994), quitting smoking (Bagozzi & Edwards, 1998; Haukkala, Uutela, Vartiainen, Mcalister, & Knekt, 2000), safer sex behavior (DiIorio, Dudley, Soet, Watkins, & Maibach, 2000; Fishbein et al., 2001; O'Leary, Goodhart, Jemmott, & Boccher-Lattimore, 1992), and performing recommended breast self-examinations (Alagna, Morokoff, Bevett, & Reddy, 1987; Rippetoe & Rogers, 1987). Further, previous researchers have also found that high rates of SE enhances adherence to diabetic control regimens (Glasgow et al., 1989; McCaul, Glasgow, & Schafer, 1987). The present results corroborated earlier researchers' findings regarding the important role SE plays in successful health behavior change.

Internal Control and HbA1c. By simply examining the zero order correlations (see Table 8) it appears that ILOC is significantly related to HbA1c. However, when evaluated in the regression model, it becomes clear that patient perception of internal control of their diabetes was not a significant predictor variable of HbA1c when compared to other perceived control variables (see Table 9). In fact, the regression analysis showed that SE was the only significant predictor, out of the three perceived control variables, of HbA1c. Further, the fact that ILOC and SE were moderately correlated, coupled with the null findings for ILOC in the regression model, suggests that the zero order correlation found between ILOC and HbA1c was probably related to ILOC's relationship with SE. In other words, the significant relationship demonstrated in the zero order correlations was most likely due to the relationship between SE and HbA1c levels. From our findings it can be concluded that differences in HbA1c levels between the participants was not likely due to participants' differences in beliefs about ILOC.

Researchers have inconsistently supported ILOC's role in health behaviors, and have more consistently demonstrated the link between SE and health behaviors (Stuare, Borland, & McMurray, 1994). The present results mirror this trend found in the diabetic and non-diabetic literature (Wallston, 1991; Wallston & Wallston, 1978; Wallston, Wallston, Smith, & Dobbins, 1989). Thus, when simply evaluating the main effect results of ILOC and HbA1c, the degree to which our patients reported beliefs that they controlled their diabetes had an impact upon their motivation to perform self-care behaviors (e.g., exercise, diet, taking medications). This was consistent with previous studies, which have demonstrated perceived internal control to be associated with better adjustment to diabetes (Burns, Green, & Chase, 1986; Hamburg & Inoff, 1982; Helgeson & Franzen, 1998; Jacobson et al., 1990), better adherence to self-care regimens (Evans & Hughes, 1987; Jacobson et al., 1986), and better metabolic control (Brown, Kaslow, Sansbury, Meacham, & Culler, 1991; Konen, Summerson, & Dignan, 1993; Murphy, Thompson, & Morris, 1997; Reynaert et al., 1995; Stenstrom, Wikby, Andersson, & Ryden, 1998; Surgenor, Horn, Hudson, Lunt, & Tennent, 2000). However, when further evaluated in conjunction with other perceived control variables such as SE, ILOC does not show a significant relationship with adherence behavior, and it becomes apparent that the initial relationship that was demonstrated between ILOC and HbA1c was probably due to ILOC's positive correlation with SE. On the other hand, even though ILOC, in its solidarity, did not demonstrate a strong relationship with HbA1c, when combined with other perceived control constructs such as OE or types of external LOC, ILOC can be meaningfully related to diabetes related adherence behaviors.

Outcome Expectancy and HbA1c. OE was defined in the beginning of this paper as the belief that performing certain behaviors will result in expected outcomes. For this study, participants were queried as to whether they believed following the specific aspects of their diabetic regimen (i.e., eating a diabetic diet, exercising, taking medication, testing their glucose regularly, following doctor's orders) were important for glycemic control. The present sample generally endorsed very strong beliefs that performing these behaviors is important in maintaining glycemic control and good diabetic health outcomes. This suggested that the patients were educated regarding what is important for the maintenance of diabetic control. On the other hand, even though patients felt following their regimen was important, OE was not found to be significantly related to actual adherence behaviors, as indicated by zero order correlations (see Table 8) and multiple regression analyses (see Table 9).

Researchers have argued that the expectations of behavioral outcomes (OE) are important in predicting health behavior outcomes (Anderson et al., 2000; Hallam & Petosa, 1998; Morrill et al., 1996). The sense that a behavior will result in desired outcomes, more so than actual outcomes, can purportedly influence the likelihood that a behavior will be performed (Bandura, 1997). Unfortunately, this contention was not supported by the present study's findings. It is unclear why OE was not related to medical regimen adherence in this diabetic population. It may be that OE is important for some health behaviors such as condom use (Morrill et al., 1996) or dietary fat reduction (Anderson et al., 2000), but is not related to overall adherence to a multifaceted diabetic regimen. Further, it may be that the scale used in this study was worded in such a way that OE ratings overlapped with knowledge ratings (i.e., ‘how is important is taking your medication to control your diabetes?’). If the OE scale was worded a little differently to tap into individual OE ratings (i.e., ‘do you think taking your medications will help control your diabetes?’), different results may have been found. Previous researchers have repeatedly found knowledge to not be related to behavior choices or changes (Braithwaite & Thomas, 2001; Eiser & Cole, 2002; Wallace, Wright, Parsons, Wright, & Barlow, 2002); thus if the patients’ OE ratings were actually more an indicator of knowledge, the null results would not be surprising. And, in general, the OE scale used in this study less than optimal. However, given the lack of research in this area, there was a lack of diabetes specific alternatives to measure OE in medical patients. Further research is needed to develop more sensitive scales to measure the construct of OE and future research in this area may benefit from assessing knowledge with OE to determine the amount of overlap between the constructs. Finally, it should be noted that even though the null findings regarding OE were unexpected, it was posited that the interaction of OE with other perceived control variables would be meaningfully related to HbA1c levels in patients with Type 2 diabetes.

Interactions of Variables and HbA1c. The interaction of the three perceived control variables (i.e., ILOC, SE, and OE) and their relationships with HbA1c was explored. Interaction variables, which represent the various interaction of the three constructs (ILOC x SE, ILOC x OE, and ILOC x SE x OE), were created and predicted to account for additional variance in HbA1c levels beyond the main effects of the independent constructs alone. As Table 11 illustrates, this hypothesis was supported by the hierarchical regression results. In step 1, SE was the only variable significantly related to HbA1c. The interaction variables were then added to step 2 and contributed an additional 6% of variance, which was considered a statistically significant $\Delta \underline{R}^2$ in the model ($\underline{p} < .01$). Out of the three interaction variables entered, only ILOC x OE was significant in the regression model, suggesting that the interaction of high internal control and high OE is more important in determining HbA1c than the other two way interaction of ILOC and SE or the three way interaction of ILOC, SE, and OE.

When the three perceived control constructs were evaluated in solidarity, ILOC and OE did not provide much information regarding adherence behaviors. In fact, if the analysis was terminated after the first step, without investigating the interaction of the perceived control variables, it may have been concluded that ILOC and OE were not meaningfully related to adherence behaviors. However, after the interaction variables were created and added to the regression, it was evident that even though SE continued to remain related to HbA1c, the interaction of ILOC x OE was also important in predicting medical regimen adherence. In other words, independently ILOC and OE were not good indicators for predicting HbA1c, but in conjunction the two variables were important in predicting adherence behaviors in diabetic patients. This is a novel finding that has yet to be published or discussed in the adherence literature, which warrants further research of the interaction of these constructs.

A forward multiple regression analysis was performed to answer the question 'which of the 6 variables (ILOC, SE, OE, ILOC x SE, ILOC x OE, and ILOC x SE x OE) were the best predictors of medical regimen adherence?' Not surprisingly, similar to the hierarchical regression, only two variables were significant in the model; SE and the interaction of ILOC x OE. Further, the partial coefficients presented in Table 12, demonstrated that SE, independently, had the strongest relationship with HbA1c (-.36), while the interaction of ILOC x OE demonstrated the second strongest relationship (-.23). In practical terms, this suggested that a diabetic patient's feelings of confidence that he or she could adhere to his/her diabetic regimen was important as to whether he or she actually followed the regimen. However, the interaction of ILOC and OE's unique variance with HbA1c was also important because it suggested that when patients have high ILOC and high OE, they were also better at following their medical regimen, as evidenced by lower HbA1c levels.

As previously stated, this interaction of ILOC and OE was paramount in predicting adherence compared to the other interactions of the perceived control variables. The interaction of ILOC, SE, and OE was expected to be the strongest predictor of HbA1c in this sample of diabetic patients. This hypothesis was based predominantly on theory and not empirical evidence, since there is no literature that has previously looked at the relationship of these variables. Theoretically, a revised social learning theory (Wallston, 1992), combining Rotter's Locus of Control Theory (1966) and Bandura's Social Learning Theory (1986), was expected to demonstrate the strongest relationship with HbA1c, compared to the other interaction variables or the main effects of the perceived control variables alone (Wallston, 1992). Results did not support the theoretically based proposal of a revised social learning theory combining ILOC, SE, and OE. Although we are unsure as to why the three way interaction was not significant related to HbA1c, it may be that the interaction of ILOC and OE accounted for the majority of the variance that was attributable to perceived control constructs. Although it would seem reasonable to assume that the addition of SE combined with the interaction of ILOC and OE would only make the interaction variable a stronger predictor, this was not the case. From the present results it appears that SE, when evaluated alone, is meaningfully linked to adherence behaviors; however, SE does not interact with ILOC or OE in a meaningful way to influence adherence behaviors among Type 2 diabetics.

In summary, out of the six-predictor variables, SE and the interaction of ILOC x OE demonstrated the strongest relationship with HbA1c. From this, it can be concluded that a person with Type 2 diabetes is more likely to have a lower HbA1c level, which indicates better medical regimen adherence, if he or she has high SE alone or a combination of high ILOC and high OE. This person will have a greater chance at medical regimen adherence than a person with low SE, or a person with both low ILOC and low OE. Although these variables appear to be important, it is notable that the variance accounted for in the regression analyses did not exceed 33%, which was with age accounting for approximately 10% of that variance as the controlled variable. Thus, only a moderate amount of the variance in HbA1c levels can be accounted for by these perceived control variables, which suggests that other variables must also be important in determining if medical patients were adherent with their diabetic regimens.

External Health Locus of Control

The Multidimensional Health Locus of Control Scales

This study was the first of its kind to examine the most recent version of the MHLC scale (Wallston et al., 1999) in a low-income, predominantly minority, medical sample with Type 2 diabetes. The means and standard deviations for all 5 scales (i.e., internal, God, chance, healthcare providers, and powerful others) were presented in Table 7. The MHLC measured beliefs regarding patient control over his or her own health. The scale consisted of positively worded questions that asked patients how much they agreed with statements that covered five types of locus of control. Responses were based on a 6-point Likert scale with 1=strongly disagree, 2=disagree, 3=disagree a little, 4 = agree a little, 5 = agree, and 6=strongly agree. Raw scores were converted to averages that correspond to the original Likert scale to improve interpretability of the results. For example, this sample endorsed that their strongest belief was that their healthcare providers (M=5.05) are in control of whether their diabetes-related health worsens or improves. This trend has been found in past research with medical populations (Wallston et al., 1999). One reason may be that sampling from active medical attendees biases ratings on the healthcare provider LOC scale. Further, it could simply have been that individuals who have stronger healthcare provider LOC are more apt to attend their medical appointments. Inversely, attending regular medical appointments for your diabetes may lead to stronger healthcare provider LOC. Given that the present sample consisted of all diabetic patients attending diabetic medical clinic appointments, it is likely the elevated ratings of healthcare provider LOC was influenced by one or all of these hypotheses.

The second highest rated LOC scale was the internal scale (M=4.54) indicating that the patients also felt as though they were partly responsible for their diabetes. Previous research has found somewhat elevated ILOC ratings for patients with diabetes (Macrodimitris & Endler, 2001; Stenstrom et al., 1998; Surgenor et al., 2000). The endorsement of God LOC was the third greatest mean (M=3.07). However, given that a score of three corresponded with 'disagree a little' on the questionnaire, this rating suggested that on average the patients disagreed a little that God was in direct control of their diabetes. The original study validating this additional subscale sampled patients with rheumatoid arthritis (Wallston et al., 1999) and demonstrated similar ratings for God beliefs (M =2.57). Further, another study (Chaplin et al., 2001) recently measured God LOC in a large sample of Canadian women and demonstrated mean ratings (M=3.28) similar to findings from the original validation study (Wallston et al., 1999) and to the present study.

Finally, chance (M=2.50) and powerful others (M=2.46) LOC mean ratings were relatively equivalent. The patients did not endorse strong beliefs in these two types of LOC compared to the other three scales. Their ratings suggested that, in general, the patients disagreed with the statements that chance or others in their social network were responsible for their diabetes. This is similar to previous studies that have repeatedly found that people generally have the weakest beliefs in chance and powerful others LOC (Chaplin et al., 2001; Wallston & Wallston, 1981).

An interesting finding concerning the 5 types of LOC was related to racial differences found in LOC beliefs in our sample (see Table 5). Blacks had significantly greater ratings of the God LOC scale than the Whites in this low-income population. This meant that the Blacks who participated in this study reported significantly stronger beliefs that God was in direct control of whether their health related to their diabetes than the White patients. Further, although it only approached significance with a $p = .06$ value, there was a trend that Blacks and Whites also differed in their ratings of healthcare provider LOC. Whites appeared to have stronger beliefs than Blacks that their healthcare providers were in control of their diabetes. There has been limited research examining racial differences in LOC, but our findings are similar to common trends found in other areas of research that 1) Blacks have stronger religious beliefs than Whites (Mansfield, Mitchell, & King, 2002); and 2) Blacks are more skeptical of modern medicine and healthcare providers than Whites (Corbie, Thomas, & St. George, 2002; Doescher, Saver, Franks, & Fiscella, 2000; Shavers, Lynch, & Burmeister, 2001). Although this was not a central question in this present project, these racial differences are intriguing and warrant more investigation.

In summary, the present sample had the strongest beliefs that their healthcare providers controlled their diabetic outcomes. They also had relatively strong beliefs that they were in control of their diabetes. However, our sample somewhat disagreed that God, chance, or others in their social network, controlled their diabetes.

Relationships Between the Five Types of Loci of Control

Based on previous literature testing the most recent version of the multidimensional health locus of control scale, hypotheses were made regarding how the scales would be intercorrelated in a low income, predominantly minority sample. Table 2 demonstrated the expected relationships between the five scales, while Table 14 shows the actual intercorrelations found in the present study. It was predicted that ILOC would only be significantly correlated with health care providers LOC and that this correlation would be positive. This hypothesis was supported ($r = .42$, $p<.01$) and is consistent with previous research that has demonstrated a positive link between ILOC and healthcare provider LOC beliefs (Wallston et al., 1994, 1999). That is, if a patient has a strong sense that she controls her health, she is also more likely to believe her physician also has some control over her health outcomes. Both ILOC and health care provider LOC have been linked with positive health behaviors (Peyrot & Rubin, 1994; Sensky & Petty, 1989; Stenstrom & Andersson, 2000).

An interesting, though unexpected, finding was that ILOC was significantly related to God LOC. Previous research has not demonstrated a meaningful relationship between ILOC and God LOC (Wallston et al., 1994; 1999). However, the present finding, drawn from a low income, largely Black sample, suggested that ILOC and God LOC were negatively correlated ($r= -.30$, $\underline{p}< .01$). In other words, our patients who endorsed ILOC beliefs were less likely to endorse God LOC beliefs. Similarly, the patients who reported belief that God was in control of their diabetes were less likely to also believe that they were in direct control of their health. This finding is notable given that previous research has not found this type of inverse relationship. Although not consistent with past studies, this was the first project to examine these constructs in a low-income population, which may have to do with the discrepant findings. Finally, ILOC was not significantly correlated with powerful others LOC, which supports previous findings that have failed to demonstrate a positive or negative relationship between the two scales (Wallston et al., 1994; 1999).

Although God LOC and ILOC were not expected to be related, it was hypothesized that God LOC would be positively correlated with chance LOC and powerful others LOC. These hypotheses were supported as demonstrated in Table 14. God LOC was strongly correlated with chance LOC ($r=.46$, $p<.01$), which is consistent with previous work in this area (Wallston et al., 1999). Patients who endorsed strong beliefs that God is in control of their diabetes, also tended to believe that their diabetes outcomes were a matter of fate or chance. Along the same lines, those individuals who did not report that they believe God was in control of their diabetes, tended to also reject the contention that their diabetes outcomes were a matter of fate or chance. A similar relationship was found between God LOC and powerful others LOC. Beliefs in God were related to concurrent beliefs that other people's behavior influences or controls one's diabetes outcomes. Finally, as hypothesized, chance LOC and powerful others LOC were significantly, and positively, correlated. Once again, this is consistent with previous investigations with the MHLC scale (Wallston et al., 1999).

In summary, the hypotheses regarding the relationships of the five loci of control scales were predominantly supported. The results were almost identical to previous research findings with the exception of the negative relationship that was found between ILOC and God LOC.

External Loci of Control, Self-Efficacy, and Outcome Expectancy

The relationships between the external loci of control scales and SE and OE were also examined in this study. As discussed in the previous section, ILOC was meaningfully related to healthcare providers and God LOC. Intercorrelations were also performed on the four external subscales and SE and OE (see Table 13). It was hypothesized that SE and OE would be negatively correlated with chance, God, and powerful others LOC, but positively correlated with healthcare providers LOC. Results supported these expected trends (see Table 13); however, the relationship between the variables were very weak. In fact, even though the variables were correlated in the expected directions, none of the relationships between SE, OE and the four types of external LOC were statistically significant. This indicated that patients' confidence in their ability to follow their medical regimen or their beliefs that following their medical regimens would result in favorable outcomes, were not related to their beliefs that external forces, such as God or chance, controlled their diabetes.

Medical Regimen Adherence

External Health Loci of Control and HbA1c. Each of the five types of LOC, internal as well as the four external scales, were examined regarding their relationship with HbA1c. Pearson R correlation coefficients of the five scales with HbA1c (see Table 14) suggested that only the internal scale was significantly correlated with medical regimen adherence, which was discussed in the previous section. ILOC was more strongly related to medical regimen adherence in our sample of patients with Type 2 diabetes than the external types of LOC. In fact, ILOC not only had a stronger correlation with HbA1c, but it was the only type of LOC that was statistically significant in the correlation matrix; none of the four external scales demonstrated a meaningful relationship with HbA1c.

Although the relationships between the external scales and HbA1c were not statistically significant, it should be noted that the directions of the correlations were similar to previous research findings (see Table 14). For example, previous studies have demonstrated that chance LOC and powerful others LOC are related to poorer adherence behaviors (Bradley, Lewis, Jennings, & Ward, 1990; Stenstrom et al., 1998). The present results demonstrated the same trend in a diabetic sample; chance ($r = .09$, $p > .01$) and powerful others LOC ($r=.10$, $p > .01$) were both positively correlated with HbA1c, indicating they were related to poorer adherence behaviors among these diabetic individuals.

On the other hand, previous research examining religious beliefs and health behaviors, have suggested that high God beliefs are positively related to recovering from illness (Pareek, 2000) and better health habits in older adults (Welton, Adkins, Ingle, & Dixon, 1996). The present results were not statistically significant, but demonstrated a trend that God LOC was positively correlated with HbA1c, indicating that God LOC was related to poorer adherence behaviors ($r=.12$, $p>.01$). However, also unlike previous research, the present study also measured internal control beliefs and found that they were negatively correlated with God beliefs. It may be a decreased internal LOC, which was negatively correlated with higher God LOC beliefs that significantly contributed to the trend that God LOC was related to poorer HbA1c levels. Moreover, this was the first study of its kind that evaluated the impact of God LOC on medical regimen adherence in patients with diabetes who have very little resources, so the relationship between God beliefs and adherence behaviors may be different because the demographic makeup is different in our sample compared to past research.

Interactions of Internal and External Loci of Control and HbA1c. The stronger main effect found between ILOC and behavior is probably one of the reasons for the pervasive neglect of external scales in the LOC literature. However, the fact that external types of LOC do not independently influence adherence does not necessarily indicate that they are not related to behavior. A primary hypothesis of the present study was that the external scales would interact with ILOC and have stronger relationships with adherence behaviors than any of the LOC scales alone. To test this hypothesis, patients' ratings of their ILOC were combined with ratings on each of the external scales to create four new interaction variables. These were ILOC x God, ILOC x Chance, ILOC x Healthcare Providers, and ILOC x Powerful Others LOC. By creating these interactions, it was expected that more variance of HbA1c would be accounted for. Specifically, the interaction of ILOC and chance was expected to have a stronger relationship with HbA1c than either of the variables independently. As predicted, the results from a hierarchical regression, which entered into the interaction variables in Step 2 of the model, demonstrated a significant $\Delta \underline{R}^2$ of 14% by adding the interaction variables into the regression model (see Table 17 and Figure 6). On closer inspection, the interaction of ILOC and chance LOC was likely responsible for this additional variance, which is evidenced by its significance in the regression model and by its partial correlation coefficient.

Finally, the findings from the simultaneous regression analysis presented in Table 18 supported the final hypotheses made regarding the present study. Namely, out of the 9 predictor variables which were entered into the regression model, ILOC x Chance LOC was the strongest and only significant predictor of HbA1c (see Figure 6). High internal/low chance individuals had the best adherence to their diabetes regimen. This finding is consistent with results that have demonstrated that individuals who are more actively engaged in preventative health behaviors have stronger internal control beliefs and weaker beliefs in chance LOC (Wallston & Wallston, 1981). Strong feelings of internal control, coupled with successful behavior change, may have bred weaker beliefs in chance LOC, making this type of high internal/low chance patient more likely to have lower HbA1c levels.

Although the interactions of these variables have scarcely been studied, recently, a study by Stenstrom and colleagues (1998) demonstrated that individuals with Type I diabetes, who scored high on ILOC and low on chance LOC, had lower HbA1c levels than just high ILOC alone or any combination of external scales with ILOC. Although these researchers used a different scale to measure LOC and created their interaction variables by artificially dichotomizing LOC scores, they too used paper and pencil scales to measure LOC and used HbA1c, instead of self-report, to indicate general adherence. Once again, their results are surprisingly similar to the present researchers. Beyond the present study's work with Type 2 diabetics and work by Stenstrom with type I diabetics (1998) LOC interactions have been neglected. However, given the significant findings from the present study, further research is warranted.

Limitations

There are some notable methodological limitations of the present study. First, as previously discussed, the present sample only consisted of patients attending medical clinics for diabetes treatment. Hence, this was not a good sampling of all diabetic patients, particularly those who are seriously non-adherent, as evidenced by the fact that they do not even attend their medical appointments. Along the same lines, the fact that our sample was drawn from a medical population may have affected the patients' ratings of the psychological constructs. For example, the finding that the highest rating of LOC was healthcare provider LOC may have been influenced by demand characteristics. Although this may be a valid representation of their belief systems, the patients' ratings of how important their healthcare providers are in controlling their diabetes may have been inflated from the fact that data was collected in a medical center while the patients were attending doctor appointments.

A second methodological problem with this study was that the cross-sectional nature of this study did not allow the researcher to examine the stability of the patient's perceived control constructs or their HbA1c levels. Through a longitudinal approach, richer information regarding how LOC may change over extended periods of time and how that may relate to disease progression, could have been gathered. Another limitation of this study was that the majority of our patients were females and Black. This limits the external validity of the study and makes the generalizability of the study only applicable to other low income, Black, females and less so to groups with other demographic characteristics. Finally, although HbA1c level is a good overall indicator of medical regimen adherence in patents with Type 2 diabetes, it does not provide specific information about adherence behaviors. However, the goal of this project was focused on overall adherence to medical regimens and not necessarily subcomponents of diabetic adherence behaviors. On the other hand, this is a good area for future research and one that HbA1c would not be as appropriate to use as an outcome measure. Alas, for the present study, HbA1c was a good indicator of general medical regimen adherence and circumvented common problems researchers face when using patient self-report measures of medical regimen adherence.

Another general limitation of this study was that many of the patients more than likely had greater than one chronic illness. Although the patients were directed to respond based on their experience with Type 2 diabetes, responses may have been confounded by the presence of comorbid health conditions. Finally, it should be noted that the patients had a relatively restricted range in variance regarding their ratings of OE. The reasons for this inflation and lack of variability are unknown; however, our scale that was supposed to measure OE, may have been tapping into knowledge regarding what behaviors are needed to control diabetes. Patients who attend the diabetic clinic at EKL hospital are required to attend a multi-session education course on how to control diabetes. Had we sampled patients who were not attending the clinic, and who had not gone through these education courses, our ratings of OE may have been dramatically lower. A more sensitive scale may need to be used in the future to detect subtle differences in levels of OE.

General Discussion and Conclusions

For decades, researchers, as well as healthcare providers, have attempted to determine why patients follow or fail to follow their medical treatment regimens. This study does not answer this question in its entirety; however, it does shed light on the role of perceived control in patient adherence with Type 2 diabetic treatments. Specifically, this study has expanded on existing knowledge regarding the different types of perceived control and how these constructs do or do not determine general adherence behaviors. From the findings, it can be concluded that self-efficacy is the most salient type of perceived control that impacts diabetes-related health behaviors. Self-efficacy is a better predictor of adherence than internal locus of control or outcome expectancy. This knowledge can be used to assist patients who are exhibiting poor adherence behaviors. Self-efficacy enhancing interventions can be created and implemented to improve patients' metabolic control. This finding may also be used to identify newly diagnosed patients who may be at risk for poor adherence to their diabetic regimen. In this regard, feelings of confidence in following their doctor's recommendations may be screened after diagnosis and intervention to identify patients with low self-efficacy. Self-efficacy enhancing interventions may then be employed before poor metabolic control causes further health complications.

Internal locus of control, independently, does not appear to be very important in predicting adherence behaviors. Once again, given the pervasive inconsistencies regarding the role of internal locus of control in the diabetic and non-diabetic adherence literature, this is an important finding. Further, the original notion outlined in the introduction of this paper was that the concept of a larger construct, namely 'perceived control', would be more important in predicting behaviors than internal locus of control alone. In a sense, this contention was supported by the null findings regarding internal locus of control and the positive findings related to the interaction of internal control and outcome expectancy. However, it was specifically stated that the construct of 'perceived control' would actually consist of a combination of internal locus of control, self-efficacy, and outcome expectancy. This model was not supported by the present findings. The concept of 'perceived control' may very well be a conglomeration of various perceived control constructs; however, these findings suggest it is not the interaction of self-efficacy, internal locus of control, and outcome expectancy that forms this larger construct.

On the other hand, it was demonstrated that, when combined with other perceived control variables such as outcome expectancy and beliefs in chance locus of control, internal locus of control can play a more important role in influencing or predicting adherence to medical regimens. This has important research implications. Namely, further research investigating the interaction of internal locus of control with other variables is needed. Research on health locus of control has been riddled with pessimistic reviews recently and it appears that Kenneth Wallston's (1992) theory that internal locus of control is important but only when combined with other perceived control constructs, may be valid. This original argument made by Wallston (1992) was theoretical and not based on empirical findings, and, to date, he has not tested his own hypothesis. Although the present study did test and support Wallston's (1992) theory, further work is now needed to determine if the findings can be replicated.

Further, this study tested the most recent MHLC scale in a low income, Type 2 diabetic population. The intercorrelations of the 5 loci of control scales were congruent with previous studies, which provides preliminary support for the use of this scale in low-income populations or simply with individuals with Type 2 diabetes. However, a novel finding regarding the new God locus of control scale was demonstrated. Interestingly, God locus of control, in this low income, predominantly minority, sample was significantly and negatively related to internal locus of control, which has not been demonstrated by previous research. Further, there was a trend in our results that the God scale was related to poorer adherence behaviors, which also has not been demonstrated in the past. Further replication research with the God scale, in similar populations, is also needed to determine if this finding is esoteric to individuals with similar demographic background.

Finally, it should be noted that this study was, to our knowledge, the first of its kind to examine the impact of these types of constructs on adherence behaviors in a sample of low-income, individuals with Type 2 diabetes. Because low-income individuals are less likely to engage in adaptive health behaviors (i.e., eating a good diet, following an exercise plan, taking medication) than middle/high-income individuals (Pamuk et al., 1998), it is beneficial that we have a basic understanding of what influences their health behaviors. From our findings, self-efficacy appears to have an influence on the ability of low-income patients attending primary care clinics to follow their diabetic treatment plan. A first step in decreasing the increased morbidity, mortality, and general health costs associated with non-adherence, that is widely found within disadvantaged communities, is the clarification of relationships between mediating variables, such as self-efficacy, and the ability to change health behaviors. This study is an important step in investigating the causes of the disproportionate high rates of non-adherence in low-income individuals with Type 2 diabetes.

REFERENCES

Aikens, J.E., Wallander, J.L., Bell, D.S., & McNorton, A. (1994). A nomothetic-idiographic study of daily psychological stress and blood glucose in women with Type 1 diabetes mellitus. Journal of Behavioral Medicine, 17, 535-548.

Ajzen, I. & Fishbein, M. (1980). Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice-Hall.

Alagna, S.W., Morokoff, P.J., Bevett, J.M., & Reddy, D.M. (1987). Performance of breast self examinations by women at high risk for breast cancer. Women and Health, 12, 29-47.

American Diabetes Association. (1994). Medical management of Non-Insulin-Dependent (Type 2) Diabetes: Third Edition. Alexandria, VA: American Diabetes Association.

American Diabetes Association. (1998). Standards of medical care for patients with diabetes mellitus. Diabetes Care, 21, S23-31.

Anderson, E.S., Winett, R.A., & Wojcik, J.R. (2000). Social-cognitive determinants of nutrition behavior among supermarket food shoppers: a structural equation analysis. Health Psychology, 19, 479-486.

Bagozzi, R.P., & Edwards, E.A. (1998). Goal setting and goal pursuit in the regulation of body weight. Psychology and Health, 13, 593-621.

Balch, P., & Ross, A. (1975). Predicting success in weight reduction as a function of LOC : A unidimensional and multidimensional approach. Journal of Consulting and Clinical Psychology, 43, 119.

Bandura A. (1977). Social Learning Theory. Englewood Cliffs, New Jersey: Prentice Hall.

Bandura, A. (1986). Social Foundations of Thought and Action: A Social Cognitive Theory. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). Health Functioning. In S.F. Brennan, & C. Hastings (Eds.), SE: The exercise of control (pp. 259-318). New York, NY: W.H. Freeman and Company.

Becker, M.H. (1974). The health belief model and sick role behavior. Health Education Monographs, 2, 409-419.

Bell, R.A., Summerson, J.H., & Konen, J.C. (1995). Racial differences in psychosocial variables among adults with non-insulin-dependent diabetes mellitus. Behavioral Medicine, 21, 69-73.

Bond, W.S., & Hussar, D.A. (1991). Detection methods and strategies for improving medication compliance. American Journal of Hospital Pharmacy, 48, 1978- 1988.

Bradley, C. (1994). Handbook of Psychology and Diabetes: A Guide to Psychological Measurement in Diabetes Research and Practice. Netherlands: Harwood Academic Publishers.

Braithwaite, K., & Thomas, V.G. (2001). HIV/AIDS knowledge, attitudes, and risk-behaviors among African-American and Caribbean college women. International Journal for the Advancement of Counseling, 23, 115-129.

Brawley, L.R., & Rodgers, W.M. (1993). Social psychological aspects of fitness promotion. In P. Seraganian (Ed.), Exercise psychology: The influence of physical exercise on psychological processes (pp. 254-298). New York: Wiley.

Brown, R.T., Kaslow, N.J., Sansbury, L., Meacham, L., & Culler, F. (1991). Internalizing and externalizing symptoms and attributional style in youth with diabetes. Journal of American Academy of Child and Adolescence Psychiatry, 30, 921-925.

Brownell, K.D., & Cohen, L.R. (1995). Adherence to dietary regimens: 2. Components of effective interventions. Behavioral Medicine, 20, 155-164.

Bunting, B.P., & Coates, V. (2000). Stability and predictors of blood glucose levels: An intra- and inter-individual analysis. Psychology, Health, and Medicine, 5, 251-258.

Burns, K.L., Green, P., & Chase, H.P. (1986). Psychosocial correlates of glycemic control as a function of age in youth with insulin dependent diabetes. Journal of Adolescent Health, 7, 311-319.

Cantor, N., & Hunt, T.M. (1987, June). Positive and negative frames for health relevant information. Paper prepared for MacArthur and Behavior Network Conference on the Effects of Pharmacology, Technology, and other Modern Interventions on Women's Health, Key Biscayne, FL.

Centers for Disease Control (1999). Statistics: Diabetes Surveillance 1999. Atlanta, GA: CDC.

Chaplin, W.F., Davidson, K., Sparrow, V., Stuhr, J., Van Roosmalen, E., & Wallston, K.A. (2001). A structural evaluation of the expanded multidimensional health LOC scale with a diverse sample of White/European, native, and black Canadian women. Journal of Health Psychology, 6, 447-455.

Chen, C.Y., Neufeld, P.S., Feely, C.A., & Skinner, C.S. (1999). Factors influencing compliance with home exercise programs among patients with upper extremity impairment. The American Journal of Occupational Therapy, 53, 171-180.

Christensen, A.J., Moran, P.J., & Wiebe, J.S. (1999). Assessment of irrational health beliefs: Relation to health practices and medical regimen adherence. Health Psychology, 18, 169-176.

Coates, V.E., & Boore, J.R. (1995). Self-management of chronic illness: implications for nursing. International Journal of Nursing Studies, 32, 628-40.

Conn, V.S. (1998). Older adults and exercise: Path analysis of SE related constructs. Nursing Research, 47, 180-189.

Cohen, J., & Cohen, P. (1983). Applied MRC analysis for the behavioral sciences (2nd edition). Hillsdale, NJ: Erlbaum.

Conner, M., & Norman, P. (1996). Predicting health behavior: Research and practice with social cognition models. Bristol, PA: The Open University.

Corbie, S.G., Thomas, S.B., & St. George, D.M. (2002). Distrust, race, and research. Archives of Internal Medicine, 162, 2458-2463.

Cowen, M.E., Jim, L.K., Boyd, E.L., & Gee, J.P. (1981). Some possible effects of patient non-compliance. Journal of the American Medical Association, 245, 1121.

Cox, D.J., & Gonder-Frederick, L. (1992). Major developments in behavioral diabetes researcher. Journal of Counseling and Clinical Psychology, 60, 628-638.

Crabtree, M.K. (1986). SE and social support as predictors of diabetic self care. Dissertation Abstracts International, 47, 2369-2620.

DiIorio, C., Dudley, W.N., Soet, J., Watkins, J., & Maibach, E. (2000). A social cognitive model for condom use among college students. Nursing Research, 49, 208-214.

DeVellis, B.M., & DeVellis, R.F. (2001). SE and health. In A. Baum, T.A. Revenson, & J.E. Singer (Eds.), Handbook of Health Psychology (pp. 235-247). New York: Plenum Press.

Devins, G.M., Binik,Y.M., Gorman, P., Dattel, M., McCloskey, B., Oscar, G., Briggs, J. (1982). Perceived SE, outcome expectancies, and negative mood states in end stage renal disease. Journal of Abnormal Psychology, 91, 241-244.

Doescher, M.P., Saver, B.G., Franks, P., & Fiscella, K. (2000). Racial and ethnic disparities in perceptions of physician style and trust. Archives of Family Medicine, 9, 1156-1163.

Dunn, S.M., Smartt, H.H., Beeney, L.J., & Turtle, J.R. (1986). Measurement of emotional adjustment in diabetic patients: validity and reliability of ATT39. Diabetes Care, 9, 480-489.

Edelstein, J., & Linn, W. (1987). LOC and the control of diabetes. Diabetes Educator, 13, 51-54.

Eiser, R.J., & Cole, N. (2002). Participation in cervical screening as a function of perceived risk, barriers and need for cognitive closure. Journal of Health Psychology, 7, 99-105.

Eizenman, D.R., Nesselroade, J.R., Featherman, D.L., & Rowe, J.W. (1998). Intraindividual variability in perceived control in an older sample. The MacArthur Successful Aging Studies. Psychology and Aging, 12, 489-502.

Evans, C.L., & Hughes, I.A. (1987). The relationship between diabetic control and individual and family characteristics. Journal of Psychosomatic Research, 31, 367-374.

Fishbein, M., Triandis, H.C., Kanfer, F.H., Becker, M., Middlestadt, S.E., & Eichler, A. (2001). Factors influencing behavior and behavior change. In A. Baum, T.A. Revenson, & J.E. Singer (Eds.), Handbook of Health Psychology (pp. 3-17). New York: Plenum Press.

Geraci, J.M., Ashton, C.M., Kuykendall, D.H., Johnson, M.L., Souchek, J., del Junco, D., & Wray, N.P. (1999). The association of quality of care and occurrence of in-hospital, treatment-related complications. Medical Care, 37, 140-148.

Glasgow, R.E. (1991). Adherence to diabetes regimens: Conceptualization, complexity and determinants. In J.A. Cramer, & B. Spilker (Eds.), Patient adherence in medical practice and clinical trials (pp. 209-224). New York: Oxford.

Glasgow, R.E., Toobert, D.J., Hampson, S.E., & Wilson, W. (1995). Behavioral research on diabetes at the Oregon Research Institute. Annals of Behavioral Medicine, 17, 32-40.

Glasgow, R.E., Toobert, D.J., Riddle, M., Donnelly, J., Mitchell, D.L., & Calder, D. (1989). Diabetes specific social learning variable sand self-care behaviors among persons with Type 2 diabetes. Health Psychology, 8, 285-303.

Gonen, B., Rubenstein, A., Rochman, H., Tanega, S.P., Horwitz, D.L. (1977). Hemoglobin A1: An indicator of the metabolic control of diabetic patients. Lancet, 2(8041), 734-737.

Grossman, H.Y., Brink, S., & Hauser, S.T. (1987). SE in adolescent girls and boys with insulin dependent diabetes mellitus. Diabetes Care, 10, 324-329.

Hallam, J., & Petosa, R. (1998). A worksite intervention to enhances social cognitive theory constructs to promote exercise adherence. American Journal of Health Promotion, 13, 4-7.

Hamburg, B.A., & Inoff, G.E. (1982). Relationships between behavioral factors and diabetic control in children and adolescents: A camp study. Psychosomatic Medicine, 44, 321-39.

Haukkala, A., Uutela, A., Vartianen, E., McAlister, A., & Knecht, P. (2000). Depression and smoking cessation: The role of motivation and SE. Addictive Behaviors, 25, 311-316.

Hayes, R.P., Bernard, A.M., SLOC um, W., el-Kebbi, I., Ziemer, D., Gallina, D., & Phillips, L.S. (2000). Diabetes in urban Blacks: Assessment of diabetes-specific LOC in patients with Type 2 diabetes. The Diabetes Educator, 26, 121-128.

Helgeson, V.S., & Franzen, P.L. (1998). The role of LOC in adjustment to diabetes. Anxiety, Stress, and Coping, 11, 113-136.

Hofstetter, C.R., Sallis, J.F., & Hovell, M.F. (1990). Some health dimensions of SE: analysis of theoretical specificity. Social Science Medicine, 31, 1051-1056.

Jacobson, A.M., Hauser, S.T., Lavori, P., Wolfsdorf, J.I., Herskowitz, R.D., Milley, J., Bliss, R., Gelfand, E., Wertlieb, D., & Stein, J. (1990). Adherence among children and adolescents with insulin dependent diabetes mellitus over a four-year longitudinal follow-up. I. The influence of patient coping and adjustment. Journal of Pediatric Psychology, 15, 511-526.

Jacobson, A.M., Hauser, S.T., Wertleib, D., Wolfsdorf, I., Orleans, J., & Veiyra, M. (1986). Psychological adjustment of children with recently diagnosed diabetes mellitus. Diabetes Care, 9, 323-329.

Kaplan, R.M., Atkins, C.J., & Reinsch, S. (1984). Specific efficacy expectations medicate exercise compliance in patients with COPD. Health Psychology, 3, 223-242.

Kavanagh, D.J., Gooley, S., & Wilson, P.H. (1993). Prediction of adherence and control in diabetes. Journal of Behavioral Medicine, 16, 509-522.

Kincey, J. (1981). Internal –external control and weight loss in the obese: Predictive and discrimant validity and some possible clinical implications. Journal of Clinical Psychology, 37, 100-103.

Kirsch, I. (1995). SE and outcome expectancies: A concluding commentary. In J.E. Maddux (Ed.), SE, adaptation, and adjustment: Theory, research, and application (pp. 331-345). New York: Plenum Press.

Kneckt, M.C., Syrjala, A.M., & Knuuttila, M.L. (1999). LOC beliefs predicting oral and diabetes health behaviors and health status. Acta Odontologica Scandinavica, 57, 127-131.

Kohlmann, C.W., Schuler, M., Petrak, F., Kustner, E., Krohne, H.W., & Beyer, J. (1993). Associations between type of treatment and illness-specific LOC in Type 1 diabetes patients. Psychology and Health, 8, 383-391.

Konen, J.C., Summerson, J.H., & Dignan, M.B. (1993). Family function, stress, and LOC . Relationships to glycemia in adults with diabetes mellitus. Archives of Family Medicine, 2, 393-402.

Lefcourt, H.M., Martin, R.A., & Saleh, W.E. (1984). LOC and social support: Interactive moderators of stress. Journal of Personality and Social Psychology, 47, 378-389.

Liakopoulou, M., Korvessi, M., & Dacou-Voutetakis, C. (1992). Personality characteristics, environmental factors and glycemic control in adolescents with diabetes. personality characteristics, environmental factors and glycemic control in adolescents with diabetes. European Child and Adolescent Psychiatry, 1, 82-88.

Litt, M.D. (1988). SE and perceived control: Cognitive mediators and pain tolerance. Journal of Personality and Social Psychology, 54, 149-160.

Mackenbach, J.P., Borsboom, G.J., Nusselder, W.J., Looman, C.W., & Schrijvers, C.T. (2001). Determinants of levels and changes of physical functioning in chronically ill persons: results from the GLOBE study. Journal of Epidemiology and Community Health, 55, 631-638.

MacLeod, M.D. (1999). Why did it happen to me? Social cognitive processes in adjustment and recovery from criminal victimization and illness. Current Psychology: Developmental, Learning, Personality, and Social, 18, 18-31.

Maddux, J.E., Brawley, L., & Boykin, A. (1995). SE and healthy behavior: Prevention, promotion, and detection. In J.E. Maddux et al. (Eds.), SE, Adaptation, and Adjustment: Theory, Research, and Application (pp. 173-202). New York: Plenum Press.

Mansfield, C.J., Mitchell, J., & King, D.E. (2002). The doctor as God's mechanic? Beliefs in the Southeastern United States. Social Science and Medicine, 54, 399-409.

Mason, B.J., Matsuyama, J.R., & Jue, S.G. (1993). Pharmacists' interventions using an electronic medication-event monitoring device's adherence data versus pill counts. The Annals of Pharmacotherapy, 27, 851-855.

McAuley, E. (1991). Efficacy, attributional, and affective responses to exercise participation. Journal of Sport and Exercise Psychology, 13, 382-393.

McAuley, E. (1994). Physical activity and psychosocial outcomes. In C. Bouchard, R.J. Shepard, & T. Stephens (Eds.), Physical activity, fitness, and health: International proceedings and consensus statement (pp. 551-568). Champaign, IL: Human Kinetics.

McCaul, K.D., Glasgow, R.E., & Schafer, L.C. (1987). Diabetes regimen behaviors. Medical Care, 25, 868-881.

McCaul, K.D., Sandgren, A.K., O'Neill, K.H., & Hinsz, V.B. (1993). The value of the theory of planned behavior, LOC , and SE for predicting health protective behaviors. Basic and Applied Social Psychology, 14, 231-252.

Melding, P.S. (1995). How do older people respond to chronic pain? A review of coping with pain and illness in elders. Pain Reviews, 2, 65-75.

Morrill, A.C., Ickovics, J.R., Golubchikov, V.V., Beren, S.E., & Rodin, J. (1996). Safer sex: Social and psychological predictors of behavioral maintenance and change among heterosexual women. Journal of Consulting and Clinical Psychology, 64, 819-828.

Murphy, L.M.B., Thompson, R.J., & Morris, M.A. (1997). Adherence behaviors among adolescents with Type I insulin dependent diabetes mellitus: The role of cognitive appraisal processes. Journal of Pediatric Psychology, 22(6), 811-825.

O'Leary, A. (1985). SE and health. Behavior Research and Therapy, 23, 437-451.

O'Leary, A., Goodhart, F., Jemmott, L.S., & Boccher-Lattimore, D. (1992). Predictors of safer sex on the college campus: A social cognitive theory analysis. Journal of American College Health, 40, 254-263.

Ollendeick, T.H., & Schmidt, C.R. (1987). Social learning constructs in the prediction of peer interaction. Journal of Clinical Child Psychology, 16, 80-87.

Oprendek, T.S., & Malcarne, V.L. (1997). College student reasoning about illness and psychological concepts. Journal of American College Health, 46, 10-19.

Padgett, D.K. (1991). Correlates of SE beliefs among patients with non-insulin dependent diabetes mellitus in Zagreb, Yugoslavia. Patient Education and Counseling, 18, 139-147.

Paes, A.H.P., Bakker, A., & Soe-Agnie, C.J. (1997). Impact of dosage frequency on patient adherence. Diabetes Care, 20, 1512-1517.

Park, C., & Cohen, L.H. (1992). Religious beliefs and practices and the coping process. In B.N. Carpenter (Ed.), Personal Coping, Theory, Research, and Application (pp. 184-198). Westport, CT: Praeger.

Perrig-Chiello, P., Perrig, W.G., & Staehelin, H.B. (1999). Health control beliefs in old age--relationship with subjective and objective health, and health behavior. Psychology, Health and Medicine, 4, 83-94.

Peyrot, M., & Rubin, R.R. (1994). Structure and correlates of diabetes specific LOC . Diabetes Care, 17, 994-1001.

Rippetoe, P.A., & Rogers, R.W. (1987). Effects of components of protection-motivation theory on adaptive and maladaptive coping with a health threat. Journal of Personality and Social Psychology, 52, 596-604.

Porte, D., & Sherwin, R.S. (1997). Ellenberg & Rifkin's Diabetes Mellitus (5th Edition). Stamford, CT: Appleton & Lange.

Reynaert, C., Janne, P., Donckier, J., Buysschaert, M., Zdanowicz, N., Lejeune, D., & Cassiers, L. (1995). LOC and metabolic control. Diabetes Metabolism, 21, 180-187.

Ricker, J.H., Delamater, A.M., Hsu, J. (1998). Correlates of regimen adherence in cystic fibrosis. Journal of Clinical Psychology in Medical Settings, 5, 159-172.

Rodgers, W.M., & Brawley, L.R. (1996). The influence of OE and SE on the behavioral intentions of novice exercisers. Journal of Applied Social Psychology, 26, 618-634.

Rodin, J. (1990). Control by any other name: Definitions, concepts, and processes. In J. Rodin, C. Schooler, & K.W. Schaie (Eds.), Self-directedness: Cause and effects throughout the life course (pp. 1-17). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rotter, J.B. (1954). Social learning and clinical psychology. Englewood Cliffs, NJ: Prentice-Hall.

Rotter, J.B. (1966). Generalized expectancies for internal vs. external control of reinforcement. Psychological Monographs, 80, 1-28.

Ruzicki, D.A. (1984). Relationship of participation preference and health LOC in diabetes education. Diabetes Care, 7, 372-377.

Schlenk, E.A., & Hart, L.K. (1984). Relationship between health LOC, health value, and social support in compliance of persons with diabetes mellitus. Diabetes Care, 7, 566-574.

Schwartz, L.S., Coulson, L.W., Toovey, D., Lyons, J.S., & Flaherty, J.A. (1991). A biopsychosocial treatment approach to the management of diabetes mellitus. General Hospital Psychiatry, 13, 19-26.

Schwebel, A.I., & Kaemmerer, W.F. (1977). Smoking, alienation, and LOC factors. Omega, 3, 239-246.

Seeman, M., & Evans, J.W. (1962). Alienation and learning in a hospital setting. American Sociology Review, 27, 772-783.

Seeman, M., & Lewis, S. (1995). Powerlessness, health, and mortality: A longitudinal study of older men and mature women. Social Science and Medline, 41, 486-517.

Sensky, T., & Petty, R. (1989). Type A Behaviour pattern and glycaemic control in Type 1 diabetes. Psychotherapy and Psychosomatics, 52, 96-100

Shapiro, D.H., Schwarz, C.E., & Astin, J.A. (1996). Controlling ourselves, controlling our world: Psychology's role in understanding positive and negative consequences of seeking and gaining control. American Psychologist, 51, 1213-1230.

Shavers, V.L., Lynch, C.F., & Burmeister, L.F. (2001). Factors that influence African-Americans' Willingness to participate in medical research studies. Cancer, 91, 233-236.

Shneider, M.S., Friend, R., Whitaker, P., & Wadhwa, N.K. (1991). Fluid noncompliance and symptomotology in end stage renal disease: Cognitive and emotional variables. Health Psychology, 10, 209-215.

Skaer, T.L., Sclar, D.A., Markowski, D.J., & Won, J.K. (1993). Effect of value-added utilities on prescription refill adherence and Medicaid health care expenditures—a study of patients with non-insulin-dependent diabetes mellitus. Journal of Clinical Pharmacy and Therapeutics, 18, 295-299.

Smith, D.E., Heckemeyer, C.M., Kratt, P.P., & Mason, D.A. (1997). Motivational interviewing to improve adherence to a behavioral weight-control program for older obese women with NIDDM. A pilot study. Diabetes Care, 20, 52-54.

Stenstrom, U., & Andersson, P. (2000). Smoking, blood glucose, and LOC beliefs in people with Type 1 diabetes mellitus. Diabetes Research and Clinical Practice, 50, 103-107.

Stenstrom, U., Wikby, A., Andersson, P.O., & Ryden, O. (1998). Relationship between LOC beliefs and metabolic control in insulin dependent diabetes mellitus. British Journal of Health Psychology, 3, 15-25.

Strickland, B.R. (1978). Internal-external expectancies and health related behaviors. Journal of Consulting and Clinical Psychology, 46, 1192-1211.

Surgenor, L.J., Horn, J., Hudson, S.M., Lunt, H., & Tennent, J. (2000). Metabolic control and psychological sense of control in women with diabetes mellitus: Alliterative considerations of the relationship. Journal of Psychosomatic Research, 49, 267-273.

Talbot, F., Nouwen, A., Gingras, J., Gosselin, M., & Audet, J. (1997). The assessment of diabetes-related cognitive and social factors: The Multidimensional Diabetes Questionnaire (MDQ). Journal of Behavioral Medicine, 20, 291-312.

Taylor, S., & Brown, J. (1988). Illusion and well-being: A social psychological perspective on mental health. Psychological Bulletin, 103, 193-210.

Tillotson, L.M., & Smith, M.S. (1996). LOC , social security, and adherence to the diabetes regimen. The Diabetes Educator, 22, 133-139.

Tobias, L.L., & MacDonald, M.L. (1977). ILOC and weight loss: An insufficient condition. Journal of Consulting and Clinical Psychology, 45, 647-653.

Van den Akker, M., Buntinx, F., Metsemakers, J.F., van der Aa, M., & Knottnerus, J.A. (2001). Psychosocial patient characteristics and GP-registered chronic morbidity: a prospective study. Journal of Psychosomatic Research, 50, 95-102.

Wallace, L.M., Wright, S., Parsons, A., Wright, C., & Barlow, J. (2002). The impact of screening for osteoporosis on bone protecting exercise and dietary calcium intake. Psychology, Health, and Medicine, 7, 477-488.

Wallston, K.A. (1989). Assessments of control in health care settings. In A. Steptoe, & A. Appels (Eds.), Stress, Personal Control, and Health (pp. 85-105). Brussels, Luxembourg: John Wiley & Sons.

Wallston, K.A. (1992). Hocus-pocus, the focus isn't strictly on LOC us: Rotter's social learning theory modified for health. Cognitive Therapy and Research, 16, 183-199.

Wallston, K.A. (2001). Conceptualization and operationalization of LOC . In A. Baum, T.A., Revenson, & J.E. Singer (Eds.), Handbook of Health Psychology (pp. 49-58). New York: Plenum Press.

Wallston, K.A., Maides, S., & Wallston. B.S. (1976). Health related information seeking as a function of health related LOC and health value. Journal of Research on Personality, 10, 215-222.

Wallston, K.A., Malcarne, V.L., Flores, L., Hansdottir, I., Smith, C.A., Stein, M.J., Weisman, M.H., & Clements, P.J. (1999). Does God determine your health? The God LOC us of health control scale. Cognitive Therapy and Research, 23, 131-142.

Wallston, K.A., Stein, M.J., & Smith, C.A. (1994). Form C of the MHLC scales: A condition specific measure of LOC . Journal of Personality Assessment, 63, 534-553.

Wallston, B.S., & Wallston, K.A. (1978). LOC and health: A review of the literature. Health Education Monographs, 6, 107-115.

Wallston, K.A., Wallston, B.S., & DeVellis, R.F. (1978). Development of the Multidimensional Health LOC (MHLC) Scales. Health Education Monographs, 6, 160-170.

Wallston, B.S., Wallston, K.A., Kaplan, G.D., & Maides, S.A. (1976). The development and validation of the health related LOC (HLC) scale. Journal of Consulting and Clinical Psychology, 44, 580-585.

Wallston, K.A., Wallston, B.S., Smith., S., & Dobbins, C.J. (1987). Perceived control and health. Current Psychological Research and Review, 6, 5-25.

Wallston, K.A., Wallston, B.S., Smith, S., & Dobbins, C.J. (1989). Perceived control and health. In M. Johnston, & M. Theresa (Eds.), Applications in health psychology (pp. 5-25). New Brunswick, NJ: Transaction Publishers.

Weaver, G.D., & Gary, L.E. (1996). Correlates of health-related behaviors in older Black adults: Implications for health promotion. Family Community Health, 19, 43-57.

Weinger, K., & Jacobson, A.M. (2001). Psychosocial and quality of life correlates of glycemic control during intensive treatment of Type 1 diabetes. Patient Education and Counseling, 42, 123-131.

Weinstein, N.D. (1993). Testing four competing theories of health-protective behavior. Health Psychology, 12, 324-33.

Wells, N. (1994). LOC over pain: Relation to distress and desirability. Research in Nursing and Health, 17, 295-302.

Woodcock, R.W., McGrew, K.S., & Mather, N. (2001). Woodcock-Johnson-III: Tests of Achievement. Itasca, IL: Riverside Publishing.

Zimmerman, B.R. (1990). Non-insulin-dependent (Type 2) diabetes: Medical overview. In C.S. Holmes (Ed.), Neuropsychological and behavioral aspects of diabetes. New York: Springer-Verlag.

VITA

In 1996 Erin L. O'Hea graduated from Lafayette College, a small liberal arts college located in Easton, Pennsylvania. While she received a bachelor of arts degree in psychology, she also earned a minor degree in anthropology and sociology. Immediately after college, Ms. O'Hea earned her master of arts degree in 1998, in clinical health psychology, from Connecticut College, which is another small liberal arts college located in New London, Connecticut. During her tenure in Connecticut, Ms. O'Hea also worked as a research assistant for Dr. Peter Salovey at Yale University. Once again, immediately after finishing her master's degree, Ms. O'Hea began doctoral training at Louisiana State University in the Fall of 1998. Her doctor of philosophy degree in clinical/medical psychology was earned under the guidance of Dr. Phillip J. Brantley. Finally, in the fall of 2002, Ms. O'Hea began her final stage of clinical training, the pre-doctoral clinical psychology internship, at Robert Wood Johnson Medical School, UMDNJ, located in Piscataway, New Jersey.