SEVERITY OF TYPE 2 DIABETES MELLITUS, WORKING MEMORY, AND SELF-CARE

by

Patricia K. Gatlin

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SIGNED: ___Patricia K. Gatlin__________________
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  To everyone who helped pave my way
  If it weren’t for you I wouldn’t be here today
  I hit walls and I wanted to quit
  I picked myself up but the truth is
  I didn’t get here alone
  I might be the one the spotlight’s on
  But, I didn’t get here alone!
DEDICATION

I would like to dedicate this Doctoral dissertation to my beautiful daughter, Grace Elizabeth. Being your mom will always be my greatest achievement. I love you Bug!
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ABSTRACT

Orem’s Self-Care Deficit Theory was used to inform hypotheses of associations between perceived severity of illness, working memory and self-care among adults (> 45 years of age) with Type 2 Diabetes Mellitus (T2DM). Working memory capacity was examined as a foundational capability using Orem’s theory. Measures include the modified Diabetes Care Profile section on Health Status Composite (HSC) providing information on severity of illness, the Working Memory Index (WMI) from the Wechsler Adult Intelligence Scale (WAIS-III), the Self-Care Inventory Revised (SCI-R) and hemoglobin A1c. Sixty-seven adults with a mean age of 62.9 years who were primarily Caucasian (92.5%) were involved. There were 30 men and 37 women. Mean body mass index was 35.11 reflecting the majority of participants were obese. Findings indicate that HSC is significantly associated with WMI ($r = .54, p < .01$) and associated with both indicators of self-care, the SCI-R and HgA1c ($r = .23, p < .05$, $r = -.37, p < .01$). Working memory was examined as a mediator between severity of illness and the indicators of self-care (SCI-R and HgA1c) with no evidence for mediation. Findings are discussed in relationship to Orem’s Theory of Self-Care Deficit.
CHAPTER 1: INTRODUCTION

The purpose of this study was to explore relationships among severity of type 2 diabetes mellitus, working memory and diabetes self-care, as well as test proposed relationships within Orem’s Self-Care Deficit Nursing Theory (Orem, 2001). Chapter one presents the background, introduction to the theoretical framework, purpose, significance, research aims and hypothesis.

Background

Diabetes mellitus is a growing epidemic in the United States with incidence and prevalence of diabetes increasing yearly. According to a 2011 report by the Center for Disease Control and Prevention (CDC), approximately 25.6 million people (11.3% of the population) have diabetes. The prevalence of diabetes among people over the age of 65 years is 26.9% (10.9% of the population). The total direct and indirect cost of diabetes is nearly $174 billion dollars a year. The pathological effects of diabetes continue to place this disease as a leading cause of death in the United States (Center for Disease Control and Prevention, 2011).

Diabetes mellitus is classified into three main types: type 1, type 2, and gestational diabetes with approximately 90-95% of people with diabetes diagnosed with type 2 diabetes (CDC, 2011). This study will focus on type 2 diabetes (T2DM). The complications associated with T2DM are well established. Micro and macro vascular complications associated with hyperglycemia, a cardinal feature of the disease, continues to place individuals with diabetes in a compromised or vulnerable state. This vulnerability is a result of the pathophysiological changes that result in retinopathy,
nephropathy, neuropathy, and/or cardiovascular disease (i.e., stroke and myocardial infarction). It has now been documented, both in longitudinal and cross sectional studies, that individuals with T2DM have poorer performance on tests of cognitive function when compared to those individuals who do not have diabetes (Allen, Frier, & Strachan, 2004; Arvanitakis, Wilson, Bienias, & Bennett, 2006; Awad, Gagnon, & Messier, 2004; Coker & Shumaker, 2003; Cukierman, Gerstein, & Williamson, 2005; Kodl & Seaquist, 2008; Roriz-Filho et al., 2009; Van den Berg, Kloppenborg, Kessels, Kapelle, & Biessels, 2009). The results of lower performance on cognitive tests in individuals with T2DM leads to concerns about their ability to provide self-care.

Currently the focus of the majority of treatments for diabetes mellitus is aimed at preventing hyperglycemia, as this is the primary cause of the complications associated with this disease (ADA, 2011). In order to control hyperglycemia, it is essential that the individual engage in self-care. It is claimed that as much as 98% of diabetic care is self-care (Anderson, R. M., 1995; Lutfey & Wishner, 1999). An individual with diabetes may have only 3 hours per year with a health professional, thus leaving 8,757 hours of the year involved in self-care of this chronic disease. These self-care actions are complex and depend on cognitive processes, as they require skill, knowledge, attention, concentration, memory, and decision-making ability. Although, there is empirical evidence suggesting an association between T2DM and lower cognitive function when compared to those without diabetes, little is known about the relationship between cognitive function, specifically working memory, and self-care among individuals with T2DM. Studies that improve understanding of how working memory is associated with the ability to engage
in self-care among individuals with T2DM are needed.

**Theoretical Framework**

Orem's (2001) general nursing theory, Self-Care Deficit Nursing Theory provides a theoretical framework to explore the relationships between cognitive function and self-care among individuals with type 2 diabetes. Orem’s general nursing theory proposes that certain factors (basic conditioning factors) such as T2DM, can at points in time condition or affect an individual’s ability (self-care agency) to engage in self-care (Figure 1). Self-care is defined by Orem as deliberate action one initiates or performs to maintain life, health, and well-being. The ability to engage in self-care is defined by Orem as self-care agency.

Figure 1
Schematic of Theoretical Relationships Proposed by Orem’s SCDNT

Self-care agency is a complex, multidimensional, hierarchical concept consisting of personal traits or human abilities such as cognitive, psychomotor, and emotional skills necessary for self-care actions. Within the concept of self-care agency, Orem (2001) describes foundational capabilities as the most basic type of human ability consisting of cognitive functions or abilities such as attention, perception, memory, knowing, and reasoning. While not listed specifically, the cognitive ability of working memory can be considered a foundational capability, as it is a combination of both attention and memory.
Working memory is a cognitive process in which an individual maintains or holds information in mind over a period of time, while simultaneously ignoring or neglecting other non-relevant information and retrieving older pertinent information to achieve a task (Engle, Tuholski, Laughlin & Conway, 1999; Kane & Engle, 2003). Thus, working memory has limits in capacity in which it holds or maintains information in mind. Working memory also involves the cognitive process of executive function, specifically executive attention (Engle et al.; Kane & Engle).

**Purpose of Study**

The purpose of this study was to explore relationships between severity of T2DM, working memory, and diabetes self-care, as well as to test a portion of Orem’s (2001) Self-care Deficit Nursing Theory among middle and older aged individuals with T2DM.

**Significance**

An important area of investigation for those with diabetes is the concept of self-care. Current standards of medical care by the American Diabetes Association (ADA) (2011) state that self-care of an individual with diabetes should consist of performing self-monitoring blood glucose testing, monitoring and regulating nutrition, engaging in aerobic and weight resistance physical activities, and monitoring/regulating complicated medication regimens, such as insulin, oral hypoglycemia agents, anti-hypertension medications and lipid lowering agents. The treatment for diabetes is aimed at preventing hyperglycemia.

Self-care is crucial in preventing diabetic complications. The self-care treatment regimen for those with diabetes may require the individual to administer insulin
subcutaneously, calculate dosage of prescribed medications and take them according to a scheduled plan that optimizes the effects, understand and manage side effects of medications and seek health care assistance if needed. Further, the individual with diabetes must plan and incorporate a special diet, blood glucose monitoring and exercise into their daily lives.

Cognitive abilities necessary for individuals to plan a diet, monitor blood glucose levels and treat blood glucose levels involve working memory. For example, individuals with T2DM who are on specialized diets must keep in mind how many calories, carbohydrates and fats are ingested with the current meal, while adding that information to ongoing knowledge of the other foods consumed that day, all while ignoring irrelevant competing information. The individual with T2DM must also keep in mind their current blood glucose while planning the meal, and decide whether or not more medication is needed before or after the meal to control blood glucose levels. Kleinman (1988) stated:

To cope [manage] with chronic illness [diabetes mellitus] means to routinely scan minute bodily processes. Attention is vigilantly focused, sometimes hour-by-hour, to the specifics of circumstances and events that could be potential sources of worsening. There is the daily quest for control of the known provoking agents. Decisions must be made about when to initiate or terminate an activity, when to move from baseline medication to second-level drugs (p. 47).

This type of vigilance requires the individual with T2DM to have adequate cognitive ability specifically working memory, which may be compromised for the individual with diabetes due to pathophysiological changes related to the disease process.
The relevance of examining the relationship between severity of T2DM, working memory and DMSC can be considered from both a clinical perspective, as well as a theoretical perspective. From a clinical perspective, little is known regarding how working memory affects the ability to engage in self-care among individuals with T2DM. Most research has focused on the relationship of decline in types of cognitive processes associated with T2DM. There has been little research investigating the relationship between the cognitive processes and self-care among individuals with T2DM that includes the concept of severity of T2DM. Therefore, this study provides evidence to improve understanding of the relationship between severity of T2DM, working memory, and self-care. Understanding the relationship among these concepts is foundational to future research studies, as intervention studies may be premature without a clear understanding of how the individual’s ability to engage in self-care is affected.

From a theoretical perspective, this research will contribute to nursing knowledge via theory testing. Theory testing will offer empirical validity to selected relationships stated as propositions within Orem’s (2001) Self-care Deficit Nursing Theory. The theoretical model tested (Figure 2) in this study articulates the nature of relationships between basic conditioning factors (severity of T2DM), self-care agency (working memory) and self-care (diabetes mellitus self-care) beyond the propositions stated by Orem. Thus, the results of this inquiry provide new insight regarding the ability for engagement in self-care among individuals with T2DM, as well as expand the current state of Orem’s theory.
Research Aims and Hypothesis

The specific aims and hypothesis of this study were as follows:

Aim 1: To test a portion of Orem’s Self-care Deficit Nursing Theory among middle and older aged individuals with T2DM.

Aim 2: To explore relationships between severity of type 2 diabetes, working memory and diabetes self-care.

Hypothesis 1: Increased severity of T2DM will be associated with decreased performance
of working memory.

Hypothesis 2: Decreased performance on measures of working memory will be associated with lower indicators of self-care.

Hypothesis 3: Working Memory will mediate the effects of severity of T2DM on diabetes self-care.

Definitions

**Basic conditioning factors**: personal or environmental characteristics that can, at points in time affect the ability to engage in self-care or the type/amount of self-care actions needed (Orem, 2001).

**Diabetes Mellitus self-care**: the practice of specific activities that arise due to the diagnosis of T2DM that an individual with T2DM must initiate and perform to maintain life, health and well-being; a type of health deviation self-care.

**Foundational capabilities**: the most basic type of human ability consisting of cognitive functions or abilities such as attention, perception, memory, knowing, and reasoning (Orem, 2001).

**Health deviation self-care**: the practice of activities that arise due to specific health states that individuals initiate and perform to maintain life, health and well-being (Orem, 2001).

**Health state**: a personal basic conditioning factor that describes the compound entity of an individual’s structural, physical, functional and mental integrity at a particular time (Orem, 2001).

**Self-care**: the practice of activities that individuals initiate and perform on their own behalf in maintaining life, health, and well-being (Orem, 2001).
**Self-care agency:** The ability to engage in self-care (Orem, 2001). Self-care agency encompasses three types of abilities necessary for self-care. These hierarchical abilities are foundational capabilities, enabling capabilities or power components, and capabilities for self-care operations.

**Severity of T2DM:** an overall appraisal of health state in an individual with T2DM, that includes assessment of obvious injuries or defects caused by T2DM and treatments related to these causes (i.e., comorbid conditions, medications, surgery, and hospitalizations), the effect of T2DM experienced by the individual (i.e., perception of health and pain), and the effects of the T2DM on effective living (i.e., limits effecting activities of daily living, social activities, or working ability) (Orem, 2001).

**Working memory:** a cognitive ability (capacity) in which an individual maintains or holds information in mind over a period of time, while simultaneously ignoring or neglecting other non-relevant information and retrieving older pertinent information to achieve a task (Engle et al., 1999; Kane et al., 2003). Includes the cognitive process of executive function (Engle & Kane, 2002).

**Summary**

Current research has shown that individuals with T2DM have poorer performance on neuropsychological tests measuring particular cognitive processes than individuals without diabetes; however, little is known regarding the relationship between cognitive function, specifically working memory, and self-care among individuals with T2DM. This study addressed this gap in knowledge and offers a foundation for future studies.
CHAPTER II: LITERATURE REVIEW

Introduction

Chapter two presents the literature that supported the proposed study. The literature review is organized in two major sections (a) an overview of Orem’s Self-care Deficit Nursing Theory, and (b) a synthesis of research relevant to the concepts (Figure 2) guiding this study.

Overview of Orem’s Self-care Deficit Nursing Theory

The Self Care Deficit Nursing Theory (SCDNT) is a general theory of nursing developed by Dorothea Orem regarding the concept of self-care (2001). Orem conceptually defines self-care as deliberate action one initiates to maintain life, health and well-being. Individuals with chronic illness, specifically T2DM must engage in specific self-care actions to maintain life, health and well-being (e.g. nutritional and medication regimens). Research has shown that individuals with T2DM have poor self-care in the areas of managing their medication regimen, monitoring blood glucose levels, following a prescribed diet, and exercise treatment plans (Peyrot, Rubin, Lauritzen, Snoek, Matthews, & Skovlund, 2005). Understanding why individuals with T2DM may have poor self-care is important to help reduce co-morbid conditions associated with T2DM and improve the quality of life of individuals with T2DM. While reasons for poor self-care has been related to multiple factors such as low socioeconomic status, health beliefs, family support, and lack of health care provider support, little is known about the effects of particular cognitive processes on self-care in this population (Delamater et al., 2001). Orem’s theory provides a theoretical framework to investigate the ability to
engage in self-care among individuals with T2DM through her concept of self-care agency.

The original ideas underpinning Orem’s (2001) theory arose out of the desire to understand when individuals need nursing. Orem worked with the Nursing Development Conference Group (NDCG), to formalize her ideas about nursing and the general theory was first published in 1979 (NDCG, 1979). Since the formalization of the theory, there have been refinements in propositions, but the theoretical concepts of self-care and self-care agency have generally remained the same. Orem’s general theory of nursing consists of three interrelated theories. The three interrelated theories are a theory of self-care, a theory of self-care deficit, and a theory of nursing system. The theory of self-care is foundational or core to the general theory and is subsumed in the theory of self-care deficit. The theory of nursing system subsumes the theory of self-care deficit, thus also subsuming the theory of self-care.

The theory of self-care deficit was the framework for this study to examine the relationships between severity of T2DM, working memory and diabetes self-care. Within the theory of self-care deficit the concepts of self-care, self-care agency, and basic conditioning factors are used to guide this study (Figure 2). Each of these concepts and their sub concepts will be discussed as they are described within Orem’s theory, starting with the concept of self-care.

**Self-care**

Self-care (SC), according to Orem (2001), is “the practice of activities that individuals [mature adults] initiate and perform on their own behalf in maintaining life,
health, and well-being” (p. 43). Self-care is deliberate action that one engages in to maintain life, health and well-being. It is action specific and goal driven.

Deliberate action refers to “actions performed by individual human beings who have intentions and are conscious of their intentions to bring about, through their actions, conditions or states of affairs that do not at present exist” (Orem, 2001, p. 62). Thus, deliberate action is human action or actions that are goal driven.

The purpose of self-care action is to meet known self-care needs; the goal is to maintain life, health and well-being. Thus, self-care action is based on need for self-care. Orem (2001) describes that at times there can be changes in health or health state requiring specific self-care actions, which is termed health deviation self-care. Health deviation self-care may require the individual to seek and secure appropriate medical assistance, be aware of and attend to the effects of the current health state, carry out medical prescribed measures specific to the current health state, be aware of and attend to the effects of medical care prescribed or performed, modify self-concept to accept the particular state of health or learn to live with the effects of the current health state (Orem). Individuals with T2DM have specialized health deviation self-care needs that can be referred to as diabetes mellitus self-care. These diabetes self-care needs could include but are not limited to performing self-monitoring blood glucose testing, monitoring and regulating medical nutrition therapy, engaging in aerobic and weight resistance physical activities, and monitoring/regulating complicated medication regimens, such as insulin, oral hypoglycemia agents, anti-hypertension medications and lipid lower agents (ADA, 2011).
**Self-care Agency**

The ability to engage in self-care is called self-care agency. To be more specific, Orem (2001) defines self-care agency as the “complex acquired capability to meet one’s continuing requirements for care of self that regulates life processes, maintains or promotes integrity of human structure and functioning and human development, and promotes well-being” (p. 254). The development of the concept of self-care agency was based on the assumption that self-care agency is the power or ability of an individual to engage in estimative, transitional and productive operations of self-care (NDCG, 1979). Orem and the NDCG (1979) further determined that in order for one to engage in these types of self-care operations or any type of deliberate action, one must have general or foundational capabilities; such as physical, mental, motivational, and emotional capabilities. Thus, self-care agency encompasses three types of complex abilities necessary for self-care. These hierarchical abilities are foundational capabilities, enabling capabilities, and operational capabilities for self-care operations (Orem).

Foundational capabilities of self-care agency are general abilities regarding sensation, attention, memory, perception and orientation. The enabling capabilities or power components of self-care agency consist of a repertoire of self-care skills, the valuing of health, energy for self-care, and self-care knowledge (Orem, 2001). The self-care operational capabilities of self-care agency are the abilities needed for knowing and understanding what should be done in regards to taking care of self, the abilities needed to judge and make decisions about what to do regarding self-care, and the abilities to perform self-care actions after deciding what should be done (Orem).
Alterations in the foundational capabilities can directly affect the higher order capabilities of self-care agency; as sensation, ability to learn, attention, perception, and memory are necessary for one to have the ability to know and reason, and make judgments and decisions for any deliberate action. The concept of working memory while not specifically described in Orem’s theory, could be classified as one type of foundational capability in that this cognitive process encompasses both attention and memory and is needed for higher-level cognitive functions such as decision-making.

Basic Conditioning Factors

Basic conditioning factors are factors internal or external to the individual that can, at points in time, affect the individual’s ability to engage in self-care or affect the kind and amount of self-care required. Orem (2001) listed ten basic conditioning factors: Age, Gender, Developmental State, Health State, Sociocultural Orientation, Health Care System Factors, Family System Factors, Patterns of Living, Environmental Factors, and Resource Availability. These basic conditioning factors can be categorized according to how they describe/characterize an individual, such as age, gender, health state and developmental state; or how they relate an individual to their family, such as family systems and sociocultural origins, or how the individual is located in their world, such as health care system factors, patterns of living, environmental factors and resource availability (Orem).

Orem (2001) has continually stressed that not all basic conditioning factors are operable at all times. Some basic conditioning factors can remain stable, such as developmental state in mature adults; whereas other basic conditioning factors can
fluctuate and change, such as health state. Basic conditioning factors may also interact with one another to condition self-care agency. An example offered by Orem is the relationship between aging and health state in persons with advanced age.

The basic conditioning factor of specific interest in this study is health state. Health as a state refers to a personal basic conditioning factor that describes the compound entity of an individual’s structural, physical, functional and mental integrity at a particular time (Orem, 2001). To fully understand the state of health of an individual, one must assess

“(1) the degree of illness, its causes, and whether it is acute or chronic; (2) obvious injuries or defects; (3) the patient’s present behavior patterns (what he or she does or does not do); (4) the effect of disease or disordered function experienced by the patient (including pain, alterations of body temperature, alterations of respiratory and circulatory functioning, gastrointestinal functioning, genitourinary functioning, nervous and musculoskeletal functioning, alterations of the skin and its appendages, and bleeding and anemia); and (5) possible or known effects of the patient’s present health state on integrated functioning and effective living” (p. 379).

Type 2 diabetes is a chronic illness defined as a metabolic disorder in which the body either cannot produce enough insulin or cannot properly use the insulin it does produce. The resulting consequence is hyperglycemia that leads to structural and functional damage to both micro and macro vascular tissue. Damage to micro and macro vascular tissue can result in multiple co-morbid conditions, such as atherosclerosis,
coronary artery disease, diabetic nephropathy, retinopathy, macular edema, cataract formation, glaucoma, and peripheral, autonomic, focal and proximal neuropathies (CDC, 2011). To understand the health state of an individual with T2DM, data regarding obvious injuries or defects caused by T2DM and treatments related to these causes (i.e., co-morbid conditions, medications, surgery, and hospitalizations), the effect of T2DM experienced by the individual (i.e., perception of health and pain), and the effects of T2DM on effective living (i.e., limits effecting activities of daily living, social activities, or working ability) should be collected to adequately appraise the effects of the chronic illness.

Relationships Among the Concepts Proposed by Orem

Basic Conditioning Factors and Self-care Agency.

The relationship between basic conditioning factors and self-care agency is the foundation of this inquiry. The relationship between basic conditioning factors and self-care agency is stated in a proposition by Orem (2001), which states, “individuals’ abilities to engage in self-care are conditioned by age, developmental state, life experience, sociocultural orientation, health state, and available resources” (p. 147). The relationship between basic conditioning factors and self-care agency is further supported by the definition of basic conditioning factors, as factors internal or external to the individual that can, at points in time, affect the individual’s ability to engage in self-care. The proposition and definition offered by Orem defines a relationship between the two concepts. Therefore, a relationship between health state (severity of T2DM), and foundational capabilities (working memory) could be hypothesized, as health state is a
basic conditioning factor within Orem’s theory and foundational capabilities are the foundational base for the hierarchical structure of self-care agency.

**Self-care Agency and Self-care.**

Orem (2001) explicitly states a relationship between self-care agency and self-care in a proposition, “persons who take action to provide their own self-care have specialized capabilities for action” (p. 147). The specialized capabilities for action referred to by Orem are consistent with her definition of self-care agency, as “the complex acquired capability to meet one’s continuing requirements for care of self” (p. 254). Thus, the proposition offered by Orem asserts a relationship between self-care agency and self-care. Therefore, it could be hypothesized that a relationship exists between foundational capabilities (working memory) and health deviation self-care (diabetes self-care) since foundational capabilities are the foundational component of the hierarchical structure of self-care agency and health deviation self-care is a type of self-care specific to specific health states that individuals initiate and perform to maintain life, health and well-being.

**Research Relevant to the Concepts of this Study**

**Research Related to Basic Conditioning Factor Health State and Self-care Agency**

Orem (2001) proposes that factors internal or external to an individual (basic conditioning factors) can, at points in time, influence/condition the ability to engage in self-care (self-care agency). Within this section of the literature review support for the relationship between the concepts of basic conditioning factor health state and self-care agency will be presented, followed by research supporting the proposed relationship
between the sub concepts of T2DM and working memory.

Research to support a relationship between the basic conditioning factor health state and self-care agency has been described in the literature (Anderson, J., 2001; Horsburg, Beanlands, Locking-Cusolito, Howe, & Watson, 2000; Sousa, Zauszniewski, Musil, McDonald, & Milligan, 2004; Wang & Laffrey, 2001). However, the direction of the relationship between the basic conditioning factor health state and self-care agency has varied depending on how the concept of health state has been measured (i.e., presence of chronic vs. perception of health vs. number of symptoms). For example, in 2000, Horsburgh and colleagues examined the relationship among health state, and self-care agency in 101 adults with end stage renal disease awaiting renal transplant. Health state was measured with six independent indicators: the number of prescription medications taken, number of diagnosed medical problems, months on the renal transplant list, number of years on dialysis, previous renal transplant, and number of uremic symptoms as measured by the Non-Specific Uremic Symptom Questionnaire (Brunier & McKeever, 1993). Self-care agency was measured using the Appraisal of Self-care Agency Scale (Evers, Isenberg, Philipson, Brouns, Halfens, & Smeets, 1987), a 24 item, 5 point Likert-type scale that measures the power to perform productive operations of self-care. The scale is based on the enabling traits and operational traits of self-care agency. A significant negative relationship was noted between health states, as measured by length of time on transplant list ($r = -0.18, p < 0.05$) and number of uremic symptoms ($r = -0.33, p < 0.001$), and self-care agency. That is, the longer the individual was on the transplant list and the more uremic symptoms they had, the lower their ability
to engage in self-care.

In a descriptive correlational cross section study with 150 homeless adults, Anderson (2001) found similar results as Horsburgh et al., (2000). Health state was conceptualized as perceived health state, health symptoms, history of mental illness, and history of substance abuse. Perceived health state was measured using Cantril’s 10 rung ladder, a component of the Cantril’s Self-Anchoring Striving Scale (Cantril, 1965) and health symptoms was measured using the participant’s total score on the 13 item Symptoms Scale of the Omega Screening Questionnaire (Mood, 1995). History of mental illness and substance abuse was measured using the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1981). Self-care agency was measured utilizing Denyes Self-Care Agency Instrument (Denyes, 1982), a 34-item questionnaire that measures factors addressing foundational capabilities and power components of self-care agency. Health State as measured independently by the number of health symptoms, history of mental illness, and history of substance abuse was negatively correlated with self-care agency ($r = -.35, p < 0.001; r = -.33, p < 0.001; r = -.23, p < 0.01$). However, Anderson also found that health state as measured by perceived health state was significantly positively correlated with self-care agency ($r = .34, p < 0.001$). That is to say, the better one perceives their health, the more able they are to engage in self-care activities. In a predictive model of self-care with 284 older women living in rural Taiwan, Wang & Laffrey (2001) supported Anderson’s (2001) findings of a significant positive relationship between health state, as measured by perceived health, and self-care agency ($r = .27, p < 0.001$).


**Research Related to Type 2 Diabetes and Self-care Agency.**

There is scant research, in the last 10 years, using Orem’s theory to investigate the relationship between the concepts of the basic conditioning factor health state, T2DM, and self-care agency. However, in 2004, Sousa, Zauszniewski, Musil, McDonald, Milligan examined the relationship between health state and self-care agency in 141 insulin dependent type 1 and type 2 diabetics. Health state was conceptualized as having the diagnosis of diabetes and was measured using three independent variables (type of diabetes, duration of diabetes, and self-rated health) from the Diabetes Care Profile-Demographic Questionnaire (Fitzgerld, J.T., Davis, W.K., Connell, C.M., Hess, G.E., Funnell, M.M., & Hiss, R.G., 1996). Self-care agency was measured utilizing the Appraisal of Self-Care Agency Scale (Evers et al., 1987), a 24 item 5-point Likert scale that measures the enabling traits and operational traits of self-care agency. The relationship between duration of diabetes and self-rate health were positively correlated with self-care agency ($r = .25, p < 0.01$; $r = .22, p < 0.01$). That is, participants who had diabetes longer and who rated their health as good or excellent had better self-care agency. The significant positive correlation between perceived health and self-care agency is in line with other studies that have conceptually measure health state as perceived health (Anderson, 2001; Wang & Laffrey, 2001). However, the significant positive correlation between duration of diabetes and self-care agency revealed an existing relationship between health state and self-care agency, but does not really speak to the state of health of the individual with diabetes as health state was only measured according to duration of disease process.
Orem scholars have commented on the lack of consistency in measuring the basic conditioning factor health state in the literature and indicate that more attention is needed on measuring the state of health as Orem recommends (Moore & Pichler, 2000; Taylor, Geden, Isaramalai, & Wognvatunye, 2000). While several of the studies have measured health state with more than the mere diagnosis of a health problem, no studies have measured health state using a total appraisal of the state of health, as recommend by Orem (2001). Therefore, this study also aimed to measure the health state of individuals with T2DM as recommended by Orem’s by assessing the individual’s structural, physical, functional and mental integrity. Health state, in this study, was measured by collecting information on obvious injuries or defects caused by T2DM and treatments related to these causes (i.e., comorbid conditions, medications, surgery, and hospitalizations), the effect of T2DM experienced by the individual (i.e., perception of health and pain), and the effects of the T2DM on effective living (i.e., limits effecting activities of daily living, social activities, or working ability).

**Research Related to Type 2 Diabetes and Working Memory.**

Currently, there is little research regarding the foundational capabilities of self-care agency and lack of any research regarding working memory as a foundational capability using Orem’s theory. However, there is an increasing body of knowledge regarding the relationship between T2DM and cognitive function, specifically working memory. Working memory includes the concept of attention. Several researchers refer to working memory while measuring attention or executive function (Cukierman-Yaffe et al., 2009; Fontbonne, Berr, Ducimetiere, & Alperovitch, 2001; Gregg et al., 2000; Yaffe
et al., 2004). While these studies have shown that individuals with diabetes have significantly lower scores on cognitive tests measuring attention and executive function compared to those without diabetes, the concept of working memory has been measured in multiple different ways. For example, three of the four studies reviewed used the Digit Symbol Substitution Test from the Wechsler Adult Intelligence Scale-III (WAIS-III) (Psychological Corporation, 1997), and two of the four use Trails A & B (Reitan, 1958) in measuring working memory as a part or component of attention or executive function. Currently, there is lack of a gold standard for measuring working memory. Many of the measures require specialized training, are expensive to purchase and are time consuming within a study. The Working Memory Index (WMI) from the Wechsler Adult Intelligence Scale-III (WAIS-III) (Psychological Corporation) measures working memory as it is conceptualized in this study. However, due to the fact that executive function is a component of working memory, the EXIT 25 (Mahurin, & Gray, 1992) is used to measure the full concept within this study. Therefore, studies that used these cognitive tests or a composite score that are similar to these measures will be reviewed.

Saczyński et al., (2008), utilized a comprehensive assessment of working memory to investigate the association of cognitive function in 4 categories of glycemic state with 1,917 nondemented men and women (average age 76). In this cross-sectional population based study the cognitive domain of executive function- working memory was assessed using a composite score derived from the following tests: Digits Span Backward Test (Psychological Corporation, 1997), the Spatial working Memory Test (Robbins et al., 1994), and the Stroop Test, Part III (Stroop, 1935). Findings revealed that individuals
who had diabetes 15 years or longer had significantly poorer performance on the test of executive function-working memory when compared to others in the study. This finding remained significant even when controlling for age.

Biessels, ter Braak, Erkelens, & Hijmin (2001) had similar findings in a small case controlled study. Working memory was assessed on 13 subjects with T2DM and 16 subjects with out diabetes, ages 45 to 70 years, using the Subject Ordering Task. The Subject Ordering Task includes the Digit Span Forward task, Missing Item Scan, Verbal randomization, and Visual randomization (Wiegersma, Van der Scheer, & Hijman, 1990). Results showed that individuals with T2DM performed significantly worse on measures of working memory as measured by all subtests of the Subjective Ordering Task (p = 0.019) when compared to the control group. The control group was matched with the diabetic group on age, sex, education, and occupational level.

In studies where working memory was measured by Digit Span task alone, there are usually no significant differences between individuals with T2DM compared to those individuals without diabetes (Asimakopoulou, Hampson & Morrish, 2002; Bruehl et al., 2009; Gold et al., 2007; Hassing et al., 2004). However, Qui et al. (2006) did find that individuals with diabetes scored significantly lower than those without diabetes on the Digit Span task (p = 0.02) in a cross-sectional population-based study with 291 homebound individuals over the age of 60 years of age.

In reviewing these studies, differences in findings may be attributed to differences in the severity of diabetes between studies. For example, subjects in the Qiu et al. study (2006) had more severity of diabetes than the diabetic subjects in the other studies with
74% of the subjects in the Qiu et al. study with a body mass index greater than 30 kg/m, 56% reporting cardiovascular disease, 25% with stroke history, and 70% of them reporting taking medications to control their diabetes. The diabetic subjects in the Qiu et al. study also had significantly higher creatinine concentrations \((p < 0.001)\) compared to the non-diabetics in the study, indicating kidney damage among this diabetic population. Where as, the subjects in the other studies, specifically the study conducted by Asimakopoulou et al. (2002), the subjects had uncomplicated T2DM with over half of individuals on no medications, only 1 report of a co-morbid heart condition, and 67% of the subjects controlling their diabetes by diet alone. The Qiu et al. (2006) study gives support to this study in that measuring health state as a composite of severity of diabetes is important when trying to determine the relationship between T2DM and the cognitive process of working memory.

Working memory is considered to be located primarily in the dorsal-lateral prefrontal cortex of the brain. Depending on the task other areas of the brain such as the hippocampus or medial temporal lobe maybe needed to complete the cognitive activity (Carpenter, Just, & Reichle, 2000; Budson & Price, 2005). For example if recall is needed to complete a task or prior understanding of a medication is need then the medial temporal lobe would be activated as well as the prefrontal cortex (Carpenter et al.).

Brain magnetic resonance imaging (MRI) studies have shown significantly more cortical, sub cortical and hippocampal atrophy among individuals with T2DM when compared to control groups with diabetes (Korf, White, Schelten, & Launer, 2006; Manschot et al., 2006; Tiehuis et al., 2008). These studies have also shown a significant
increase in white matter lesions and more infarcts in those with T2DM when compared with a control group with diabetes. The findings from these studies remained statistically significant after adjustment for age, intelligence quotient and vascular risk factors.

Trying to connect the cause of poorer performance on cognitive testing and findings of MRI studies in those with T2DM is complex and multifaceted. However, the some research has related lower performance on cognitive testing and MRI findings with long-term effects of hyperglycemia, and insulin regulation (Awad et al., 2004; Biessels et al., 2002; Sima, Kamiya, & Li, 2004; Tan et al., 2002). Chronic hyperglycemia may contribute to these findings via vascular impairment and neurodengeneration by three major metabolic pathways (1) formation of advanced glycation end products (AGEs); (2) activation of protein kinase C (PKC); and (3) intracellular hyperglycemia with disturbances in polyol pathways (oxidative stress) (Maitra & Abbas, 2005).

The stimulation of these metabolic pathways in response to elevated serum blood glucose levels cause an increase in free radical formation, increase in inflammatory response, and an increase in amyloid deposits, which in turns results in damage to vascular tissue, impaired endothelial function, impaired RNA and DNA synthesis and impaired mitochondria function (Chung, Ho, Lam, & Chung, 2003; Piano & Huether, 2002; Ramasamy et al., 2005; Tan et al., 2002; Wright & McMaster, 2002). These pathophysiological changes can result in decreased cerebral blood flow and decreased neurotransmitter function, which ultimately reduces cognitive function via neuronal apoptosis and or ischemia (Awad et al., 2004; Biessels et al., 2002; Sima et al., 2004; Tan et al., 2002).
Insulin regulation is linked to cognitive impairment (Awad et al., 2004; Biessels et al., 2002; Sima et al., 2004). Individuals with type 2 diabetes can have increased insulin production, which can result in hyperinsulinemia. In constant states of hyperinsulinemia, blood brain barrier insulin receptors down-regulate, thus reducing insulin transport into the brain resulting in neuronal apoptosis (Watson & Craft, 2006). Hyperinsulinemia can also lead to beta-amyloid deposits in the brain, as a result of insulin-degrading enzyme binding more readily with high levels of insulin than with amyloid beta-protein (Biessels et al., 2002). Hyperinsulinemia may also inhibit choline acetyltransferase, an enzyme involved in forming neurotransmitters necessary for regulating memory and learning (Okereke, Hankinson, Hu, & Grodstein, 2005).

Research Related to Self-care Agency and Self-care

Orem (2001) proposes that individuals who engage in self-care have specialized capabilities for action. These specialized hierarchical capabilities encompass the foundational capabilities, power components, and capabilities for self-care operations. Within this section of the review of literature the support for the relationship between the concepts of self-care agency and self-care will be presented first according to research utilizing Orem’s framework and then research supporting the relationship between the sub concepts of working memory and self-care will be presented.

Research Related to Self-care Agency and Self-care.

Due to the complexity of self-care agency, there are no instruments available that measure all the capabilities of self-care agency (Carter, 1998). Among the instruments available, self-care agency can be measured as either personal abilities, which are
abilities associated with the enabling capabilities or power components or it can be measured according to the ability to take action for self-care, which are abilities associated with the self-care operations. Thus, throughout the literature the term self-care agency has been used in general terms regarding an individual’s ability (power) to engage in self-care regardless of what element of the concept were being measured. Research to support a relationship between self-care agency and self-care has been described in the literature (Anderson, 2001; Horsburg et al., 2000; Sousa et al., 2004; Wang & Laffrey, 2001).

In a descriptive correlational cross section study with 150 homeless adults, Anderson (2001) examined the relationship between self-care agency and self-care. Self-care agency was measured using Denyes Self-Care Agency Instrument (Denyes, 1982), which is a 34-item questionnaire that measures factors addressing foundational capabilities and power components of self-care agency. Self-care was measured utilizing Denyes Self-Care Practice Instrument (Denyes, 1988), which is a 22-item questionnaire measuring general and specific self-care actions. The positive relationship between the power components of self-care agency and self-care was significant ($r = .69, p < .001$). The results of the multiple hierarchical regression showed that the dimensions of self-care agency explained 25% of the 54% variance in the overall model.

Horsburgh et al. (2000) also found a significant positive relationship between self-care agency and self-care ($r = .48, p < 0.001$) among 198 adults with end stage renal disease awaiting renal transplant. Self-care agency was measured using the Appraisal of Self-Care Agency Scale (Evers et al., 1987) a 24 item, 5 point Likert-type scale that
measures the power to perform productive operations of self-care. The scale is based on the enabling traits and operational traits of self-care agency. Self-care was measured using the Universal Self-Care Inventory (Gazda, 1986), a 10-item self-report instrument that measures basic or universal self-care like sleep, appetite and physical activity.

In a model of well-being and self-care, Wang & Laffrey (2001) examined the relationship of self-care agency and self-care in 284 older women living in rural Taiwan (mean age 69). Self-care agency was measured using the Exercise of Self-Care Agency Scale (Kearney & Fleischer, 1979) and self-care behaviors were measured using the Health Promotion Lifestyle Profile (Walker, Sechrist, & Pender, 1987). Bivariate correlations revealed that self-care agency was strongly correlated with self-care behaviors \((r = .80, p < 0.001)\) and using path analysis, the results of the model testing revealed that 60% of the total variance in self-care behaviors was contributed by self-care agency and social support, \(F (2, 281) = 270.02, p < 0.0001\).

In regards to the relationship between self-care agency and self-care actions specifically related to diabetes (diabetes self-care), Sousa et al. (2004) tested a conceptual model for diabetes self-care and examine the relationship between self-care agency and diabetes self-care management. Self-care agency was conceptualized as an individual’s capability to perform diabetes self-care actions, which is consistent with Orem’s (2001) theory. Self-care agency was measured utilizing the Appraisal of Self-Care Agency Scale (Evers et al., 1987), a 24-item 5-point Likert scale that measures the power to perform productive operations of self-care. Diabetes self-care management was conceptualized as an individual’s performance of diabetes self-care actions (i.e., diet, exercise, blood
glucose monitoring, and medications). Diabetes self-care management was empirical measured using Hurley’s Insulin Management Diabetes Self-Care Scale (Hurley, 1988), a 28-item 6 point Likert scale. Among the 141 participants in the study the mean average score for self-care agency was positively skewed (92.42), indicating that participants in the study reported a relatively high self-care agency. A significant strong positive relationship between self-care agency and diabetes self-care management ($r = .61$, $p < .01$) was noted in the study findings.

**Research Related to Working Memory and Self-care.**

To date there is lack of research regarding the relationship between the foundational capabilities of working memory and self-care using Orem’s (2001) theory. However, there is a body of knowledge regarding the relationship between working memory and self-care behaviors such as activities of daily living and medication adherence that can give support for the relationship proposed in this study.

For example, in 2006, Insel and colleagues conducted a cross-sectional community based study with 96 adults over the age of 67 to determine the associated between executive function-working memory and the self-care activity of medication adherence (Insel, Morrow, Brewer, & Figueredo, 2006). Subjects were followed for eight weeks with daily adherence to one medication. Executive function-working memory composite was comprised of the following tests: Wisconsin Card Sorting Test (Heaton, Chelune, Talley, Kay & Curtis, 1993), and the Letter-number sequence, Mental Control and Digit Span Backward subtests from the WMS-III (Psychological Corporation, 1997). The higher the composite score the better executive function-working memory. Results
revealed that executive function-working memory composite scores were significantly correlated with medication adherence \( (p < 0.01) \) and in a simultaneous regression model with all variables entered at once in the model, executive function-working memory accounted for 44% of the variance in medication adherence and was the only significant predictor variable of medication adherence \( (p < 0.05) \). These results reveal that executive function and working memory are strongly related to medication adherence, yielding better self-care.

In another cross-sectional study, Wood et al., (2005) used factor analysis to determine the extent of the relationship among cognitive and sensory factors in relation to functional abilities in 530 older adults between the ages of 62-94. Functional abilities were measured using the Timed Instrumental Activities of Daily Living test (Owsley, Sloane, McGwin & Ball, 2002). This test required the subjects to perform a series of time simulated everyday activities that included looking up and reading aloud a specific telephone number in the phone book, counting out 67 cents in change from a handful of coins, locating and reading ingredients from 3 food can labels, finding 2 specified items on a crowded grocery shelf and reading instructions from 2 prescription medications. The higher the score on the Timed Instrumental Activities of Daily Living test the better performance of ADLs. Using a Varimax rotation with Kaiser normalization, multiple tests measuring sensory and cognitive domains of vision, hearing, balance, processing speed, attention switching, working memory, intellectual functioning, and executive function were found to load on to three different cognitive speeds: (1) tests that are considered speed cognitive abilities, tests that are considered non-speed cognitive
abilities, and test that are considered sensory measures. The Digit Span test from the WAIS-III (Psychological Corporation, 1997) loaded onto the factor of non-speed cognitive abilities and was found to significantly correlated with the Timed Instrumental Activities of Daily Living (0.417, \( p < 0.001 \)) and in step wise multiple regression analysis significantly accounted for 43.4\% of the overall variance in the Timed Instrumental Activities of Daily Living variable. These finding indicate that working memory does play a significant role in everyday self-care.

Burton, Strauss, Hultsch & Hunter (2006) found similar results when examining the relationship of cognitive function and everyday functional ability using the Everyday Problem Test (EPT) (Willis & Marsiske, 1993) in 291 community dwelling non-demented older adults, average age 74. The Everyday Problem Test is a paper and pencil test that uses everyday real life situations to tap problem solving for self-care (i.e., medication management, meal preparation/calorie counting). Higher scores on the EPT indicate better performance. In bivariate correlations better performance on the EPT was significantly related to better cognitive function as measured by all cognitive tests, including those used as components of working memory (\( p < 0.01 \) for all). In a hierarchical multiple regression model, the executive function-working memory composite score accounted for the largest significant proportion of variance in EPT total scores (11.4\%, \( p < 0.001 \)) outside of demographic variables (age, education, gender, and chronic illness). Thus, revealing deficits in executive function can reduce a person’s ability to engage in everyday self-care and specifically health deviation self-care such as medication management and prescribed meal preparation.
Research Related to Basic Conditioning Factors, Self-care Agency and Self-care

Research has been presented to support a relationship between the basic conditioning factor health state and self-care agency, and between self-care agency and self-care, thus supporting a linear view of the model guiding this study (Anderson, 2001; Horsburg et al., 2000; Sousa et al., 2004; Wang & Laffrey, 2001). However, there is conflicting evidence regarding the direct and indirect effects of health state and self-care.

In a predictive model of well-being and self-care with 284 women aged 60-88, Wang & Laffrey (2001) found that the basic conditioning factor health state was not directly linked to self-care behavior in path analysis, but indirectly through self-care agency, thus providing evidence for a mediated effect of self-care agency on the basic conditioning factor health state and self-care. However, Horsburg et al., (2000) and Anderson (2001) found that the basic conditioning factor of health state was directly associated with self-care agency and self-care.

Using multiple hierarchical regression analysis, Horsburg et al., (2001) found that health state, as independently measured by the number of months on the transplant list and number of uremic symptoms, significantly accounted for 9% of the 45% variance of self-care agency and 26% of the 61% of the variance in self-care in individuals with end-stage renal disease. Self-care agency accounted for a small significant percentage (about 2%) of 61% variance in self-care after controlling for other factors mainly, health state. This finding does illustrate the overall negative impact of health state on self-care, but does not illustrate the mediating effects of self-care agency.

Anderson (2001) found similar results regarding a direct relationship between the
basic conditioning factor health state and self-care agency and health state and self-care in 150 homeless adults, average age 38 years old. Health state factors, as measured by history of mental illness, history of alcohol abuse, perceived health state and number of health symptoms, significantly accounted for 26% of the 37% variance in self-care agency and 16% of the 54% variance in self-care. Self-care agency (power components) accounted for 25% of the 54% variance in self-care.

While there is lack of evidence to support a mediation effect of self-care agency among the research presented, there is support for a linear view of the relationships proposed in the research model. Some of the inconsistency in the findings could be related to how health state was conceptualized and measured in the studies presented, as well as the complexity of measuring self-care agency.

**Research Related to Type 2 Diabetes, Working Memory, and Self-care.**

Currently, there is little research that has investigated the relationship between severity of T2DM, working memory and diabetes self-care, and no research investigating the mediating effects of self-care agency on the basic conditioning factor health state and self-care among middle age and older adults with type 2 diabetes.

Sinclair, Girling & Bayer (2000) were among the first to gain understanding of the relationship between cognitive function and self-care among individuals with type 2 diabetes over the age of 65. In a large community based case control study with 396 individuals with type 2 diabetes and 393 non-diabetics control subject cognitive function was measured utilizing the Mini Mental State Examination (MMSE) (Folstein, Folstein & McHugh, 1975) and Clock Draw test (Shuhnan, Shedletsky, & Silver, 1986). Self-care
was measured with two dichotomous questions regarding self-care management, an Activities of Daily Living Scale (Mahoney & Barthel, 1965) and the Extended ADL Scale (Lincoln & Gladman, 1992). Overall the result showed that subjects with T2DM had significantly worse cognitive scores than the control group on both measures of cognitive function. Further within group analysis showed that individuals with T2DM with a MMSE < 24 were significantly less likely to undertake diabetes self-care, require more help with self-care and have lower scores on activities of daily living compared with individuals with a MMSE greater than 24. While this study does give a glimpse of the relationship between cognitive function and self-care, the cognitive assessment tools used by Sinclair et al. are typically used as a screening tool to rule out dementia, and are not sensitive enough for specific cognitive processes such as working memory.

de Wet, Levitt & Tipping (2007) also found evidence to support the relationship between T2DM, cognitive function, specifically executive function and self-care. Using a tool they termed the Bedside Executive Screening Tool, they found that the presence of executive function impairment was significantly associated with poor glycemic control as measured by HbgA1c greater than 7% in 98 participants with the average age of 58. However, working memory is not measured in this study specifically, nor was diabetes self-care actions. However, in a study by Thabit, et al. (2009) executive function and self-care were measured in fifty elderly subjects with T2DM (mean age 67). They studied the relationship between executive function and diabetes self-care. Executive function was assessed using the Frontal Assessment Battery (Slachevsky et al., 2004) and the EXIT 25 (Royall, et al.). Diabetes self-care was assessed using the Summary of Diabetes Self-Care
Activities scale (Toobert & Glasgow, 1994). Results showed that the EXIT 25 was negatively correlated with the measure of self-care \((r = -.03, p < .05)\), but no significant relationship was noted between the Summary of Diabetes Self-Care Activities scale and HgbA1c. This study gives evidence that poor performance on the measures of executive function can result in poor self-care activities.

On the other hand, Asimakopoulou et al. (2002) found a lack of association between T2DM, cognitive function and self-care in a cross-sectional study of 51 people average age 63, with uncomplicated T2DM. Cognitive function was measured using a comprehensive neuropsychological test battery comprised of 11 test, including measures of working memory such as Digit Span Forward and Back tasks from the WAIS-III (Psychological Corporation, 1997). Diabetes self-management was assessed using the Summary of Diabetes Self-Care questionnaire (Toobert & Glasgow, 1994). While the study showed a lack of association between most of the cognitive test and self-care, exercise self-care was significantly correlated with Digit Span Forward \((r = .33, p < 0.03)\). One reason for this lack of association between cognitive function and self-care could be related to the fact that the sample had very few comorbid conditions related to diabetes and more than half where on no medications other than an oral antihyperglycemic agent for treating diabetes. Asimakopoulou et al. also state that the findings should be interpreted with caution due to the small sample size affecting the ability to detect significant findings.

**Summary**

Research presented in this literature review provides empirical support for the
model guiding this study. Research examining the relationship among the severity of type 2 diabetes, working memory, and diabetes self-care does not exist. Research regarding how a composite measure of health state affects self-care agency in middle age and older adults with type 2 diabetes also does not exist. Research regarding the mediation effects of self-care agency on the basic conditioning factor health state and self-care is lacking and inclusive. Explication of the relationships between severity of T2DM, working memory, and diabetes self-care is needed. Self-care in diabetes is crucial in preventing complications associated with the diabetes, such as such as retinopathy, nephropathy, neuropathy, cardiovascular disease, and problems with cognitive function. Seeking to understand how working memory is associated with diabetes self-care will allow for future intervention programs aimed at improving aspects of self-care in those with type 2 diabetes.
CHAPTER III: METHODOLOGY

Introduction

This study was designed to test specific relationships proposed by Orem’s (2001) Self-Care Deficit Nursing Theory in middle age and older adults with type 2 diabetes. Specifically, relationships between severity of type 2 diabetes, working memory, and diabetes self-care were explored. This chapter describes the study design, sample, setting, measures of the variables, procedures, data management and analysis, and protection of human subjects.

Study Design and Overview

A cross-sectional, non-experimental theory testing design was used to test the hypotheses proposed regarding the relationships between severity of T2DM, working memory and diabetes self-care. This design is appropriate to use when a strong conceptual framework is proposed to support the possibility of a relationship among the variables when there is no manipulation of variables (Pittenger, 2003).

Sample

A convenience sample of individuals with type 2 diabetes was recruited within the Portland, Vancouver, Beaverton OR-WA area. The Portland, Vancouver, Beaverton OR-WA Metropolitan Statistical Area has an estimated population of 2,175,113 with approximately 6.9% of the population having diabetes (CDC, 2007; United States Census Bureau, 2007).

Recruiting efforts included advertising in local newspapers, such as the Oregonian, Portland Observer, Portland Tribune, Willamette Weekly, Vancouver Voice.
and the Columbian (Appendix A) and posting a recruitment flyer at multiple churches within the Northwest Parish Nurse Ministries (Appendix B). Recruiting efforts were also made by sending a recruitment letter explaining the purpose of the study to potential subjects with site permission from the University of Portland School of Nursing Client/Partner Program (Appendix C and D).

To determine an adequate sample size for this research study, with 2 predictor variables, a power analysis was performed. To achieve an 80% power at a significance level (alpha) of 0.05 a sample size of 67 subjects was needed (Cohen, 1992).

Inclusion criteria included a self-reported diagnosis of type 2 diabetes (minimum of 1 year), over the age of 45, ability to understand, speak, and write English, ability to give consent, and the ability to complete the instruments and testing procedures. Individuals over the age of 45 were selected as the inclusion criteria based on previous research findings related to cognitive function and age of participants (presented in chapter 2) and the incidence of onset type 2 diabetes as reported by the CDC (2007). The exclusion criteria included a history of stroke or head injury, diagnosis of Parkinson’s disease, history of alcohol or drug abuse. A score less than 24 on the Mini Mental State Examination (Folstein, et al., 1975) and a score greater than 16 on the Center for Epidemiologic Studies Depression Scale (Radloff, 1977), as dementia and depression are known predictors of decreased cognitive function (Anderson et al., 2002; Folstein et al., 1975; Jorm, 2000; Santacruz & Swagerty, 2001; Tombaugh & McIntyre, 1992; Watari et al., 2006). Exclusion criteria also include a random blood glucose of less than 70 mg/dl or greater than 250 mg/dl on the day of data collection as research studies have shown that
blood glucose levels below 70 or greater than 250 can affect cognitive testing results especially in the areas of working memory (Cox et al., 2005; Draelos et al., 1995; Sommerfield, Deary, & Frier, 2004; Strachan, Deary, Ewing, & Frier, 2000).

**Setting**

The setting for this study was located within the University of Portland School of Nursing in Portland, OR. The University of Portland is a well-known private Catholic university in North Portland. A designated lab space within the nurse practitioner lab of the School of Nursing was utilized for all finger stick blood glucose and venipuncture lab draws to maintain Occupational, Health and Safety Administration guidelines. The investigator’s private office, located on the same floor as the lab space, was utilized for all other data collection procedures.

**Measures**

Screening Measures

The Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977) (Appendix E) was used to assess for the presence of symptoms of depression. The CES-D scale is a self-report 20 item questionnaire that takes approximately 20 minutes to complete and is a valid and reliable scale for screening for depression in the general population, as well as for screening for depressive symptoms in individuals with T2DM (Bell et al., 2005; Stahl et al., 2008). Participants are asked to indicate how often they have felt about each question over the past week. Responses include rarely or none of the time, some or a little of the time, occasionally or a moderate amount of time or all of the time. Scores range from 0-60, with higher scores indicating more symptoms of
depression (Radloff). A score of 16 or greater is considered indicative of the presence of depression, therefore, subjects who score 16 or greater on the CES-D would have been excluded from the study.

The Mini-Mental State Examination (MMSE) (Folstein et al., 1975) (Appendix F) was used to screen for signs of dementia. The 11 items tool measures orientation, registration, attention, calculation, language and recall. It takes approximately 15 minutes to administer and has been shown to be a reliable and valid tool for screening individuals for dementia (Folstein et al., 1975; Santacruz & Swagerty, 2001; Tombaugh & McIntyre, 1992). Scores on the MMSE can range from 0-30; a score less than 24 is considered indicative of dementia. Thus, subjects who scored less than 24 were excluded from the study.

Finger stick blood glucose was used to assess for the presence of hypo or hyperglycemia on the day of cognitive testing. Finger stick blood glucose allows for a quick assessment of current blood glucose levels by pricking the participant’s finger with a lancet to obtain a small drop of blood on a glucose test strip that is then inserted into a glucose monitor. The OneTouch UltraSmart Blood Glucose Monitoring System and a Surgilance Safety Lancet were used to complete the random blood glucose finger stick. Research has shown that the One Touch Ultra Glucose machine is 96% accurate when compared with a laboratory reference (Weinzimer et al., 2005). To insure accuracy during the study, OneTouch Ultra Control Solution was used before each finger stick to ensure the glucose meter was calibrated correctly. A quality control record of the glucose meter was kept throughout the study (Appendix G).
Demographic and Severity of Type 2 Diabetes

Demographic data and data to appraise severity of T2DM was gathered using a modified questionnaire derived from the Diabetes Care Profile and Diabetes History Form (Fitzgerald et al., 1996). The self-administered modified Diabetes Care Profile (m-DCP) (Appendix H) used for this study had two sections and a total of 35 questions. The first 14 questions were related to demographic data, and the last 21 questions were used to assess severity of T2DM. The approximate time to complete the m-DCP was 20-30 minutes.

The original Diabetes Care Profile and Diabetes History Form are self-administered questionnaires that were developed by the Michigan Diabetes Research and Training Center to assess social, psychological, quality of life, mediation usage and potential comorbid factors related to diabetes and the treatment associated with diabetes (Fitzgerald et al., 1996). In total, the original Diabetes Care Profile has 16 profile sections and the Diabetes History Form has 13 profiles sections. After viewing both tools it was determined that not all original 29 profile sections were needed for this study, therefore a modified version of the tool was created and used for this study and named the modified Diabetes Care Profile (m-DCP) (Appendix H).

The original Diabetes Care Profile is a reliable and valid survey tool with internal reliability ranging from 0.66 to 0.97 having been used with elderly, minority (Hispanic and African Americans), insulin dependent, and non-insulin dependent subjects (Anderson, Fitzgerald, Wisdom, Davis & Hiss, 1997; Cunningham et al., 2005; Fitzgerald et al., 1996; Fitzgerald et al., 1998; Fitzgerald et al., 2000; Watkins et al.,
Information regarding the reliability and validity of the Diabetes History Form could not be located. The form is used for medical history collection. The original tools require a 4th grade reading level to complete.

The m-DCP (Appendix H) consists of two sections. Section one included 14 questions regarding demographic data such as age, birth date, zip code, gender, height, weight, year diagnosed with diabetes, marital status, ethnic origin, education level, employment status, type of insurance, and annual household income. Section two of the m-DCP has 21 questions to assess severity of type 2 diabetes. The questions for section two of the m-DCP were derived from the quality of life indicators from the health status section of the Diabetes Care Profile, number of comorbidities from the Diabetes History Form, and the number and type of medications used to control blood glucose levels and other comorbid conditions from the medication use section of the Diabetes Care Profile.

While the original Diabetes Care Profile and Diabetes History Form were not initially designed to measure severity of diabetes, there is leeway within the two forms to assess severity of T2DM. Section two of the m-DCP (Appendix H) can assess severity of type 2 diabetes by calculating a composite score of health status (HSC) from the quality of life indicators, the total number of medications used, and the total number of comorbid conditions experience by the individual. The health status composite consists of questions regarding physical function, role function, pain and general health. A z-score was computed for each quality of life indicator within the modified diabetes care profile. The z-scores were then summed together for a composite score for HSC. The higher the score on HSC, the lower the severity of T2DM. The value of the scores obtained from the m-
DCP for number of prescription medications and number of comorbidities is continuous with lower scores indicating less severe T2DM, while higher scores indicate more severe T2DM. The m-DCP is consistent with Orem’s (2001) theory for measuring health state, which indicates the description of health state should be an overall appraisal of health including obvious injuries or defects caused by T2DM and treatments related to these causes (i.e., comorbid conditions, medications, surgery, and hospitalizations), the effect of T2DM experienced by the individual (i.e., perception of health and pain), and the effects of the T2DM on effective living (i.e., limits effecting activities of daily living, social activities, and/or working ability).

**Working Memory**

Working Memory was measured using the Working Memory Index from the Wechsler Adult Intelligence Scale, Third edition (WAIS-III). A component of working memory is executive function, specifically executive attention; therefore, the EXIT 25 (Royall et al., 1992) was also employed to measure executive function in this study.

The Working Memory Index (WMI) of the WAIS-III is comprised of the total correct score from the Letter-Number Sequencing subtest, Digit Span subtest, and the Arithmetic subtest. These three subtests, when combined, measure high level attention tasks that stress the ability to attend to information, to hold and process that information in memory, and formulate a response based on that information (Psychological Corporation, 1997). The reliability for the WMI is .93 and has been found to correlate strongly with other measures, including the Working Memory indexes of the Wechsler Memory Scale-III (Psychological Corporation). The Working Memory Index from the
WAIS-III was chosen to measure Working Memory based on the reliability and validity of the tool, accessibility of the tool, ease of use of the tool and past training obtained on the tool during a research intensive.

The Letter-Number Sequencing subtest from the WAIS-III (Psychological Corporation, 1997) measures auditory short-term memory, sequencing ability and concentration/attention (Groth-Marnat, 2003). The subject is required to keep in mind a series of scrambled letters and numbers that are read aloud to them, manipulate the letters and numbers into numerical order and alphabetical order, and repeat the new sequence with the number first in ascending order followed by letters in alphabetical order. For example the researcher will say 9-C-3, and the correct response by the participant is 3-9-C. There are a total of 7 items with 3 trials in each item. The test is discontinued after scores of 0 on three trials of an item. The maximum score for this subtest is 21 points (Psychological Corporation).

The Digit Span subtest from the WAIS-III (Psychological Corporation, 1997) measures immediate rote recall, concentration/attention, auditory sequencing and rote learning (Groth-Marnat, 2003). This subtest is comprised of two tasks: Digits Forward and Digits Backward. For the Digits Forward task the subject is read aloud a series of numbers and is required to repeat the number sequence in the same order as given. Maximum score for the Digits Forward task is 16. There are 8 items with 2 trials each. The task is discontinued after a score of 0 on both trials of any item (Psychological Corporation).

For the Digits Backward task the subject is read aloud a series of numbers and is
required to repeat the number sequence in reverse order. Maximum score for the Digits Backward task is 14. There are 7 items with 2 trials each. The task is discontinued after a score of 0 on both trails of any item. Maximum score for the Digit Span Subtest is 30 points, 16 points for Digits Forward task and 14 points for Digits Backward task (Psychological Corporation, 1997).

The Arithmetic subtest of the WAIS-III (Psychological Corporation, 1997) measures auditory memory, sequencing ability, concentration/attention, and logical reasoning (Groth-Marnat, 2003). This subtest is comprised of 20 arithmetic word problems/items that the participant must mentally answer after hearing the question read aloud to them. No paper or pencil can be used by the subject to answer the question. The subtest is started on item 5. If the participant answers item 5 correctly, then the researcher proceeds to item 6. However, if the participant scores a 0 on either 5 or 6, then the researcher administers items 1-4 in reverse sequence until the participant obtains a perfect scorer on two consecutive items. At this point, the researcher proceeded with the rest of the items until the participant scores 0 on four consecutive items, at which time the subtest is discontinued. Scoring for the Arithmetic Subtest is based on if the participant answered the questions correctly and within the given time limit. Maximum score for the Arithmetic Subtest is 22 (Psychological Corporation).

The EXIT 25 is a bedside tool used to measure executive function (Royall et al., 1992). It consist of 25 items measuring motor sequencing, spoken alternate sequencing, verbal fluency, design fluency, persistence and resistance to interference, as well as items that measure primitive reflexes. The maximum score is 30, with a cut off of 23 indicating
executive function impairment. Thus, the higher the score on the EXIT 25 the poorer is the executive function performance. The EXIT 25 takes about 15 minutes to administer and has been used with subjects with HIV dementia, mild dementia, bipolar disorders, Alzheimer’s disease, frontal-temporal dementia and individuals with T2DM (Gildengers et al., 2004; Royall et al., 1994; Stokholm, Vogel, Gade, & Waldemar, 2005; Thabit et al., 2009). In past studies, the EXIT 25 has had good interrater reliability ($r = .90$) and has proven to discriminate among different types of executive function disorders (Royall et al., 1992).

**Self-care: Diabetes Self-care Actions**

Diabetes self-care actions were measured using the Self-Care Inventory-Revised (SCI-R) (Weinger et al., 2005) (Appendix I). La Greca (2004) developed the original SCI as a self-report questionnaire to assess a patient’s perceptions of self-care behaviors. Self-care is defined, according to the developers, as the daily regimen tasks that individuals perform to manage diabetes. Weinger, Butler, Welch, & La Greca (2005) revised the original SCI to reflect current diabetes practice. The 25 item self-report SCI-R tool asks subjects to rate how well they followed recommendations for self-care during the past month on a 5-point Likert scale (i.e., 1= never do it to 5= always do this as recommended). The items on the SCI-R address diet, glucose monitoring, medication administration, exercise, low glucose levels, and preventative/routine aspects of self-care. Scores on the SCI-R range from 15 to 75. The lower the score, indicates poorer or lower the self-care actions by the individual, where as the higher the score the more self-care actions by the individual. The SCI-R is written at a 6th grade reading level and takes
approximately 10-15 minutes to complete. Research by Weinger et al. found that the SCI-R tool is a reliable (internal consistency $\alpha = 0.87$) and valid tool for measuring self-care behaviors in adults with type 2 diabetes.

Another test used to measure diabetes self-care was Hemoglobin A1c (HgbA1c) blood test (Sacks et al., 2002). The HgbA1c test measures plasma glucose levels over the past 90 days and is a good indicator regarding the degree of glycemic control (ADA, 2007). HgbA1c levels less than 7% is considered good glycemic control, indicating good self-care, according to the ADA (2010); whereas HgbA1c levels greater than 7% is considered poor glycemic control, indicating lack of self-care.

This researcher obtained all blood samples for HgbA1c analysis on the day of data collection following collection procedure guidelines from Quest Diagnostic Laboratories. One milliliter of venous blood was collected in a lavender-top tube labeled with the participant’s unique identifying number. The labeled lavender-top tube and laboratory request form with the participant’s unique identifying number were placed in a lab supplied biohazard plastic bags and placed in a room temperature locked biohazard container for currier pickup. Quest Diagnostic Laboratories has established written quality control procedures for handling and evaluating the testing process of blood samples to insure accurate and reliable results (personal communication, Melissa Van Dyken, February 10, 2010).

**Procedures**

**Access to Potential Participants**

All clients in the Well-Elder Database from the University of Portland School of Nursing received a letter inviting them to potential participation in the study if they met
the stated inclusion criteria in the letter ( Appendix C ). Participants were also recruited from local churches within the Portland/Vancouver area by placing recruitment flyers on church bulletin boards and church new letters ( Appendix B ). Recruitment advertisement ads were placed weekly in the following local newspapers, the Oregonian, Portland Observer, Portland Tribune, Willamette Weekly, Vancouver Voice and the Columbian ( Appendix A ).

All recruitment advertisement material had the researcher’s name and a telephone number included. During the initial telephone contact, a pre-written script ( Appendix J ) about the study was read to potential subjects and when the potential participant agreed to participate in the study, initial eligibility and exclusion criteria were validated. If the potential participant met the initial eligibility criteria, an appointment time was set at a mutually convenient time for the participant to come to the University of Portland for data collection. An information letter ( Appendix K ) confirming the appointment date and time, driving directions to the University, parking and a temporary parking permit was then mailed to the participant’s address. Also included in the information letter were the consent form ( Appendix L ) and a campus map ( Appendix M ) indicating main parking at the university and the location of the data collection center.

Upon arrival to the data collection site, the participant was met by the researcher and taken to a quiet environment to minimize distractions. The study was reviewed with the participant and all questions were answered before informed consent was obtained. Once informed consent was signed by both the participant and the researcher, a unique numeric identifier was assigned to the participant’s file.
Data Collection

After signing the informed consent, the researcher had the participant complete the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977) (Appendix E) on a pre-print worksheet identified only by the participant’s unique numerical identifier. The CES-D was immediately scored by the researcher and if the participant scored a 16 or greater (indicating symptoms of depression), the participant was excluded from the study. The participant was told that the score on the CES-D is indicative of symptoms of depression, but is not a diagnosis of depression, and the score is greater than the score allowed for participation in the study. If participants were to have experienced any signs of distress or depression after completing the CES-D, the local crisis hotline number would have been made available. No participants were excluded from the study based on CESD scores.

The researcher then administered The Mini-Mental State Examination (MMSE) (Folstein et al., 1975) (Appendix F) to participants to screen for symptoms of dementia. The researcher recorded and immediately scored the results of the MMSE on a pre-printed worksheet identified only by the participant’s unique numerical identifier. If the participant scored less than 24 (indicative of dementia) on the MMSE they were excluded from the study and were told that the score on the MMSE was lower than the cut off score for this study, but is not a diagnosis of dementia. No participants were excluded from the study based on MMSE scores.

After completing the CES-D Scale and the MMSE, a finger stick blood glucose test was performed by the investigator to assess the subject’s current glucose level using
the OneTouch UltraSmart Blood Glucose Monitoring System and a Surgilance Safety Lancet. The third or fourth finger of the participant’s non-dominant hand was cleaned with an antiseptic wipe and allowed to air dry. Using a Surgilance Safety lancet the participant’s finger was pricked to obtain one to two drops of blood on an OneTouch testing strip. The testing strip was then inserted into the OneTouch UltraSmart Blood Glucose machine to read the random blood glucose level. A cotton ball was used to apply pressure to the finger stick area to stop the bleeding. Subjects experiencing a blood glucose levels below 70mg/dl or above 250 mg/dl were to be excluded from the study. If the subject was experiencing an episode of hypoglycemia (blood sugar less than 60mg/dl) 15-20 grams of carbohydrate would have been offered to the subject via ReliOn Glucose tablets, per recommendation from the ADA (2011) and the subject would have been encouraged to contact their primary care physician. If the subject was experiencing an episode of hyperglycemia with a blood sugar greater than 250 mg/dl the subject was encouraged to contact their primary care physician. Prior to any random blood glucose testing quality control was completed on the OneTouch Ultra Smart Blood Glucose machine using the OneTouch Ultra Control Solution to insure the glucose meter was calibrated correctly (Appendix G). No participants were excluded from the study based on finger stick blood glucose levels.

After determining the subject’s random blood glucose, the researcher collected 1 milliliter of venous blood via venipuncture to test for HgbA1c. The blood sample was taken from a vein inside of the participant’s elbow or from the back of their hand. The venipuncture site was cleaned with an antiseptic wipe and allowed to dry. An elastic band
was wrapped around the upper part of the participant’s arm to apply pressure to the area to make the vein swell with blood. The researcher gently inserted a needle into the vein to collect about 1 milliliter of blood into an airtight lavender-top tube attached to the needle. The elastic band and the needle were then removed from the participant’s arm. The puncture site was covered with a bandage to stop any bleeding. The lavender-top tube and the laboratory request form were labeled with the participant’s unique identifying number and placed in a lab supplied biohazard plastic bag inside a room temperature locked biohazard container for currier pickup. After the participant completed all data collection items and left the research site, the researcher contacted the currier from Quest Diagnostic Laboratory via telephone to pick up the lab specimen. All laboratory findings reporting the participant’s HgbA1c were printed with the participant’s unique identifying number and sealed in an envelope. Results were hand delivered via Quest Diagnostic currier to the researcher. If requested, a copy of the HgbA1C results was mailed to the participant.

With the help of the researcher, participants then completed the pre-printed self-report m-DCP and the SCI-R (Appendix H and I). Participants were identified on the self-report questionnaires by their unique numerical identifier. Next, the researcher administered the EXIT 25 and the 3 subtests of the WMI from the WAIS-III in the following order: Letter-Number Sequencing, Digit Span Forward, Digit Span Backward, and Arithmetic subtest. Participant results on each of the test were recorded on a pre-printed EXIT 25 and WMI forms identified only by the participant’s unique numerical identifier. After data collection was complete the participant was asked if they had
questions and were given a $10.00 Visa Gift Card for taking time to participate in the study.

**Data Management and Analysis Plan**

All data was entered into a password-protected computer. The Predictive Analytics Software (PASW, Statistics 18; 2009) was used to analyze the data. Univariate data analyses were completed once all data were entered in the database. This was helpful in cleaning and checking the quality of the data, as well as describing the sample from the demographic data gathered (Munro, 2005).

Correlation and regression statistics were used to analyze the proposed hypothesis. Specifically, to examine the direction, strength and significance of the relationships among the variables of severity of T2DM and working memory and diabetes self-care, Pearson’s Product-moment correlation was used. Linear and multiple regression analysis were used to determine the mediation effects of working memory on severity of T2DM and diabetes self-care (Baron & Kenny, 1986). Three equations are used to test for statistical significance of a mediator effect. First, the dependent variable self-care was regressed on the predicator variable Severity of type 2 diabetes to first establish that an effect may be mediated between the two concepts. Then secondly, to show that mediator variable is correlated with independent variable, working memory was regressed on severity of T2DM. The third, and last equation to test for mediation included entering both the independent and mediator variable into the model to test for mediation effects.

**Protection of Human Subjects**

Prior to initiating the study, the research protocol was approved by the
Institutional Review Board for Human Subjects at the University of Arizona and the University of Portland. Through a formal consent procedure (Appendix M), each participant received written and verbal information regarding the purpose, the benefits, and the risks of the study. Assurances of confidentiality, anonymity, and protections of privacy were provided to each participant. Before participating in the study, written consent was obtained from each participant.

The risks to the participants in this study were minimal. The involvement of the participants in the study consisted of answering questionnaires, completing neuropsychological testing, a random finger stick for blood glucose testing and a venipuncture for collection of blood for the HgbA1c test. All data collected from participants was coded to ensure confidentiality by using a unique identification code number on questionnaire forms, cognitive function tests and laboratory forms. All paper data was kept in a locked file cabinet, only accessible by this researcher, at the University of Portland. All computer data was password protected on a personal computer at the University of Portland. Data was presented in aggregate format to protect the anonymity of subjects.

**Summary**

The purpose of this non-experimental study was to test proposed relationships stated in Orem’s SCDNT by examining the relationships between severity of T2DM, working memory and diabetes self-care. Participants with type 2 diabetes were recruited from the Portland, Vancouver, Beaverton OR-WA area. After recruitment and informed consent, the CED-S and MMSE were administered to assess for symptoms of depression
and dementia. A finger stick blood glucose testing was completed to assess for hypo or hyperglycemia before cognitive testing. Venipuncture to collect a blood sample for HgbA1c was performed followed by completion of the modified DCP and cognitive testing to assess working memory.

Pearson’s Product-moment correlation was used to analyze the direction, strength and significance of relationships among the variables of severity of T2DM, working memory and diabetes self-care and linear and multiple regression analysis was used to determine the mediation effects of working memory.
CHAPTER IV: RESULTS

Overview

The aims of this study were to (1) test a portion of Orem’s Self-care Deficit Nursing Theory among middle and older aged individuals with type 2 diabetes and (2) explore relationships between severity of type 2 diabetes, working memory and diabetes self-care. In this chapter, the results of the study are presented. Descriptive statistics and tables are used to describe the characteristics of the sample and the major study variables. Correlation analysis was used to describe the relationship among major study variables. The Predictive Analytics Software (PASW, Statistics 18; 2009) was used for data analysis. A p-value of < 0.05 was the criterion used to determine statistical significance.

Characteristics of the Sample

Sixty-seven participants were recruited for this study. The participants consisted of 30 males (44.8%) and 37 females (55.2%) between the ages of 45-89 years with a mean age of 62.9 years (SD = 10.98). Gender was analyzed as a dichotomous variable (male = 1, female = 2). Participants’ ethnicity included 62 Caucasians (92.5%), 4 Hispanic (6%), and 1 Asian/Pacific Islander (1.5%). The majority of the participants were married (n = 47, 70.1%) and had insurance coverage as a group plan through an employer (n = 38, 56.7%). One third of the participants worked full time, 35 hours or more a week (n = 23, 34.3%), another one third were retired (n = 21, 31.3%) and the less than one third worked part time, were unemployed, or a homemaker. Sixteen of the participants (23.9%) had a graduate degree, 24 were college graduates (35.8%) and 23 had some college or technical school training (34.3%) (Table 1).
Table 1
Demographic Variables (N = 67)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td>62.9 (10.9)</td>
<td>45-89</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30 (44.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>37 (55.2)</td>
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<td></td>
</tr>
<tr>
<td>Marital Status</td>
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<td></td>
</tr>
<tr>
<td>Never Married</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>47 (70.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>5 (7.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>62 (92.5)</td>
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<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>4 (6)</td>
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</tr>
<tr>
<td>Asian or Pacific</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Islander</td>
<td>1 (1.5)</td>
<td></td>
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</tr>
</tbody>
</table>

Note: SD-standard deviation

The duration of type 2 diabetes ranged from 2-33 years, with the mean 10.61 years (SD = 6.127). Overall 47.8% of the participants rated their health as good (n = 32) and 67.2% rated their health about the same as it was a year ago (n = 45). The body mass index ranged from 23 to 71 with the average being 35.11 (SD = 9.31), thus placing the majority of the participants (n = 44, 65.7%) in the obesity category according to the CDC (2011). The mean HgbA1C was 6.89 (SD = 1.48) with a range from 5-11. Finger stick blood glucose levels on the day of testing ranged from 83-247 with 149 (SD = 36.65) as the average. In the past year, 13 participants (19.4%) were hospitalized overnight with length of stay ranging from 1 to 18 nights. On average participants had 7.46 (SD = 3.83) prescription medications with 34.3% (n = 23) taking insulin to control their blood glucose. (Table 2).
The mean number of comorbidities self-reported was 5.54 ($SD = 3.36$), with 83.6% ($n = 56$) having high cholesterol, 82.1% ($n = 55$) being treated for hypertension and 50.7% ($n = 34$) having peripheral neuropathy. (Table 3)
Diabetic self-care activities were measured using the self-report SCI-R scale. The mean score on the SCI-R was 62.66 ($SD = 12.25$) with scores ranging from 33.93-91.07. The majority of the participants reported that they test their blood glucose level ($n = 58$, 86.6%) with 52.2% ($n = 35$) checking their blood glucose 7 days a week. More than half of the participants reported keeping a record of their blood glucose level ($n = 37$, 55.2%). The majority of the participants ($n = 43$, 64.2%) reported they take the correct dose of diabetes pills or insulin and 47.8% ($n = 32$) report always taking the medication at the right time. Thirty-two participants (47.8%) reported they ate the correct food portions only some of the time, with 40.3% reporting they sometimes eat meals/snacks on time. The majority of the participants ($n = 39$, 58.2%) reported they never keep a food record, but 44.8% ($n = 30$) report always reading food labels. The majority of the participants reported that they usually ($n = 19$, 28.4%) or always ($n = 33$, 49.3%) treat low blood glucose levels with the recommended amount of carbohydrate, but the majority of the participants ($n = 35$, 52.2%) report never carrying quick acting sugar to treat low blood glucose. The majority of the participants ($n = 57$, 85.1%) reported always coming to the

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever been told that you have high cholesterol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>16.4</td>
</tr>
<tr>
<td>Yes</td>
<td>56</td>
<td>83.6</td>
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<tr>
<td>Have you ever been told that you have high blood pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>17.9</td>
</tr>
<tr>
<td>Yes</td>
<td>55</td>
<td>82.1</td>
</tr>
<tr>
<td>Have you ever been told you have peripheral neuropathy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>49.3</td>
</tr>
<tr>
<td>Yes</td>
<td>34</td>
<td>50.7</td>
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</table>

Table 3
Comorbidities of the Sample (N=67)
clinic for appointments as scheduled and 89.6% \((n = 60)\) reported never wearing a medic alert ID. As for exercise, 32.8% \((n = 22)\) reported always engaging in some form of exercise.

Participants in the study were screened using the MMSE and CESD. No subjects were excluded from the study due to MMSE or CESD scores. The mean score of the participants on the MMSE was 29.9 \((SD = 0.34)\) with scores ranging from 28-30. The mean score on the CESD was 4.93 \((SD = 3.82)\) with scores ranging from 0-13.

The mean score on the EXIT 25 was 4.70 \((SD = 2.8)\) with scores ranging from 0-11. The mean WMI score was 37.52 \((SD = 8.34)\) range 25-59. The WMI score was comprised of three subtests (LNS, DSS, and Arithmetic) from the WAIS-III. The mean score on the LNS was 9.31 \((SD = 2.15)\) with scores ranging from 4-17. The mean score on the DSS was 15.76 \((SD = 4.01)\) with scores ranging from 10-26. The mean score on the Arithmetic subtest was 12.45 \((SD = 3.60)\) with scores ranging from 7-20. (Table 4)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>EXIT 25</td>
<td>0</td>
<td>11</td>
<td>4.79</td>
<td>2.799</td>
</tr>
<tr>
<td>Working Memory Index</td>
<td>25</td>
<td>59</td>
<td>37.52</td>
<td>8.34</td>
</tr>
<tr>
<td>Letter Number Sequencing Subtest</td>
<td>4</td>
<td>17</td>
<td>9.31</td>
<td>2.148</td>
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<tr>
<td>Digits Span Forward</td>
<td>5</td>
<td>15</td>
<td>9.69</td>
<td>2.291</td>
</tr>
<tr>
<td>Digits Span Subtest</td>
<td>10</td>
<td>26</td>
<td>15.76</td>
<td>4.008</td>
</tr>
<tr>
<td>Digits Span Backward</td>
<td>2</td>
<td>13</td>
<td>6.07</td>
<td>2.382</td>
</tr>
<tr>
<td>Arithmetic Subtest</td>
<td>7</td>
<td>20</td>
<td>12.45</td>
<td>3.603</td>
</tr>
</tbody>
</table>

\(\text{Min} = \text{Minimum}; \text{Max} = \text{Maximum}, \text{SD} = \text{Standard Deviation}\)

**Correlational Analysis of Major Study Variables**

The extent to which the major study variables related to each other was examined. Zero-order correlations of major study variables are displayed in Table 5. Age was
significantly negatively correlated with MMSE scores \((r = -.363, p < .01)\), the WMI \((r = -.408, p < .01)\), and BMI category \((r = -.269, p < .05)\) as well as HSC \((- .219, p < .05)\).

Age was significantly positively correlated with number of years diagnosed \((r = .236, p < .05)\), total number of medications \((r = .225, p < .05)\), EXIT 25 \((.272, p < .05)\), and total number of comorbidities reported \((r = .356, p < .01)\).

The MMSE was correlated with the EXIT 25 \((r = -.203, p < .05)\), number of comorbidities \((r = -.218, p < .05)\) and HSC \((r = .203, p < .05)\). Finger stick blood glucose was significantly correlated with HgbA1c \((r = .631, p < .01)\), EXIT 25 \((r = .511, p < .01)\), and HSC \((r = -.439, p < .01)\).

The number of years diagnosed was significantly correlated with the total number of medications \((r = .281, p < .05)\), as well as, HgbA1c \((r = .455, p < .01)\), BMI \((r = -.212, p < .05)\), EXIT 25 \((r = .351, p < .01)\), WMI \((r = -.233, p < .05)\), and total number of comorbidities \((r = .293, p < .01)\).

Severity of T2DM was measured as total number of medications, total number of comorbidities, and HSC. All three of the measures were significantly correlated with one another. The total number of medications was highly significantly correlated with the number of comorbidities \((r = .705, p < .01)\) and negatively correlated with HSC \((r = -.360, p < .01)\). Total number of comorbidities was negatively correlated with HSC \((r = -.409, p < .01)\).

Working memory was measured using the WMI and executive function was measured using the EXIT 25. There was significant negative correlation between WMI and the EXIT 25 \((r = -.450, p < .01)\). All subtests of the WMI (LNS, DSF, DSB,
Arithmetic) were highly significantly correlated with one another and the WMI. All subtest of the WMI were significantly inversely correlated with the EXIT 25.

Diabetes self-care was measured using the SCI-R and HgbA1C. There was not a significant relationship noted between these two measures. When evaluating the components of the SCI-R in relation with HgbA1C, significant negative relationships were noted with the following: taking correct dose of diabetes pills or insulin \((r = -.203, p < .05)\), eats meals/snacks at the right time \((r = -.377, p < .01)\), comes to the clinic for appointments as scheduled \((r = -.510, p < .01)\), and adjust insulin dosage based on glucose values, food and exercise \((r = -.403, p < .01)\). A significant positive relationship was noted between HgbA1c and carrying a quick acting sugar to treat low blood glucose \((r = .440, p < .01)\) and wearing a medic alert ID \((r = .471, p < .01)\).
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<tbody>
<tr>
<td>1 Age</td>
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<tr>
<td>2 MMSE</td>
<td>-0.363**</td>
<td></td>
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<td>3 BG</td>
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<tr>
<td>4 BMI</td>
<td>-0.269*</td>
<td>0.203*</td>
<td>0.032</td>
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<tr>
<td>5 Years Dx</td>
<td>0.236*</td>
<td>-0.026</td>
<td>0.416**</td>
<td>0.212*</td>
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<tr>
<td>6 # Meds</td>
<td>0.225*</td>
<td>-0.163</td>
<td>0.158</td>
<td>0.113</td>
<td>0.281*</td>
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<tr>
<td>7 # Comor</td>
<td>0.356**</td>
<td>0.218*</td>
<td>0.183</td>
<td>0.327**</td>
<td>0.293**</td>
<td>0.705**</td>
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<tr>
<td>8 HSC</td>
<td>-0.219*</td>
<td>0.203*</td>
<td>0.439**</td>
<td>-0.185</td>
<td>-0.086</td>
<td>-0.360**</td>
<td>-0.409**</td>
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<tr>
<td>9 EXIT 25</td>
<td>0.272*</td>
<td>-0.203</td>
<td>0.511**</td>
<td>0.087</td>
<td>0.351**</td>
<td>0.326**</td>
<td>0.492**</td>
<td>-0.504**</td>
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<td>0.191</td>
<td>-0.157</td>
<td>-0.11</td>
<td>-0.233*</td>
<td>-0.344**</td>
<td>-0.476**</td>
<td>0.542**</td>
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<td>0.108</td>
<td>-0.093</td>
<td>0.153</td>
<td>-0.202</td>
<td>-0.302**</td>
<td>-0.359**</td>
<td>0.381**</td>
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<td>-0.748**</td>
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<td>12 DSF</td>
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<td>0.053</td>
<td>-0.127</td>
<td>-0.168</td>
<td>-0.152</td>
<td>-0.182</td>
<td>-0.275*</td>
<td>0.411**</td>
<td>-0.254*</td>
<td>0.791**</td>
<td>0.522**</td>
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<tr>
<td>13 DSB</td>
<td>-0.286**</td>
<td>0.228*</td>
<td>-0.073</td>
<td>-0.037</td>
<td>-0.066</td>
<td>-0.218*</td>
<td>-0.238*</td>
<td>0.430**</td>
<td>0.245*</td>
<td>0.766**</td>
<td>0.496**</td>
<td>0.471**</td>
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<tr>
<td>14 Arithmetic</td>
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<td>0.194</td>
<td>-0.18</td>
<td>-0.214*</td>
<td>-0.278*</td>
<td>-0.356**</td>
<td>-0.555**</td>
<td>0.482**</td>
<td>-0.541**</td>
<td>0.859**</td>
<td>0.475**</td>
<td>0.574**</td>
<td>0.517**</td>
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<tr>
<td>15 HgbA1C</td>
<td>0.045</td>
<td>0.118</td>
<td>0.631**</td>
<td>0.148</td>
<td>0.455**</td>
<td>0.286**</td>
<td>0.299**</td>
<td>0.375**</td>
<td>0.510**</td>
<td>0.352**</td>
<td>0.327**</td>
<td>0.332**</td>
<td>-0.158</td>
<td>-0.304**</td>
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<tr>
<td>16 SCI-R</td>
<td>-0.123</td>
<td>-0.114</td>
<td>-0.230*</td>
<td>0.082</td>
<td>0.106</td>
<td>0.147</td>
<td>0.075</td>
<td>0.233*</td>
<td>-0.313**</td>
<td>0.011</td>
<td>-0.039</td>
<td>0.024</td>
<td>-0.083</td>
<td>0.089</td>
<td>-0.093</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

Note: MMSE=mine mental state examination; BG=blood glucose; BMI=Body Mass Index; Dx= diagnosed;
#Meds=number of prescription medications; #Comor=number of comorbidities; HSC=health status composite;
WMI=Working Memory Index; LNS=Letter Number Sequencing; DSF=Digit Span Forward; DSB=Digit Span Backward
SCI-R=Self-care inventory revised
Hypothesis One

Hypothesis 1: Increased severity of T2DM will be associated with decreased performance scores on measures of working memory. The relationship between severity of T2DM (as measured by the HSC score, number of comorbidities, and number of prescription medications) and working memory (as measured by EXIT 25 and WMI) was investigated using Pearson product-moment correlation coefficient. Preliminary analysis was performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity.

There was a significant negative correlation between HSC and the EXIT 25, $r = -.504, p < .01$ and a significant positive correlation between HSC and WMI, $r = .542, p < .01$. That is, the worse individuals rated their overall health status, the worse their scores on measures of working memory cognitive test. Using partial correlation analyses, these relationships remained statistically significant after controlling for the effects of age ($r = -.474, p < .01, r = .508, p < .01$).

There was a significant positive correlation between the number of comorbidities a person reported and the EXIT 25, $r = .492, p < .01$ and a significant negative correlations between number of comorbidities and WMI, $r = -.476, p < .01$. Meaning, the more comorbidities a person reported the worse the scores on the EXIT 25 and WMI, indicating worse working memory capacity/executive function. Using partial correlation analyses, these relationships remained statistically significant after controlling for the effects of age ($r = .440, p < .01, r = -.387, p < .01$).

There was a significant positive correlation between the number of prescription
medications reported and the EXIT 25, \( r = .326, p < .01 \) and a significant negative correlation between the number of prescription medications reported and the WMI, \( r = -.344, p < .01 \). Meaning, the more prescription medications a person reported the worse the scores on the EXIT 25 and WMI, indicating worse working memory capacity/executive function. Using partial correlation analyses, these relationships remained statistically significant after controlling for the effects of age (\( r = .282, p < .05; r = -.283, p < .05 \)).

Overall, hypothesis one was supported in that the worse the severity of type 2 diabetes as measured by self-report of health status, number of comorbidities, and number of prescription medication, the worse the scores on the EXIT 25 and WMI, indicating worse performance on measures of working memory and executive function.

**Hypothesis Two**

Hypothesis 2: decreased performance scores on measures of working memory will associated with lower indicators of self-care. The relationship between working memory/executive function (as measured by the EXIT 25 and WMI) and self-care (as measured by SCI-R and HgbA1c) was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity.

There was a significant strong positive correlation between the scores on the EXIT 25 and HgbA1c (\( r = .510, p < .01 \)), and negative correlation between EXIT 25 and SCI-R (\( r = -.313, p < .01 \)). These significance findings reveal that the worse the scores on executive function as measured by the EXIT 25 the worse the scores for self-care, as
measured by SCI-R and HgbA1c. Using partial correlation analyses, these relationships remained statistically significant after controlling for the effects of age \( r = .544, p < .01, r = -.293, p < .01 \).

There was significant negative correlation between the scores on the WMI and HgbA1c \( r = -.352, p < .01 \). Using partial correlation analyses, the relationship remained statistically significant after controlling for the effects of age \( r = -.406, p < .01 \).

However, there was not a statistically significant relationship between the WMI and SCI-R. Upon farther analyses of the components of the WMI (LNS, DSF, DSS, DSB, Arithmetic) in relationship with the SCI-R also revealed no statistical significance between the two variables.

Overall, hypotheses two is not supported. Working memory, as measured using the WMI, did show a significant relationship with self-care as measured by the HgbA1C. However, working memory, as measured using the WMI did not show a statistically significant relationship with the SCI-R. Executive function, a component of working memory, as measured using the EXIT 25 did show a significant relationship with both measures of self-care (SCI-R & HgbA1c).

**Hypothesis Three**

Hypothesis 3: Working Memory will mediate the effects of severity of T2DM on diabetes self-care. Using the Baron & Kenny (1986) method to test for the mediating effects of Working memory two different models were for the two different outcome variables (SCI-R and HgbA1c) was to test this hypothesis.

The first model used to test for mediation included the independent variable
severity of T2DM as measured by the HSC, the mediating variable WMI and the outcome variable SCI-R. Hierarchical multiple regression was used to assess the mediation between these concepts. Health state composite was entered during Step 1. The beta weight of HSC in the model was 0.233, significance 0.058. Thus, the first model did not support a mediator effect between Working Memory, severity of T2DM and self-care, as measured by WMI, HSC, and SCI-R.

The second model used to test for mediation included the independent variable severity of T2DM as measured by the HSC, the mediating variable WMI and the outcome variable HgbA1c. Hierarchical multiple regression was used to assess the mediation between these concepts. Health state composite was entered during Step 1. The beta weight of HSC in the model was -0.375, significance 0.002. After entry of WMI at Step 2 the beta weight decreased to -0.262, significance changed to 0.058. Indicating the association between HSC and HgbA1c is decreased in the presence of WMI; however, the association between WMI and HgbA1c was not significant. Thus, the second model did not support a mediator effect between Working Memory, severity of T2DM and self-care as measured by WMI, HSC and HgbA1c.

Summary

The results from the analysis of the data collected from a convenience sample of middle aged and older adult with T2DM was presented in this chapter. Descriptive statistics were used to summarize the data and to describe the characteristics of the sample. A correlation matrix was created to explore the strength and direction of a linear relationship between the concepts of severity of T2DM, working memory and diabetes.
self-care. Findings demonstrate that as severity of T2DM increases, performance on cognitive measures of working memory decrease, and as performance on cognitive measures of working memory decreases, diabetes self-care decreases as evidenced by increased in HgbA1c values. However, the relationship between severity of T2DM and self-report self-care measure SCI-R did not yield a significant value. Overall, there was no evidence to support a mediation effect between WM (WMI), severity of T2DM (HSC), and self-care (SCI-R and HgbA1c).
CHAPTER V: DISCUSSION

In this chapter, each of the proposed hypotheses will be addressed and the findings discussed. The implications of the study findings for the association between severity of T2DM, working memory, and self-care are presented. The chapter concludes with a discussion of study limitation and future research.

This study examined the relationship between severity of T2DM, working memory and diabetes self-care among adults age 45 and over. The results of this study demonstrate that severity of T2DM is significantly associated with working memory and self-care, and that working memory is significantly associated with self-care.

This was the first known study to explore the relationship between severity of T2DM, working memory and self-care and the first study to examine the concept of working memory as a foundational capability using Orem’s theory. The results of this study provide support that working memory is a predictor of self-care when measured using HgbA1c, and executive function is important to consider when assessing self-care activities of individuals with T2DM. The results of this study also provide theoretical support for Orem’s Self-Care Deficit Theory.

Characteristics of the Sample

Adults age 45 and older were recruited to participate in this study because existing evidence associates T2DM with cognitive function (Allen, Frier, & Strachan, 2004; Arvanitakis, Wilson, Bienias, & Bennett, 2006; Awad, Gagnon, & Messier, 2004; Coker & Shumaker, 2003; Cukierman, Gerstein, & Williamson, 2005; Kodl & Seaquist, 2008; Roriz-Filho et al., 2009; Van den Berg, Kloppenborg, Kessels, Kapelle, & Biessels,
The mean age of the sample was 63 years, and participants ranged in age from 45 to 89. Fifty-five percent of the sample was women. Ninety-three percent of the study sample was Caucasian. These demographic characteristics are consistent with national findings, in that the majority of the individuals who have diabetes are over the age of 60 and Caucasian (CDC, 2011). In comparing this study’s demographic characteristics to other studies that investigated the relationship among T2DM and working memory, the age span average of study participants is early to mid-sixty to mid-seventies. However, the sample characteristics of gender and race varies depending on the study (Asimakipoulou et al., 2002; Gold et al., 2007; Bruehl et al., 2009; Qiu et al., 2006; Saczynski et al., 2008; and Thabit et al., 2009). Overall, the sample characteristics of this study are comparable to other studies that have investigated the relationship between T2DM and working memory.

**Screening Measures**

The zero-order correlations revealed that finger stick blood glucose levels and the MMSE were significantly correlated with executive function as measured by the EXIT 25. In studies investigating cognitive function and T2DM, baseline blood glucose testing is a common practice to eliminate confounding variables of hypoglycemia and severe hyperglycemia. Studies have shown that when blood glucose levels are above 270 mg/dl performance on cognitive test is significantly worse, especially on cognitive tests that assess working memory and executive function (Cox et al., 2005; Sommerfield et al., 2004). The results of this study indicate that acute hyperglycemia (blood glucose levels lower than 270 mg/dl) also affect executive function.
The MMSE is frequently used to screen for cognitive impairment and research related to cognitive function and T2DM. The significant correlation between the MMSE and EXIT 25 is consistent with other research demonstrating a strong associated between the two measures when attempting to validate the EXIT 25 as a measure for executive function (Larson, Lehay, Duff, & Wilde, 2008; Larson & Heinemann, 2010). Overall, the mean scores on the MMSE and the EXIT 25 in this study show that the participants did not have evidence of dementia or executive dysfunction. This study continues to support the association between the MMSE and the EXIT 25 and offers validation of the EXIT 25 among individuals with T2DM. No significant correlations were found in examining the CES-D with measures of working memory/executive function.

**Severity of Type 2 Diabetes Variables**

Severity of T2DM was significantly correlated with measures of working memory and executive function in this study. This study is one of the first to conceptualize severity of T2DM when investigating the relationship between T2DM and working memory. Most studies investigating this phenomenon have correlated the diagnosis of T2DM or the duration of disease with cognitive assessments. In this study, severity of T2DM was conceptualized using Orem’s theoretical definition of health state by assessing number of comorbidities, number of prescription medications and overall self-report of health status (HSC). Each of the variables was significantly correlated with one another.

On average participants had 6 comorbidities, with the majority having high cholesterol, high blood pressure, and peripheral neuropathy. These findings are consistent
with the overall statistics reported by the CDC (2011) for individuals with T2DM. Heart disease (high cholesterol), high blood pressure and peripheral neuropathy rank among top complications associated with diabetes. Zero order correlations revealed the number of comorbidities reported by the study participants was significantly correlated the number medications prescribed, duration of diabetes, BMI, and overall self-reported health status. These significant associations provide evidence to support the concept of severity of T2DM. The longer one has the disease, the more comorbid conditions, more obese and the worse they rate their overall health the more severe the T2DM.

On average participants had approximately 8 prescription medications with about one third taking insulin to control their blood glucose levels. Increases in comorbid health conditions is associated with the increased use of prescribed medications. These findings are consistent with several research studies investigating multiple medical diagnoses and increase prescription drug use (Jorgensen Johansson, Kennerfalk, Wallander & Syardsudd, 2001; Rigler, Perera, Jachna, Schireman, & Eng, 2004).

In reviewing the zero order correlations between major study variables, it was noted that the number of years diagnosed with T2DM was significantly correlated with all three variables of severity of T2DM in this study, as well as the WMI and EXIT 25. The significant relationship between duration of T2DM and executive function is consistent with research by Saczynski et al., (2008), where duration of T2DM was significantly correlated with poorer performance on measures of executive function. The duration of T2DM may contribute to poorer performance on measures of working memory/executive function due to possible pathological changes in the brain that occur
due to chronic states of hyperglycemia over time. Korf et al., (2006) noted that MRI findings showed increased hippocampal atrophy, infarcts, and white matter hyperintensities in those with T2DM longer than 15 years. These findings support the relationship between duration of diabetes and the poorer performance on measures of working memory and executive function. Thus, when assessing the relationship of the severity of T2DM and working memory and executive duration of T2DM needs to be considered as it contributes to the overall severity of the disease.

**Diabetes Self-care Variables**

Diabetic self-care activities were measured using the self-report SCI-R scale and the biologic marker HgbA1c. The results of this study show that participants had relatively high self-care as evidence by a high mean score on the SCI-R. The participants also had fairly good glucose control with the mean HgbA1c around 6.95%. The overall HgbA1c goal, according to the ADA (2011) is to keep the HgbA1c below 7% to reduce the risk of microvascular complications.

In evaluating the relationship between the two measures of self-care, there was not a significant relationship between the self-report SCI-R scale and HgbA1c. This finding is not consistent with the research by Weinger (2005), in that the SCI-R was found to highly correlate with HgbA1c in three separate studies. However, in a study by Thabit et al., (2009), a lack of association between HgbA1c and the self-report of self-care activities were noted among individuals with T2DM. The lack of association between the two measures of self-care in this study and the inconsistent findings in the literature regarding self-report self-care practices and the biological marker of self-care
practices could be related to social desirability, where the study participant chooses to answer the self-care questionnaire in a favorable manner.

Overall the participants in this study self-reported high self-care practices in the areas of taking the correct dose of diabetes pills or insulin, testing blood glucose as recommended, and coming to the clinic for scheduled appointments. These findings are consistent with the DAWN study, in which 78% of study participants self-reported taking medications as recommended, 64% of the participants checked their blood glucose daily and 72% kept clinic appointments (Peyrot et al., 2005).

Throughout the literature, diet and exercise are two of the most difficult components of diabetes self-care practices as evidence by low self-report adherence rates (Peyrot et al., 2005; Toljamo & Hentinen, 2001). However, both diet and exercise are critical components of self-care in controlling blood glucose levels. This study is also consistent with findings from the research in regards to diet and exercise self-care activities. Among study participants in this study, half of the participants reported they ate the correct food portions only some of the time, with less than half reporting they sometimes eat meals/snacks on time. The majority of the participants reported they never keep a food record, however, half of them reported always reading food labels. The DAWN study reported that when asked about diet regimen only 37% of the participants in the study self-reported following the recommended diet regimen. As for exercise, in this study about one third of the participants reported engaging in a form of exercise as recommended. Again, this finding is consistent with the DAWN study in which only 35% of the participants reported following an exercise regimen as recommended (Peyrot et
Overall, this study is consistent with other studies in regards to self-care practices of an individual with T2DM. The one area of self-care that seems to be the hardest to attend to is the diet regimen. While there are mixed results regarding the relationship among measures of working memory and executive function and measures of self-care in this study, when evaluating the self-care practices regarding eating the correct portion of food as recommended and eating on time, there is a significant correlation noted with measures of working memory and executive function. Managing a diet regimen requires an individual with T2DM to keep in mind how many calories, carbohydrates and fats are ingested with a current meal, while adding that information to ongoing knowledge of other foods consumed that day, all while ignoring irrelevant competing information. The cognitive abilities necessary for this type of management require working memory and executive function. This study gives support to the relationship between the self-care practices involved in managing diet and the cognitive skills necessary to carry out the self-care plan.

**Cognitive Variables**

This study used the WMI and the EXIT 25 to measure working memory as working memory was conceptualized to include executive function. The overall mean scores for the WMI and the EXIT 25 showed high levels of working memory capacity and no evidence of executive dysfunction among the study participants. Zero order correlations showed that the WMI and EXIT 25 were significantly inversely correlated, and each subtest of the WMI (LNS, DSS, and Arithmetic test) was significantly inversely correlated with the EXIT 25.
The EXIT 25 is a reliable and valid tool used to measure executive function, and has strongly correlated with other cognitive measures of executive function such as the Stroop Color, Word Test, and the Trail Making Test Part B (Larson et al., 2008; Larson & Heinemann, 2010). The WMI (and each of the subtest of the WMI) is a reliable and validity tool to assess working memory capacity, which involves the cognitive process of executive function. While currently there is no gold standard for assessing working memory or executive function, research does support a strong correlation between the two constructs in which they share a common underlying executive attention component that is predictive of higher-level cognition (McCabe, Roediger, McDaniel, Balota, & Hamberick, 2010). This study provides evidence that a simple bedside tool such as the EXIT 25 can adequately assess executive function when compared to more complex neuropsychological tests such as the WMI.

**Hypotheses**

Hypothesis 1: Increased severity of T2DM will be associated with decreased performance scores of working memory. This hypothesis was tested by examining the correlational relationships between severity of T2DM (as measured by the health status composite score, number of comorbidities, and number of prescription medications) and working memory (as measured by EXIT 25 and WMI). A bivariate correlational matrix was computed to determine the existence of significance of the variables. The results of the analysis show that in this sample participants who had worse severity of T2DM, as evidence by increased number of medications, increased number of comorbidities, and lower self-report of health status demonstrated poorer performance on measures of
working memory. The relationship between the variables of severity of T2DM and working memory remained significant after controlling for the effects of age.

Research regarding the relationship between T2DM and working memory has been conducted with mixed results. Most research conducted has been comparing working memory performance between T2DM participants and non-diabetic participants. In research studies where the T2DM participants are uncomplicated results have yielded lack of an association between T2DM and working memory. However, in research where participants have more complex illness and more severe, the relationship between T2DM and working memory is significant (Qiu et al., 2006). For example, Qiu et al., investigated executive dysfunction in a group of 292 homebound people elders age 60 and over. The T2DM subjects in this study were quite complex with 74% of the subjects having a body mass index greater than 30k/m, 56% reporting cardiovascular disease, 25% with stroke history, and 70% of them reporting taking medications to control their diabetes. Roberts et al., (2008) also found longer duration of T2DM and increase in diabetes complications resulted in an increased risk of mild cognitive impairment.

Findings from these studies support the findings from this study. The more severe the T2DM, the more likely there is to be a problem with working memory.

Hypothesis 2: Decreased performance scores on measures of working memory will be associated with lower indicators of self-care. This hypothesis was tested by examining the correlational relationships between working memory and executive function and self-care (as measured by SCI-R and Hgb A1C). A bivariate correlational matrix was computed to determine the existence of significant association of the
variables. The results of the analysis show that in this sample, participants who have poorer performance on measures of working memory as measured by EXIT 25 and WMI have poorer self-care as measured by HgbA1c. The findings from this study regarding the relationship between working memory and HgbA1c are consistent with other research. deWet et al., (2007) investigated executive cognitive impairment in 98 study participants and found that the presence of executive function impairment was significantly associated with poorer glycemic control as measured by HgbA1c.

However, analysis from this study showed mixed results between measures of working memory and self-care as measured by the SCI-R. The EXIT 25 was significantly correlated with the SCI-R, where the WMI (and all subtests of the WMI) was not significantly correlated with the SCI-R. Research investigating the relationship of T2DM and working memory and executive function, using like measures as this study, report similar findings.

For example, Thabit et al., (2009) found similar findings with the EXIT 25 when assessing executive function in relationship to diabetes self-care. The EXIT 25 was significantly negatively correlated with self-care activities as measured by the Summary of Diabetes Self-Care Activities. However, Asimakopoulou et al., (2002) found lack of an association between measures of working memory as measured by DSF and DSB, and self-care care activities.

While the EXIT 25 and the WMI were found to be correlated in this study, and research has supported the construct of working memory to include executive function,
previous research as well as this current research suggest that the EXIT 25 maybe more sensitive to the cognitive processes affected by T2DM.

Hypothesis 3: Working Memory will mediate the effects of severity of T2DM on diabetes self-care. This hypothesis was tested using the Barron and Kenny (1986) method for mediation. Due to multiple outcome variables (SCI-R and HgbA1C), two different models were used to test this hypothesis.

Final analysis of each model revealed working memory did not mediate the effects between severity of T2DM and self-care. In reviewing the analysis, all measures of the severity of T2DM significantly correlated with the outcome variable self-care as measured by HgbA1c, however, all the independent variables did not correlate with outcome variable SCI-R. Severity of T2DM as measured by the HSC did significantly correlate with the SCI-R, showing the better participants rated their overall health the better their overall self-care scores were on the SCI-R.

However, in reviewing the analysis of severity of T2DM as measured by number of medications and number of comorbidities in relation to the SCI-R no significant relationship is noted. The number of medications taken by a subject and the number of comorbidities reported did significantly correlate with some components of the SCI-R such as check blood glucose with a monitor, carry quick acting sugar to treat low blood glucose, wear medic alert ID, and adjust insulin as needed based on glucose values, food and exercise. The number of comorbidities also significantly correlated with keeping a record of blood glucose results, and treating low blood glucose with the correct amount of carbohydrate.
Currently, this is the first research to look at the mediating effects of working memory on severity of T2DM and self-care. However, the findings of this study are similar with other studies that reveal the inconsistent relationship between T2DM, working memory and self-care (Saczynski et al., 2008; Asimakipoulou et al., 2002; Gold et al., 2007; Bruehl et al., 2009; Qiu et al., 2006; Sinclair et al., 2000; and Thabit et al., 2009).

One of reasons why the lack of an association between these variables may exist in this study is the effect of social desirability in completing the self-report scale of self-care activities (the SCI-R). This stands out as an issue in this study because of the significant correlation between all independent variables and all mediating variables significantly correlating with the outcome self-care measure HgbA1c and lack of significant correlation between the self-care measures SCI-R and HgbA1c.

**Theoretical Significance**

One of the purposes of the study was to test selected relationships within Orem’s (2001) Self-Care Deficit Nursing Theory. Orem’s general nursing theory proposes that certain factors (basic conditioning factors) such as T2DM, can at points in time condition or affect an individual’s ability (self-care agency) to engage in self-care. Specifically, the relationships proposed by Orem between basic conditioning factors (severity of T2DM), self-care agency (working memory) and self-care were analyzed in this study using bivariate correlation.

Findings from this study support that a significant relationship does exist between severity of T2DM and working memory and a significant relationship does exist between
working memory and diabetes self-care. Therefore, from a theoretical perspective, the proposition asserted by Orem: that certain factors (basic conditioning factors) can at points in time condition or affect an individual’s ability (self-care agency) to engage in self-care is supported.

The findings from this study regarding the proposed relationships of the major concepts are consistent with several research studies investigating the proposition asserted by Orem (Anderson, 2001; Horsburg et al, 2000; Sousa et al., 2004; Wang & Laffrey, 2001). However, what is unique to this study is the concept of working memory as a type of foundational capability within the theoretical concept of self-care agency.

**Future Research**

The purpose of this study was to explore relationships among severity of type 2 diabetes mellitus, working memory and diabetes self-care, as well as test proposed relationships within Orem’s (2001) Self-Care Deficit Nursing Theory in middle aged and older adults. Findings from this dissertation research support that increased severity of T2DM is associated with poorer performance on cognitive test that measure working memory and that poorer performance on cognitive test that measure working memory are associated poorer self-care activities as measured by HgbA1c. However, this study did not find an association between working memory and self-report self-care activities. This could be in part to the effects of social desirability of the participants in this study or the inability of the WMI to capture the cognitive processes affected by T2DM.

In past research the SCI-R has been found to be a reliable and valid tool for assessing self-report self-care activities (Weinger et al., 2005). While the SCI-R is a valid
and reliable tool for assessing self-care activities in both type 1 and type 2 diabetics, this research found the tool not to be sensitive to the population in this study. When assessing self-care activities, it is standard practice to use a self-report tool. However, when one uses a self-report tool regarding self-care practices there is a risk participants will answer the questions based on what they think the researcher wants to hear. Therefore, it is important to consider using multiple tools, such as self-report and biological markers, to elicit information from study participants or employ a tool to measure for social desirability so that one can account for the mitigating effects.

In this study, working memory was measured using the WMI and executive function with the EXIT 25. Currently, there is lack of a gold standard to assess working memory and many of the assessment tools to measure this concept are expensive, require specialized training to administer and take a long time to administer to research participants. The EXIT 25 is an inexpensive, brief bedside test of executive function that does not require specialized training to administer. Currently, there is limited research with the EXIT 25 in diabetic individuals; however, the current findings are showing that the tool is reliable and valid in measuring executive function among this population. Research has also shown that test of WMI and executive function share the concept of executive attention. Future research looking at the relationship working memory, specifically executive function should consider using measures that specifically tap the cognitive process of executive function or executive attention. One last thing to consider for future research is the concept of severity of T2DM. The concept of severity of T2DM was a key to the theoretical model guiding this study. Orem
states that when assessing health state of an individual one must assess the degree of illness, obvious injuries or defects from the illness, the effect of disease experienced by the individual and the effects of the illness on daily living. This study assessed severity of T2DM by measuring number of comorbidities the individual reported, number of medications the individual is prescribed, and the individual’s over all perception of health. Each of these measures was treated as an independent variable in assessing the relationship to the working memory and self-care. However, to fully understand the how severity of T2DM can effect cognitive function efforts should be made to develop a composite measure of severity of T2DM that encompasses all the components suggested in study as well as include duration of disease.

**Study Limitations**

The findings of this study are important as they give support to Orem’s theory and provide more information regarding the relationship between severity of T2DM, working memory and self-care. However, the research presented has several limitations. First, the majority of the participants in the study were Caucasian. While it is true that the majority of the individuals who have diabetes are Caucasian, it is well known that non-Hispanic blacks and Hispanics have poorer outcomes and more comorbid conditions than Caucasians (CDC, 2011). Therefore, future studies investigating the relationship between severity of T2DM and working memory should consider recruiting minority groups such as non-Hispanic blacks and/or Hispanics.

Second, the theoretical model guiding this study had multiple independent, multiple mediator and multiple outcome variables. In an attempt to assess for meditating effects
using the Barron & Kenny (1986) method analysis showed that there was lack of mediation due to lack of association between two independent variables and one outcome variable. Future research using the stated variables in this study should opt for an alternative method for analyzing mediation effects such as structural equation modeling or path analysis.

Lastly, a limitation to this study could be the effects of social desirability on the self-report scale to measure self-care activities. While strength of this study was to measure self-care activities using both a self-report scale and a biologic marker, there was not a significant correlation between the two measures. Future studies investigating self-care activities should critically evaluate a self-report scale to determine if the questions posed give the researcher the data needed to fully analyze the participant's self-care activities or determine if a social desirability scale should also be employed.

Summary

This study provides evidence that severity of T2DM is associated with working memory performance and in return, working memory performance in associated with overall self-care. Thus, individuals with more severe T2DM may be at greater risk for poor working memory, specifically executive function, which in turn can impact diabetes self-care. While this research failed to show the mediation effects of working memory, it did provide findings that support working memory could affect self-care activities. More research is needed to gain a better understanding how working memory is associated with self-care activities. Once more is known about how working memory affects self-care
activities then research can progress to provide information on how to improve overall self-care for individuals with T2DM.
APPENDIX A

ADVERTISEMENT FOR STUDY
Appendix A. Advertisement for Study

Are you a Type 2 Diabetic? If you have been diagnosed with Type 2 Diabetes for more than a year, over the age of 45, and are English speaking you may be eligible for a research study investigating how the cognitive process of working memory effects self-care actions in individuals with Type 2 Diabetes. Both men and women are invited to participate.

The study is being conducted at the University of Portland as part of a dissertation study from the University of Arizona. The study consists of answering questionnaires, blood glucose testing, and cognitive testing to measure working memory. It will take approximately 2 ½ hours of your time to participate in the study. Eligible participants will be compensated for participating in the study.

If you would like more information regarding the study or would like to participate in the study, please contact Patricia Gatlin at (503) 516-0699.
APPENDIX B

RECRUITMENT FLYER
Are You a Type 2 Diabetic?

- Have you had Type 2 Diabetes for over a year?
- Are you over the age of 45?
- Do you speak English?

Then you are invited to participate in a research study investigating how the cognitive process of working memory effects self-care actions in individuals with type 2 diabetes.

The research study is being conducted at the University of Portland as part of a dissertation study from the University of Arizona.

Study consist of answering questionnaires, blood glucose testing, and cognitive testing to measure working memory.

Takes approximately 2 ½ hours to participate in the study.

INTERESTED?
Please call Patricia Gatlin, PhDC, RN at 360-521-8312 for more information!

Eligible participants will be compensated for participating in the study.
APPENDIX C

RECRUITMENT LETTER
Appendix C. Recruitment Letter

Date

Dear __________________,

You are being sent this letter as a recruitment effort to locate individuals with Type 2 Diabetes in the Portland/Vancouver Metropolitan Area. As part of a large recruiting effort your name was provided to me by the University of Portland School of Nursing from the Client Partner Database.

My name is Patricia Gatlin. I am a doctoral student a University of Arizona and I teach at the University of Portland School of Nursing as a full time instructor. I am conducting a research study to learn more about how the cognitive process of working memory effects self-care actions in individuals with type 2 diabetes.

If you have been diagnosed with Type 2 Diabetes for more than a year, over the age of 45, and are English speaking you may be eligible for this study. Both men and women are invited to participate.

The study is being conducted at the University of Portland and consists of answering questionnaires, blood glucose testing, and cognitive testing to measure working memory. It will take approximately 2 1/2 hours of your time to participate in the study. Eligible participants will be compensated $10 for participating in the study.

If you would like more information regarding the study or would like to participate in the study, please contact me at (503) 516-0699. If you choose not to participate in the study, your relationship with the University of Portland School of Nursing will not be affected in any way.

Thank you in advance for your consideration,

Patricia K. Gatlin, PhD, RN
APPENDIX D

INSTITUTION SUPPORT LETTER
Appendix D: Institution Support Letter

March 1, 2010

Patricia K. Gatlin
101611 NE 112th Place
Vancouver, WA 98662

Dear Ms. Gatlin

I have reviewed your request regarding your study and am pleased to support your research project entitled "Severity of Type 2 Diabetes, Working Memory and Self-Care." Your request to use the University of Portland School of Nursing as a recruitment and research site is granted. The research will include recruitment from our well-elder database, as well as laboratory and office space to conduct your research. This authorization covers the time period of March 1, 2010 to March 1, 2011. We look forward to working with you.

Sincerely,

Joanne R. Warner, DNS, RN
Dean and Professor
University of Portland
School of Nursing
APPENDIX E

CENTER FOR EPIDEMIOLOGIC STUDIES DEPRESSION SCALE
Appendix E. Center for Epidemiologic Studies Depression Scale (CES-D)

Participant #: _________

Date: _________

Directions: Below is a list of some of the ways you may have felt or behaved. Please read each statement and then circle the appropriate number to indicate how often you have felt this way during the past week:

<table>
<thead>
<tr>
<th>During the past week…</th>
<th>Rarely or none of the time (less than 1 day)</th>
<th>Some or a little of the time (1-2 days)</th>
<th>Occasionally or a moderate amount of time (3-4 days)</th>
<th>All of the time (5-7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I was bothered by things that usually don’t bother me</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. I did not feel like eating; my appetite was poor</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. I felt that I could not shake off the blues even with the help from my family</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. I felt that I was just as good as other people</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. I had trouble keeping my mind on what I was doing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. I felt depressed</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. I felt that everything I did was an effort</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. I felt hopeful about the future</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. I thought my life had been a failure</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>10. I felt fearful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>11. My sleep was restless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. I was happy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13. I talked less than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. I felt lonely</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. People were unfriendly</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
During the past week… | Rarely or none of the time (less than 1 day) | Some or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | All of the time (5-7 days)
---|---|---|---|---
16. I enjoyed life | 0 | 1 | 2 | 3
17. I had crying spells | 0 | 1 | 2 | 3
18. I felt sad | 0 | 1 | 2 | 3
19. I felt that people disliked me | 0 | 1 | 2 | 3
20. I could not “get going” | 0 | 1 | 2 | 3
APPENDIX F

MINI-MENTAL STATE EXAMINATION
Appendix F. Mini-Mental State Examination

Participant #: __________
Date: __________

What is the year?
1 (1)
   Season? (1)
   Month? (1)
   Date? (1)
   Day of the Week? (1)

Where are we? State? (1)
2 County? (1)
   City? (1)
   Name of Place? (1)
   Floor we are on? (1)

Please repeat the following three words:
3
   Shirt, Brown, Honesty
I would like you to remember these three words.
What are they?
   Shirt (1)
   Brown (1)
   Honesty (1)

Repeat the three words until the patient learns all three.
Number of trials: ______

Spell the word "world": _ _ _ _ _
4 Now spell the word "world" backwards: _ _ _ _ _

Do you remember the three words I gave you a few minutes ago?
5 Shirt (1)
   Brown (1)
   Honesty (1)

What is this called? (Point to a pencil and then a watch)
6 Pencil (1)
   Watch (1)
7 Please repeat the following phrase: 
"No ifs, ands or buts".

8 Listen carefully, I want you to:
( ) Take the paper in your right hand (1)
( ) Fold it in half, and (1)
( ) Put it on the floor (1)

9 Hand the examinee a piece of paper that states "Close your eyes"
Have the examinee read and obey the statement.

10 Have the examinee write a sentence of their own choice.
Sentence should contain a subject and object and should make sense.
Ignore spelling errors when scoring.
If the examinee can write a sentence spontaneously,
dictate:
"This is a very nice day."

Have examinee copy the design: Give one point if all sides and
angles are preserved and if the intersecting sides form a Quadrangle.

APPENDIX G

QUALITY CONTROL FOR BLOOD GLUCOSE METER
Appendix G. Quality Control Record for Blood Glucose Meter

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Control Solution Lot #</th>
<th>Control Solution Expiration Date</th>
<th>Testing Strip Code #</th>
<th>Testing Strip Lot #</th>
<th>Testing Strip Expiration Date</th>
<th>Reference Range for Control Solution</th>
<th>Control Solution Result</th>
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APPENDIX H

MODIFIED DIABETES CARE PROFILE
Appendix H. Modified Diabetes Care Profile

Participant #: ___________
Date: ___________

Section I - Demographics

Please answer each of the following questions by filling in the blanks with the correct answers or by choosing the single best answer.

Note: For this survey, a Health Care Provider refers to a doctor, nurse practitioner, or physician assistant.

Q1. Age: __ __ years old
Q2. Birth date: __ __ /__ __ /__ __
   (Month / Day / Year)
Q3. Zip Code: __ __ __ __ __
Q4. Sex: □ 1 Male □ 2 Female
Q5. How tall are you? _____ feet ____ inches
Q6. How much do you currently weigh? _______ pounds
Q7. What year were you first told you had diabetes? (Please enter the year) __ __ __ __
Q8. What is your marital status? (check one box)
   □ 1 Never married
   □ 2 Married
   □ 3 Separated/Divorced
   □ 4 Widowed
Q9. What is your ethnic origin/race? (check one box)

☐ 1. White
☐ 2. Black
☐ 3. Hispanic
☐ 4. Native American
☐ 5. Asian or Pacific Islander
☐ 6. Arabic
☐ 7. Other: _______________

Q10. How much schooling have you had? (Years of formal schooling completed) (check one box)

☐ 1. 8 grades or less
☐ 2. Some high school
☐ 3. High school graduate or GED
☐ 4. Some college or technical school
☐ 5. College graduate (bachelor’s degree)
☐ 6. Graduate degree

Q11. Which of the following best describes your current employment status? (check one box)

☐ 1. Working full-time, 35 hours or more a week
☐ 2. Working part-time, less than 35 hours a week
☐ 3. Unemployed or laid off and looking for work
☐ 4. Unemployed and not looking for work
☐ 5. Homemaker
☐ 6. In school
☐ 7. Retired
☐ 8. Disabled, not able to work
☐ 9. Something else (please specify): ______________________
Q12. How would you describe the insurance plan(s) you have had in the past 12 months? (check all that apply)

1. An individual plan – the member pays for the plan premium
2. A group plan through an employer, union, etc. – the employer pays all or part of the plan premium
3. U.S. Governmental Health Plan (e.g., Military, CHAMPUS, VA)
4. Medicaid
5. Medicare
6. I have not had an insurance plan in the past 12 months

Q13. Which of the categories best describes your total annual combined household income from all sources? (check one box)

1. Less than $5,000
2. $5,000 to $9,999
3. $10,000 to $14,999
4. $15,000 to $19,999
5. $20,000 to $29,999
6. $30,000 to $39,999
7. $40,000 to $49,999
8. $50,000 to $59,999
9. $60,000 to $69,999
10. $70,000 and over

Q14. Do you test your blood sugar? (check one box)

1. No  2. Yes

Q14b. How many days a week do you test your blood sugar?

_____ (days / week)

Q14c. On days that you test, how many times do you test your blood sugar?

_____ (times / day)

Q14d. Do you keep a record of your blood sugar test results? (check one box)

1. No  2. Yes
**Section II- Health Status**

Q1. In general, would you say your health is: *(check one box)*

- [ ] 1 Excellent
- [ ] 2 Very Good
- [ ] 3 Good
- [ ] 4 Fair
- [ ] 5 Poor

Q2. Compared to one year ago, how would you rate your health now? *(check one box)*

- [ ] 1 Much better now than 1 year ago
- [ ] 2 Somewhat better now than 1 year ago
- [ ] 3 About the same
- [ ] 4 Somewhat worse now than 1 year ago
- [ ] 5 Much worse now than 1 year ago

Q3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? *(circle one answer on each line)*

<table>
<thead>
<tr>
<th></th>
<th>No, Not Limited At All</th>
<th>Yes, Limited A Little</th>
<th>Yes, Limited A Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>B.</strong> Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>C.</strong> Lifting or carrying groceries?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>D.</strong> Climbing several flights of stairs?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>E.</strong> Climbing one flight of stairs?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>F.</strong> Bending, kneeling, or stooping?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>G.</strong> Walking more than a mile?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>H.</strong> Walking several blocks?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>I.</strong> Walking one block?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>J.</strong> Bathing or dressing yourself?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Q4. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**? 

*(circle one answer on each line)*

<table>
<thead>
<tr>
<th>Problem Description</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut down the <strong>amount of time</strong> you spent on work or other activities</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Accomplished less than you would like</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Were limited in the <strong>kind</strong> of work or other activities</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Had <strong>difficulty</strong> performing the work or other activities (for example, it took extra effort)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Q5. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? *(check one box)*

- [ ] 1 Not at All
- [ ] 2 Slightly
- [ ] 3 Moderately
- [ ] 4 Quite a Bit
- [ ] 5 Extremely

Q6. How much **bodily** pain have you had during the **past 4 weeks**? *(check one box)*

- [ ] 1 None
- [ ] 2 Very Mild
- [ ] 3 Mild
- [ ] 4 Moderate
- [ ] 5 Severe
- [ ] 6 Very Severe

Q7. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)? *(check one box)*

- [ ] 1 Not at All
- [ ] 2 A little Bit
- [ ] 3 Moderately
- [ ] 4 Quite a Bit
- [ ] 5 Extremely
Q8. Please choose the answer that best describes how true or false each of the following statements is for you. (circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th>Definitely False</th>
<th>Mostly False</th>
<th>Not Sure</th>
<th>Mostly True</th>
<th>Definitely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. I seem to get sick a little easier than other people.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B. I am as healthy as anybody I know.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. I expect my health to get worse.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. My health is excellent.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Q9. During the past 12 months, were you a patient in a hospital overnight? (check one box)

Q9b. How many times in the past 12 months did you stay in a hospital overnight?

_____ (days / week)

Q9c. How many nights altogether during the past 12 months did you stay in a hospital?

_____ (nights)
Medication Use

Q10. Do you now use insulin? (check one box)

□ 1. No  □ 2. Yes

Q10b. How many times during the day do you usually take your insulin? (check one box)

□ 1. Once a day (Taken in the Morning)
□ 2. Once a day (Taken in the Evening)
□ 3. Twice a day
□ 4. Three times a day
□ 5. Four or more times a day
□ 6. I use an infusion pump

Q10c. How long have you taken insulin?

______ years

Q10d. Have you taken insulin for as long as you have had diabetes? (check one box)

□ 1. No  □ 2. Yes
Q11. Provide a list of all medications you are currently taking or have taken in the last 4 weeks

<table>
<thead>
<tr>
<th>Name of Medication</th>
<th>Dose of Medication</th>
<th>How often do you take the medication?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of total medications: ____________

Q12. In the past year, has your health care provider made changes in your insulin or pill dose? (check one box)

☐ 1  No
☐ 2  Yes
Comorbidities

Q13. Have you ever been told by a health care provider that you have any of the following problems with your eyes? (circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>No</th>
<th>Yes, on one eye</th>
<th>Yes, on both eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cataracts</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>Glaucoma</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>Detached retina</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>Blurred vision (not correctable with eye glasses)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>E</td>
<td>Retinopathy (diabetic changes in the back of the eye)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>F</td>
<td>Blindness</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>G</td>
<td>Macular degeneration (an aging change in the back of the eye)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>H</td>
<td>Macular Edema</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q14. Have you ever had any of the following operations on your eyes? (circle one answer on each line)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>No</th>
<th>Yes, on one eye</th>
<th>Yes, on both eyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cataract Surgery</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>Laser Treatment</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>Other (please specify below):</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Q15. Have you ever been told by a health care provider that you have any of the following problems related to your heart or circulation? *(circle one answer on each line)*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart attack</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart failure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High cholesterol</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angina (Chest Pain)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Q16. Have you ever been told by a health care provider that you have high blood pressure? *(check one box)*

☐ 1 No  ☐ 2 Yes

Q17. Have you ever had any of the following operations or procedures related to your heart? *(circle one answer on each line)*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary artery bypass surgery (open heart surgery)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary angioplasty (“balloon” heart procedure)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart catheterization (angiogram)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Q18. Have you ever been told by a health care provider that you have any of the following bladder, kidney, or urinary problems? (*circle one answer on each line*)

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney or bladder infections</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney failure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein in your urine</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enlarged prostate (Men only)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>E.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginitis (Women only)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Q19. Have you ever been told by a health care provider that you have any of the following problems with your feet or legs? (*circle one answer on each line*)

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral vascular disease (poor circulation in the legs)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermittent claudication (cramping in the calves after exercise)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral neuropathy (nerve problems causing numbness, tingling, or burning)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gangrene</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>E.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot ulcers</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>F.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athlete’s foot or fungus infection of the feet</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Q20. Have you ever had an amputation of a toe, foot, part of a leg, or all of a leg for a poorly healing sore or poor circulation? (An amputation that is not due to an injury or accident [car crash, power tool injury, war injury, etc.])?

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes, right side only</th>
<th>Yes, left side only</th>
<th>Yes, both sides</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>B.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>C.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>D.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Q21. During the past 4 weeks, how many days have you lost from school, work, or household activities due to illness or injury?

_____ days
APPENDIX I

SELF CARE INVENTORY-REVISED
Appendix I. Self Care Inventory-Revised Version (SCI-R)

Participant #: __________
Date: __________

Directions: This survey measures what you actually do, not what you are advised to do. Please read each statement and then circle the appropriate number to indicate how much you have followed your diabetes treatment plan in the past 1-2 months.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check blood glucose with monitor</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Record blood glucose results</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. If type 1: Check ketones when glucose level is high</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Take Correct dose of diabetes pills or insulin</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Take diabetes pills or insulin at the right time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Eat the correct food portions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Eat meals/snacks on time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Keep food records</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Read food labels</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Treat low blood glucose with just the recommended amount of carbohydrate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>---</td>
<td>-------</td>
<td>--------</td>
<td>-----------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>11. Carry quick acting sugar to treat low blood glucose</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. Come in for clinic appointments</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. Wear Medic Alert ID</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. Exercise</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. If on insulin: Adjust insulin dosage based on glucose values, food, and exercise</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
APPENDIX J

TELEPHONE SCRIPT
Appendix J. Telephone Script

This telephone script will be used with each potential participant who makes contact with the researcher via the telephone.

Script for returning a message left by potential participant:
“Hello, my name is Patricia Gatlin, may I please speak with _______?"
(If unavailable, find out when to call back. Leave no message to ensure confidentiality).
State: “Thank you, I will call him/her back later”.

If person is available, state:
“Hello ______________________, my name is Patricia Gatlin, I am a doctoral candidate at the University of Arizona College of Nursing and an instructor at the University of Portland School of Nursing. How are you today?” (Wait for a reply and respond accordingly).

“Do you have a few minutes to speak with me regarding the research study on Type 2 Diabetes, Working Memory and Self-Care?” (If yes, proceed. If no, say “When would be a better time for me to call you back?”) Make an appointment for a later time/date and call back at the time indicated.

If yes state: “Great. I would like to first thank you for your interest in the study. While you may know from the letter you received or the advisement you saw, I would like to take the time to tell you that this study is about how cognitive process of working memory effects the self-care actions among individuals with type 2 diabetes. I am looking for individuals who have type 2 diabetes for at least 1 year, over the age of 45, and can speak English? Can you confirm for me that you meet these criteria?” (If yes, proceed. If not, stop and thank them for their time.)

If yes, state: “Great. I would like to now ask you a few more questions to make sure you are eligible to participate in the study. Do you have:

____ a history of having a Stroke    ____ a history of a Head Injury
____ Parkinson’s Disease           ____ history of Alcohol abuse
____ history of Drug abuse

If yes to any of the above exclusion criteria, the potential participant is not eligible to participate in the study. Thank them for their time and willingness to participate but let them know they did not meet the study criteria.
If they answered no to the above exclusion criteria state, “Based on the information you provided you are eligible to participate in the study. Now, I would like to set up an appointment for you to come to the University of Portland School of Nursing for an in-person interview and to complete some questionnaires, problem solving task to assess working memory, and to draw some lab work. We will need about 2½ hours to complete everything. When would be a good date/time for you? (Find a mutually agreeable date/time).

State: “Now that we have our appointment set, I would like to mail you some information regarding the study (informed consent), directions to the University, a map of the University showing parking and where I am located, and a temporary parking pass for parking on campus. May I please have your address?

_____________________________________________

_____________________________________________

_____________________________________________

State: “When you come to our appointment it would be most helpful if you would bring in all of your medications that you are currently taking including herbs and homeopathic medications.”

“Do you have any questions for me at this time”? (Answer any questions).

“Again, I want to thank you for your time and willingness to participate in this study. I look forward to meeting with you on_________________. The day before our appointment I will call you to remind of you of the appointment. In the meantime, if you have any other questions please feel free to contact me at 503-516-0699. Thank you. Goodbye”.
APPENDIX K

INFORMATION LETTER TO PARTICIPANT
Appendix K. Information Letter to Participant

Date

Participant Name
Address 1
Address 2

Dear __________________,

Thank you again for agreeing to participate in the study: Severity of Type 2 Diabetes, Working Memory and Self-Care. I am looking forward to meeting with you on _______________________. Enclosed you will find more information about the study on the page titled “Informed Consent”; you will also find a campus map and a temporary parking permit.

The University of Portland is located in north Portland with the entrance located at 5000 North Willamette Blvd, Portland, OR 97203-5798. Directions to the University are below.

**From I-5 Northbound**

- From I-5, take the Rosa Parks Way (formerly Portland Blvd.) exit (#304)
- Take a left onto Rosa Parks Way (Portland Blvd.)
- Follow Rosa Parks Way (Portland Blvd.) to Willamette Blvd., where you will take a right
- Stay on Willamette Blvd. for approximately one-and-a-half miles; the main entrance to the University will be on your left hand side

**From I-5 Southbound**

- From I-5, take the Rosa Parks Way (formerly Portland Blvd.) exit (#304)
- Take a right onto Rosa Parks Way (Portland Blvd.)
- Follow Rosa Parks Way (Portland Blvd.) to Willamette Blvd., where you will take a right
- Stay on Willamette Blvd. for approximately one-and-a-half miles; the main entrance to the University will be on your left hand side
General parking is marked on the campus map provided for you. Handicap parking is available along the sidewalk in front of Buckley Center. Please place the temporary parking permit on your rear view mirror on the day of your appointment.

Buckley Center is marked on your campus map. The building is located just across the main parking lot. I am located inside Buckley Center on the 3rd floor, room 332.

As I stated during our initial conversation, please bring all your current medications, including herbs and any homeopathic therapies, to our appointment as this is most helpful when we fill out one of your questionnaires.

Again, I look forward to meeting with you. If you have any questions or concerns, please feel free to contact me at (360)521-8312.

Sincerely,

Patricia K. Gatlin, MS, RN
Principal Investigator
College of Nursing, University of Arizona
(360)521-8312
APPENDIX L

CONSENT FORM
THE UNIVERSITY OF ARIZONA HUMAN SUBJECTS PROTECTION PROGRAM

INFORMED CONSENT FORM

Project Title: Severity of Type 2 Diabetes, Working Memory and Self-Care

You are being invited to take part in a research study being conducted by The University of Arizona and asked to read this form so that you know about this research study. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you, and you will not lose any benefit you normally would have.

WHY IS THIS STUDY BEING DONE?
The purpose of this study is to gain a better understanding of the cognitive process of working memory (attention span) can affect how individuals with type 2 diabetes engage in self-care.

WHY AM I BEING ASKED TO BE IN THIS STUDY?
You are being asked to be in this study because you are diagnosed with type 2 diabetes, over the age of 45, able to speak and write English, do not have a history of stroke or head injury, diagnosis of Parkinson’s disease, or a history of alcohol or drug abuse.

HOW MANY PEOPLE WILL BE ASKED TO BE IN THIS STUDY?
Approximately 67 people (participants) will be enrolled in this study locally.

WHAT ARE THE ALTERNATIVES TO BEING IN THIS STUDY?
The alternative is not to participate.

WHAT WILL YOU BE ASKED TO DO IN THIS STUDY?
Your participation in this study will last approximately 2 ½ hours and include 1 visit. The procedures you will be asked to perform are described below.

- First, to determine if you meet the eligibility criteria for the study you will complete one pre-screening questionnaire, a pre-screening memory test and have a random blood glucose test.
- The first pre-screening questionnaire consists of questions regarding how you have
felt over the past week. If you score over 16 on this questionnaire you will not be eligible to continue in the study.

- I will then ask you some questions about how you think and remember to pre-screen your memory. If you score less than 24 on this memory test you will not be eligible to continue in the study.
- Next I will complete a random blood glucose test via a finger stick. The third or fourth finger of your non-dominant hand will be cleaned with an antiseptic wipe, and a spring lancet will be used to prick your finger. One to two drops of blood will be collected on the testing strip and then inserted into the blood glucose monitor. A cotton ball will be used to apply pressure to the finger stick area to stop the bleeding. If your random blood glucose is below 70 or greater 250 you will not be eligible to continue in the study.
- If you are eligible to continue in the study after completing the pre-screening procedures, I will then proceed to collect a blood sample from a vein in the inside of your elbow or the back of your hand to test how your blood glucose levels have been over the last 90 days. The site will be cleaned with an antiseptic wipe and then I will wrap an elastic band around the upper part of your arm to apply pressure to the area to make the vein swell with blood. I will then gently insert a needle into the vein to collect about one tablespoon of blood into an airtight tube attached to the needle. The elastic band will then be removed from your arm as well as the needle. The puncture site will then be covered with a bandage to stop any bleeding.
- After blood testing is completed, you will complete two questionnaires regarding demographic information, information regarding your health status as it relates to your diabetes, and information regarding how you care for yourself in regards to your diabetes.
- Finally, I will ask to repeat several series of letter and numbers and to do some arithmetic problems.

You may be removed from the study by the investigator if during the pre-screening your:

- random blood glucose is <70 or > 250 at the time of testing
- score on the Mini Mental State Examination is less than 24
- score on the Center for Epidemiologic Studies Depression Scale is greater than 16.

ARE THERE ANY RISKS TO ME?
The things that you will be doing have little more risk than you would come across in everyday life. There is the risk that performing finger stick blood glucose testing and drawing blood may result in temporary discomfort from the lancet or needle. Rarely a finger stick or needle stick could result in infection. Sterile technique will be used by the PI to obtain finger stick and blood samples.

Although the researchers have tried to avoid risks, you may feel that some questions/procedures that are asked of you will be stressful or upsetting. You do not have to answer anything you do not want to. Information about individuals who may be able to help you with these problems will be given to you.

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ARE THERE ANY BENEFITS TO ME?
There is no direct benefit to you by being in this study. What the researchers find out from this study may help other people with Type 2 Diabetes.

WILL THERE BE ANY COSTS TO ME?
Aside from your time, there are no costs for taking part in the study.
Your insurance will not be billed for blood work used for this study.

WILL I BE PAID TO BE IN THIS STUDY?
You will not be paid for being in this study. However, you will be compensated for your time at the end of the study visit.

WILL INFORMATION FROM THIS STUDY BE KEPT CONFIDENTIAL?
Information about you will be stored in a locked file cabinet and on computer files protected with a password. This consent form will be filed in an official area.

Information about you will be kept confidential to the extent permitted or required by law. People who have access to your information include the Principal Investigator and research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the University of Arizona Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly. However, any information that is sent to them will be coded with a number so that they cannot tell who you are. Representatives from these entities can see information that has your name on it if they come to the study site to view records. If there are any reports about this study, your name will not be in them.

WHOM CAN I CONTACT FOR MORE INFORMATION?
You can call the Principal Investigator to tell him/her about a concern or complaint about this research study. The Principal Investigator Patricia Gatlin, PhD(c) can be called at (360) 521-8312. You may also contact the Principal Investigator’s advisor, Kathleen C. Insel, PhD, RN at (520) 626-6220.

For questions about your rights as a research subject; or if you have questions, complaints, or concerns about the research and cannot reach the Principal Investigator or want to talk to someone other than the Investigator, you may call the University of Arizona Human Subjects Protection Program office.
• Local phone number: (520) 626-6721
• Website (this can be anonymous): http://ocr.vpr.arizona.edu/irb/contact
You may also contact the IRB at the University of Portland at the following email address:
IRB@up.edu

MAY I CHANGE MY MIND ABOUT PARTICIPATING?
You have the choice whether or not to be in this research study. You may decide to not begin or to stop the study at any time. If you choose not to be in this study, there will be no effect on your medical care. You can stop being in this study at any time with no effect on your medical care.
Any new information discovered about the research will be provided to you. This information could affect your willingness to continue your participation.

STATEMENT OF CONSENT
I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it is available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want, and I can still receive medical care if I stop participating in this study. A copy of this entire, signed consent form will be given to me.

Subject's Signature _______________ Date _______________

INVESTIGATOR'S AFFIDAVIT:
Either I have or my agent has carefully explained to the subject the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, demands, benefits, and risks involved in his/her participation.

_____________________________ Date _______________
Signature of Presenter

_____________________________ Date _______________
Signature of Investigator
APPENDIX M

CAMPUS MAP
Entrance

The University of Portland

1. Wadsworth Hall - administrative offices; Admission, Alumni; Cashier; Controller, Development, Financial Aid, Graduate School, Personnel and Purchasing, Public Relations, Registrar, Student Accounts, Executive Office, classroom.
2. Howard Hall - full-service recreation center; gymnasium, swimming pool, camping green, tennis court.
3. Pilot House - student center with bookstore, music room, and study lounge, Campus Ministry, Outreach, Campus Information Center, small classrooms.
5. Kenna Hall - men's and women's residence; Air Force ROTC offices.
6. Shipstad Hall - men's and women's residence, archives, University Museum.
7. McClo Field - 5,000-seat soccer field.
8. Fuller Center - 3,000-seat convocation and athletic center. Office of University Relations.
9. Magoo House Center - academic and practice rooms for drama, music, student theater, and student hall.
10. Foreman Hall - Dr. Robert R. Paepke Jr. School of Business Administration; School of Education, classrooms, computer labs.
12. Buckley Center - College of Arts and Sciences; School of Nursing; Residence Life; classrooms; computer labs; language labs; Shepard Freshman Resource Center; Instructional Media Center; auditoriums, in-house services, printing services, Adult Programs, International Student Services.
13. Science Hall - classrooms; laboratories; science library.
14. Swindells Hall - laboratories; seminar rooms, faculty offices.
16. Campus Radio Station (KEDU).
17. Chapel of the Immaculate Conception: Campus Ministry, worship.
18. University Commons - student facility; dining hall, meeting and banquet facilities.
19. Broad Test Laboratory.
20. Louisiana-Pacific Tower - Center - 1 outdoor, 3 indoor courts.
22. Engineering Hall - classrooms, laboratories, offices, University Computer Center.
23. KEM - Catholic radio station.
24. Garth Hall - Career Services, University Health Center.
25. Webley Hall - women's residence.
27. Corrado Hall - men's and women's residence.
29. Public Safety Building.
30. University Court - men's and women's residence.
31. Haggerty Hall - men's and women's residence.
REFERENCES


